



# KANSIL'S

## LIST OF PUBLICATIONS 2017-18

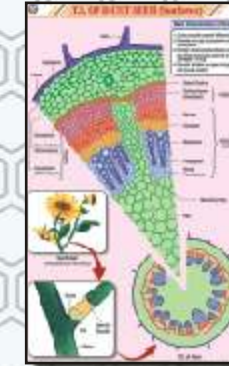
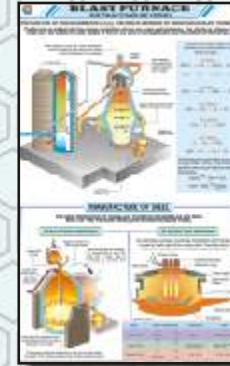
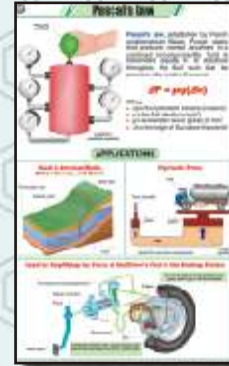
Math

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Students are able to infer meanings from the pictures quicker than from text. This well known fact itself is the testimony of importance of charts and maps for teaching. Our charts and maps produced under the expert guidance catalyse the understanding of large and complex topics.

# INDEX

ITEMS	PAGE NO.	ITEMS	PAGE NO.
1. Science and Technology Charts		22. Map Reading Charts .....	78
Charts on Botany.....	1-6	23. Man & Environment Charts .....	79-80
Charts on Zoology.....	7-12	24. Weather Maps of India .....	81-82
Charts on Chemistry.....	13-18	25. Alphabet Charts .....	83
Charts on Physics .....	19-25	26. Special Charts for Children .....	84-87
Charts on General Science .....	26-30	27. Children Chart Nursery Rhymes .....	88
2. Chemistry Lab Display Charts .....	31	28. Moral Story Charts .....	89-93
3. Genetics & Evolution Charts .....	32-33	29. Special Rollups .....	94
4. Human Physiology Charts .....	34-37	30. General Education Charts .....	95
5. Life Sketch of Scientists .....	38-40	31. Struggle for Indian Freedom Charts .....	96-97
6. Food & Nutrition Charts .....	41-42	32. National Integration Charts .....	98-99
7. Health Care Charts .....	43-44	33. Life Sketch of Great Men .....	100-101
8. Prevent the Diseases Charts .....	45-47	34. English Teaching Charts .....	102-103
9. AIDS Charts .....	48	35. English Grammar Charts .....	104-106
10. First Aid Charts .....	49-50	36. Hindi Teaching Charts .....	107-108
11. Yoga Charts .....	51-52	37. Hindi Vyakaran Charts .....	109-110
12. Important Nursing Charts .....	53-55	38. Sanskrit Shikshan Charts .....	111-112
13. New Medical Nursing Charts.....	56-62	39. Civil Defence Charts .....	113
14. Human Reproduction Charts .....	63	40. Field Craft Charts .....	114
15. Maths (Primary Charts) .....	64	41. Army, Police & NCC Charts .....	115
16. Maths Charts Printed on Polyart (Senior Kit) .....	65	42. Basic Essentials of Good Shooting .....	116
17. Maths (Upper Primary Charts) .....	66-67	43. World, Continents, Country Maps .....	117-119
18. Understanding Maths .....	68-70	44. Maps of Indian States .....	120-124
19. Geography Charts .....	71-72	45. South Africa Maps .....	125
20. Latest Geography Charts .....	73-75	46. Desk Outline Maps .....	126
21. Changing Face of the Earth Charts .....	76-77		



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STB01 : Plant Kingdom

### Plant Kingdom

Classification of plants was first proposed by Linnaeus. Presently, the plant kingdom is divided into two subkingdoms - Cryptogams and Phanerogams. Fungal members of the Monera and Protista having cell walls have been excluded from Kingdom Plantae.

**PLANT KINGDOM**

- CRYPTOGAMIA** (Non-flowering plants)
  - Algae
  - Bryophytes
  - Phanerogams
- PHANEROGAMIA** (Flowering plants)
  - Gymnosperms
  - Angiosperms

**Cryptogams are non-flowering or seedless plants.**

- Algae:** The algae are divided into three main groups: Green Algae, Brown Algae and Red Algae. The main body is not differentiated into stem, leaf or root but it is usually systemically branched.
- Bryophytes:** Bryophytes have a thalloid body that is not differentiated into stem, leaf and root. They are divided into three main groups: Liverworts, Mosses and Hornworts. They are the first plants to have a vascular system in the form of leaf-like structures called rhizoids.
- Phanerogams are all seed bearing plants.**
  - Gymnosperms:** Gymnosperms have naked seeds, which are usually woody.
  - Angiosperms:** Angiosperms have seeds covered by a fleshy fruit called pericarp.
  - Dicotyledons:** Dicotyledons have two cotyledons in the embryo. They are usually woody plants with tap roots and secondary growth.

STB02 : Typical Plant

### Typical Plant

Plants can be divided into two broad categories - non-flowering and flowering plants.

#### Non-flowering Plants

Plants such as algae, mushrooms and mosses do not bear flowers. These are called non-flowering plants.

#### Flowering Plants

Most flowering plants have two main systems - root and shoot.

**Other Methods of Classification**

- By Habitat:**
  - Aquatic:** Plants that live in water.
  - Terrestrial:** Plants that live on land.
- By Growth Habit:**
  - Climbers:** Plants that climb over other plants.
  - Creeper:** Plants that creep along the ground.
  - Shrub:** Plants that are woody and have many branches.
  - Tree:** Plants that are woody and have a single main stem.
  - Herb:** Plants that are not woody.

STB03 : Typical Plant Cell

### Typical Plant Cell

**Cell Wall:** It is a thick layer of cellulose surrounding the cell membrane.

**Plasma Membrane:** It is a thin layer of phospholipids surrounding the cell.

**Cytoplasm:** It is a fluid matrix of cytoplasmic granules and organelles.

**Nucleus:** It is a large, spherical organelle containing genetic material.

**Chloroplasts:** They are green organelles that perform photosynthesis.

**Mitochondria:** They are bean-shaped organelles that produce energy.

**Other organelles shown:** Golgi apparatus, Endoplasmic reticulum, Vacuole, Tonoplast, Cell plate, Plasmids, Centrioles, Lysosomes, Peroxisomes, Ribosomes, Spindle fibers, Spindle apparatus, Spindle fibers, Spindle apparatus, Spindle fibers, Spindle apparatus.

STB04 : Plant Cell Organelles

### Plant Cell Organelles

- Nucleus:** Contains genetic material.
- Chloroplast:** Site of photosynthesis.
- Mitochondrion:** Site of cellular respiration.
- Golgi Apparatus:** Involved in protein synthesis and transport.
- Endoplasmic Reticulum:** Site of protein and lipid synthesis.
- Vacuole:** Maintains cell turgidity.
- Plasmids:** Small circular DNA molecules.
- Centrioles:** Involved in cell division.
- Lysosomes:** Contain digestive enzymes.
- Peroxisomes:** Involved in lipid metabolism.
- Ribosomes:** Site of protein synthesis.
- Spindle Fibers:** Involved in cell division.
- Spindle Apparatus:** Involved in cell division.
- Cell Plate:** Formed during cytokinesis.

STB05 : Plant Tissues

### Plant Tissues

Tissues are a kind of cellular fabric that occur in a living being's body. Usually a body has several kinds of tissues which can be distinguished on the basis of functions. Such tissues are called specialized cells.

#### Meristematic Tissue

These are the tissues in which the cells are capable of undergoing cell division throughout their life. They are present in the growing regions of plants like shoot tips and root tips.

#### Permanent Tissue

These are the tissues in which the cells are no longer dividing. They are present in the non-growing regions of plants.

##### Simple Permanent Tissue

- Parenchyma:** They are the most common type of simple permanent tissue. They are present in the cortex, pith, and other parts of the plant.
- Collenchyma:** They are present in the corners of the cells. They provide mechanical strength to the plant.
- Sclerenchyma:** They are present in the form of fibers and sclerenchyma fibers. They provide mechanical strength to the plant.
- Sclerids:** They are present in the form of thick-walled cells. They provide mechanical strength to the plant.

##### Complex Permanent Tissue

- Xylem:** It is responsible for the conduction of water and minerals from the roots to the leaves.
- Phloem:** It is responsible for the conduction of food from the leaves to the other parts of the plant.

#### Secretory Tissue

These are the tissues that secrete substances. They are present in the form of glands.

#### Laticiferous Tissue

These are the tissues that secrete latex. They are present in the form of laticifers.

#### Glandular Tissue

These are the tissues that secrete hormones. They are present in the form of glands.

STB06 : Plant Cell Mitosis

### Plant Cell Mitosis

Mitosis is a kind of cell division in which the chromosomes are duplicated and distributed equally to the daughter cells. It occurs in somatic cells.

- I. Interphase:** During interphase, the parent cell grows and replicates its DNA. It is the longest phase of the cell cycle.
- II. Prophase:** The chromatin condenses into visible chromosomes. The nuclear envelope and nucleolus disappear.
- III. Metaphase:** The chromosomes align themselves at the equatorial plate. The spindle fibers attach to the centromeres.
- IV. Anaphase:** The sister chromatids separate and move towards opposite poles of the cell.
- V. Telophase:** The nuclear envelope and nucleolus reappear. The chromosomes decondense.

STB07 : Plant Cell Meiosis

### Plant Cell Meiosis

Meiosis is a kind of cell division in which the number of chromosomes in the cell is halved. It occurs in reproductive cells.

**MEIOSIS I**

- Prophase I:** The chromosomes condense and synapse. The nuclear envelope and nucleolus disappear.
- Metaphase I:** The homologous chromosomes align themselves at the equatorial plate.
- Anaphase I:** The homologous chromosomes separate and move towards opposite poles.
- Telophase I:** The nuclear envelope and nucleolus reappear. The chromosomes decondense.

**MEIOSIS II**

- Prophase II:** The chromosomes condense. The nuclear envelope and nucleolus disappear.
- Metaphase II:** The chromosomes align themselves at the equatorial plate.
- Anaphase II:** The sister chromatids separate and move towards opposite poles.
- Telophase II:** The nuclear envelope and nucleolus reappear. The chromosomes decondense.

STB08 : T.S. Stem-Monocot

### T.S. Stem-Monocot

#### MAIZE STEM

**Microscopic View:**

- Cuticle:** The outermost protective layer.
- Epidermis:** The outermost layer of cells.
- Hypodermis:** The layer of cells just below the epidermis.
- Pith:** The central part of the stem.
- Scattered vascular bundles:** Each bundle contains xylem, cambium, and phloem.
- Ground tissue:** The tissue between the vascular bundles.

**As seen under the Microscope:**

The diagram shows the internal structure of a maize stem. The vascular bundles are scattered throughout the ground tissue. Each bundle is closed, and the cambium is absent. The ground tissue is composed of parenchyma cells.

### STB09 : T.S. of Dicot Stem (Sunflower)

#### T.S. OF DICOT STEM (Sunflower)

**Major Characteristics of Dicot Stem**

1. Dicot stem has an oval or round shape.
2. Secondary growth may be present in some dicot stems.
3. Vascular bundles are arranged in a ring.
4. Vascular bundles are arranged in a ring.
5. Vascular bundles are arranged in a ring.

**Major Characteristics of Dicot Stem**

1. Dicot stem has an oval or round shape.
2. Secondary growth may be present in some dicot stems.
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**Major Characteristics of Dicot Stem**

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### STB10 : T. S. Root - Monocot

#### T. S. Root - Monocot

**Monocot Root**

In this, the central part of the ground tissue is very large and well developed. For example, in the roots of plants like maize, petio, orchids, grass and etc.

**Transverse Section of a Portion of Maize Root**

**Monocot Root Cross Section**

### STB11 : T. S. of Dicot Root

#### T. S. of Dicot Root

**Transverse Section of Dicot Root (a part cellular)**

**Major characteristics of Dicot Roots**

1. Dicot roots are cylindrical in shape.
2. Pith is small, surrounded by a ring of vascular bundles.
3. A ring of vascular bundles is present in the ground tissue.
4. Cambium develops into the secondary growth.

### STB12 : T. S. Leaf - Monocot

#### T. S. Leaf - Monocot

**T.S. of a Monocot Leaf**

Monocot leaf is mostly leathery. It is equally illuminated on both the surfaces.

**T.S. of C4 Grass Leaf**

In the leaves of C4 grasses, the mesophyll cells and bundle sheath cells typically form two concentric layers around the vascular bundles. The compactly arranged bundle sheath cells of the C4 grasses are very large parenchyma cells that contain many large conspicuous chloroplasts. In C3 grasses, more than four small mesophyll cells intervene between adjacent bundle sheaths.

**T.S. of C3 Grass Leaf**

In the leaves of C3 grasses, the mesophyll cells and bundle sheath cells are not concentrically arranged. The relatively small cells of the parenchymatous bundle sheaths in these plants have rather small chloroplasts. In C3 grasses, more than four small mesophyll cells intervene between adjacent bundle sheaths.

### STB13 : T. S. Leaf - Dicot

#### T. S. Leaf - Dicot

**T.S. of Dicot Leaf (Mango)**

Dicot leaf is dorsiventral. A dorsiventral leaf is more strongly illuminated on the upper surface than the lower surface. In the internal structure, there is a good deal of difference between the two sides.

**T.S. of Hydrophytic Dicot Plant Leaf**

Water lily, a magnoliaid, floats on the surface of water and has stomata in the upper epidermis only. Vascular tissue is much reduced, especially the xylem. The palisade parenchyma consists of several layers of cells above the spongy parenchyma. The large intercellular spaces add buoyancy to this floating leaf.

**T.S. of Xerophytic Dicot Plant Leaf**

Nerium oleander, a xerophyte, have very thick cuticle, covering the multiple epidermis on the upper and lower surfaces of the leaf. The stomata and trichomes are restricted to invaginated portions of the lower epidermis, called stomatal crypts.

### STB14 : Types of Leaves

#### Types of Leaves

**Simple Leaves**

Consist of one blade and a petiole. The blade may be ovate, elliptical, lanceolate, etc.

**Compound Leaves**

The leaf blade is divided into several leaflets. The petiole and rachis are part of the main stem.

**Heterophyllous**

More than one kind of leaves are present on the same plant. For example, in the water lily, the leaves are of two different types.

**Phyllotaxy**

Hydrophytic leaves with large arrangement of veins.

1. Alternate type
2. Opposite type
3. Whorled type

**Parallely Venation**

1. Parallel Veinlets
2. Parallel Veins
3. Parallel Veinlets

**Retiulate Venation**

1. Reticulate Veinlets
2. Reticulate Veins
3. Reticulate Veinlets

### STB15 : Root Systems

#### Root Systems

**TAP ROOT SYSTEM**

Taproot develops from the radicle of the seed which forms the primary root. It grows vertically downwards from which smaller lateral roots branch. These roots may further branch to form nodules. Example: carrot, radish and turnip.

**FIBROUS ROOT SYSTEM**

A root system in which both primary and lateral roots are fairly divided without an enlarged central root. It is usually formed by thin, moderately branching roots growing from the stem. Most monocots have a fibrous root system. Grasses are an example of fibrous root systems.

**ADVENTITIOUS ROOT SYSTEM**

Some roots arise from parts of the plant other than the radicle. Such roots are called adventitious roots. Mosses and gametophytes have supporting roots coming out of the lower nodes of stem. These are called stilt roots. Hanging roots of banyan tree are also an example of adventitious roots.

### STB16 : Structure of Flower

#### Structure of Flower

Flower is a modified shoot meant essentially for the reproduction of the plant.

**Parts of a Typical Flower**

**Symmetry of Flower**

- Floral Diagram
- Actinostegia
- Zygomorphic
- Mosaic
- Asymmetrical

**Position of Floral Organs on the Thalamus**

- Hypogynous
- Perigynous
- Epigynous

STB17 : Calyx and Corolla

### Calyx and Corolla

**CALYX MODIFICATIONS**  
The outermost green and leaf like floral whorl consisting of sepals is calyx. However, it is modified into following forms in some plants.

<b>Pappus</b> Examples - Sorghum, Euphorbia	<b>Spurred</b> Examples - Begonias	<b>Leafy</b> Examples - Mustards
<b>Spinous</b> Examples - Tribes	<b>Hood Like</b> Examples - Asclepias	<b>Blabiate</b> Examples - Ocimum, Salvia

**SHAPES OF COROLLA**  
The second coloured and leafy floral whorl consisting of petals is corolla. Following are the common shapes of corolla.

<b>Cruciform</b> Examples - Brassicas	<b>Caryophyllaceous</b> Examples - Dianthus, Carnations, Petunias	<b>Rosaceous</b> Examples - Rose	<b>Campanulate</b> Examples - Solanum, Petunia
<b>Tubular</b> Examples - Sunflower, Hibiscus	<b>Bilabiate</b> Examples - Ocimum, Salvia	<b>Hypocroteriform</b> Examples - Mustards, Beans	<b>Rotata</b> Examples - Petunia, Solanum
<b>Infundibuliform</b> Examples - Petunia, Solanum	<b>Personate</b> Examples - Asclepias	<b>Ligulate</b> Examples - Solanum, Garden pea flowers	<b>Papilionaceous</b> Examples - Peas, Laburnum

STB18 : Inflorescences

### Inflorescences

**RACEMOSE INFLORESCENCES**

<b>Raceme</b> Inflorescence axis is upright, elongated and bears axillary flowers (e.g. Mustard)	<b>Panicle</b> Inflorescence axis is branched & flowers are borne axillary or terminal	<b>Spike</b> Some axillary flowers have no stalks
<b>Catkin</b> It is a spike with unisexual flowers (e.g. Almond)	<b>Spikelet</b> It is a spike with flowers on a short pedicel (e.g. Hibiscus, Cereus)	<b>Corymb</b> The axis is short and the lower flowers have longer stalks than the upper ones. (Fruit of Hibiscus comes in the same form (e.g. Cereus))

**CYMOSE INFLORESCENCES**

<b>Umbel</b> The main axis is short and all the flowers arise from the same point (e.g. Sunflower)	<b>Head or Capitulum</b> The main axis is short and all the flowers arise from the same point. The flowers are small and numerous. The inflorescence is surrounded by bracts (e.g. Sunflower)	
<b>Monochasial Scorpioid</b> The main axis is short and all the flowers arise from the same point. The flowers are small and numerous. The inflorescence is surrounded by bracts (e.g. Sunflower)	<b>Dichasial</b> The main axis is short and all the flowers arise from the same point. The flowers are small and numerous. The inflorescence is surrounded by bracts (e.g. Sunflower)	<b>Polychasial</b> The main axis is short and all the flowers arise from the same point. The flowers are small and numerous. The inflorescence is surrounded by bracts (e.g. Sunflower)

STB19 : Fruits

### Fruits

The ovary undergoes changes immediately after fertilization to transform into a fruit.

**TRUE FRUIT:** When only ovary takes part in the formation of fruit.

**FALSE FRUIT:** When the other floral parts such as thalamus, calyx, etc. form a major part of the fruit.

**PARTS OF A FRUIT**

**CLASSIFICATION OF FRUITS**

**Dry SIMPLE FRUITS**

- Fleshy:** Drupe (Mango), Pome (Apple), Berry (Grapes), Hesperidium (Lemon), Balausta (Pineapple)
- Dry:** Dehiscent (Pea/Peanut), Siliqua (Mustard), Silicle (Cress), Siliqua (Mustard), Siliqua (Mustard), Siliqua (Mustard)

**AGGREGATE FRUITS**

- Cluster of Follicles (Strawberry)
- Cluster of Achenes (Raspberries)
- Cluster of Drupe (Raspberry)
- Cluster of Berries (Currant Apple)

**COMPOSITE FRUITS**

- Synconium (Fig)
- Synconium (Jack Fruit)

STB20 : The Seed : Structure and Germination

### The Seed: Structure and Germination

**TYPICAL STRUCTURE OF A SEED**

**CONDITIONS NECESSARY FOR GERMINATION**

Water, Air, Temperature

**EPIGEAL GERMINATION**

**HYPOGEAL GERMINATION**

STB21 : Germination of Seed - Bean & Pea

### Germination of Seed - Bean & Pea

**Germination of Pea Seed (Hypogeal)**

- Cotyledons do not come out of the soil surface.
- Cotyledons do not expand and the first root comes out of the soil.
- The cotyledons grow upward and the first root comes out of the soil.
- The radicle forms the primary root which is soon replaced by secondary roots.

**Germination of Bean Seed (Epigeal)**

Cotyledons are brought above the ground due to the elongation of the hypocotyl.

STB22 : Dispersal of Fruits & Seeds

### Dispersal of Fruits & Seeds

Fruits and Seeds can not move independently from one place to another. They are transported to new areas by the external agencies according to which their dispersal is categorised into following types:

**Dispersal by Wind**

- Light Weight & Minute Seeds:** Light weight seeds are blown by the wind.
- Winged Seeds & Fruits:** Winged seeds and fruits are blown by the wind.
- Balloon Like Appendages:** Some fruits have balloon like appendages which help them to float in the air.
- Censer Mechanism:** Some fruits have a censer mechanism which helps them to disperse seeds.
- Parachute Mechanism:** Some fruits have a parachute mechanism which helps them to disperse seeds.
- Hairs:** Some seeds have hairs which help them to disperse.

**Dispersal by Animals**

- Hooked Fruits & Seeds:** Some fruits have hooks which help them to disperse.
- Sticky Fruits & Seeds:** Some fruits have sticky substances which help them to disperse.
- Edible Fruits & Seeds:** Some fruits have edible parts which are eaten by animals and the seeds are dispersed.

**Dispersal by Water**

- Edible Fruits & Seeds:** Some fruits have edible parts which are eaten by animals and the seeds are dispersed.

**Dispersal by Explosion**

- Edible Fruits & Seeds:** Some fruits have edible parts which are eaten by animals and the seeds are dispersed.

STB23 : Photosynthesis

### Photosynthesis

Process of manufacturing food by green plants with the help of water, carbon dioxide, sunlight and chlorophyll is called photosynthesis. Oxygen is released in this process.

$$6CO_2 + 12H_2O \xrightarrow[\text{Chlorophyll}]{\text{Light}} C_6H_{12}O_6 + 6H_2O + 6O_2$$

**1. Light Reaction:**

- Chlorophyll absorbs solar energy and converts it into chemical energy.
- The photolysis of water takes place in the chloroplast.
- Thus, ATP is synthesized from ADP and inorganic phosphate.
- Photolysis of water also takes place and oxygen is released.

**2. Dark Reaction:**

- Stroma Calvin-Benson Cycle.
- Stroma is the site of the chloroplast where most of the photosynthesis takes place.
- Here carbon dioxide enters into a cycle of reactions starting with Ribulose biphosphate (RuBP).
- At the end of the cycle carbon dioxide is synthesized and RuBP is regenerated.

**Requirements for Photosynthesis**

- Light:**
  - Soak a potted green plant.
  - Keep one leaf in the sun, with a disk with black paper and keep the plant in sunlight again.
  - Decolourise this leaf by boiling it in alcohol.
  - The covered part does not turn blue black while the originally exposed part turns blue black with iodine solution.
  - This shows that light is necessary for photosynthesis.
- Chlorophyll:**
  - Decolourise a potted green plant.
  - Put it in light condition for 3-4 days.
  - Soak a leaf from that plant and decolourise it by boiling it in alcohol.
  - The originally green part turns blue black while the originally white part does not turn blue black with iodine solution.
  - This shows that chlorophyll is necessary for photosynthesis.
- Carbon Dioxide:**
  - Place half of a leaf of a plant in a bottle containing KOH (which absorbs CO<sub>2</sub>) and leave it in sunlight.
  - Leave the other half in sunlight.
  - Test the leaf with iodine solution. The portion of leaf which was in sunlight turns blue black.
  - The other portion turns blue black.
  - This shows that CO<sub>2</sub> is necessary for photosynthesis.

STB24 : Plant Diseases

### Plant Diseases

<b>Black Rot of Crucifers</b> Caused by <i>Alternaria brassicae</i> . Symptoms: Dark brown necrotic lesions on leaves and stems.	<b>Late Blight of Potato</b> Caused by <i>Phytophthora infestans</i> . Symptoms: Dark brown necrotic lesions on leaves and tubers.	<b>Bacterial Wilt of Tomato</b> Caused by <i>Burkholderia solanaceae</i> . Symptoms: Wilt and necrosis of leaves and stems.
<b>Hill Bunt (Stunt) of Wheat</b> Caused by <i>Tilletia tritici</i> . Symptoms: Stunted growth and white powdery masses on spikes.	<b>Brown Spot of Rice</b> Caused by <i>Blightoryctes conglutinans</i> . Symptoms: Brown necrotic lesions on leaves and panicles.	<b>Tobacco Mosaic Virus Disease</b> Caused by Tobacco Mosaic Virus. Symptoms: Mosaic pattern on leaves and stunted growth.
<b>Leaf (Brown) Rust of Wheat</b> Caused by <i>Puccinia striiformis</i> . Symptoms: Brown necrotic lesions on leaves.	<b>Yellow Mosaic of Okra</b> Caused by Yellow Mosaic Virus. Symptoms: Yellow mosaic pattern on leaves and stunted growth.	<b>Red Rot of Sugarcane</b> Caused by <i>Sclerotium sacchari</i> . Symptoms: Red rot of leaves and stems.
<b>Bacterial Blight of Cowpea</b> Caused by <i>Burkholderia fabae</i> . Symptoms: Wilt and necrosis of leaves and stems.	<b>Powdery Mildew of Wheat</b> Caused by <i>Blumeria tritici</i> . Symptoms: White powdery masses on leaves and stems.	<b>Leaf Curl of Chili</b> Caused by Tobacco Etch Virus. Symptoms: Curling and necrosis of leaves.

### STB25 : Reproduction in Plants

#### Reproduction in Plants

**VEGETATIVE REPRODUCTION IN PLANTS**

Commoning eye leaf, Stem, Node, Internode, Scale leaf, Leaf bud on branch, Adventitious roots, Root, Offshoot (Plant), Corm (Colocasia), Adventitious root, Daughter tuber, Leaf bud (Ginger), Tuber (Potato), Rhizome (Ginger), Runner (Ginger), Bulb (Onion), Rhizome (Ginger), Runner (Ginger).

**REPRODUCTION BY SPORE FORMATION**

Found in Bryophytes and Pteridophytes. Spores ( $n$ ), Meiosis, Mitosis, Fertilization, Embryo sac, Zygote ( $2n$ ).

**SEXUAL REPRODUCTION OF FLOWERING PLANTS**

Flower, Pollen grain, Pollen tube, Embryo sac, Fertilization, Zygote, Embryo sac, Seed, Seed germination, Fruit, Pollen tube, Pollen grain, Embryo sac, Fertilization, Zygote, Embryo sac, Seed, Seed germination, Fruit.

### STB26 : Pollination

#### Pollination

Transfer of pollen from the anther of a flower to the stigma of another flower is known as **pollination**. Pollination is a prerequisite for fertilisation.

**ACCORDING TO MEDIUM OF POLLINATION**

- Self-pollination:** Pollen grains from anther of a flower reach the stigma of the same flower.
- Cross-pollination:** Pollen grains from anther of one flower reach the stigma of another flower.

**ACCORDING TO AGENTS INVOLVED**

- Autogamy:** Self-pollination.
- Allogamy:** Cross-pollination.
- Chasmogamy:** Cross-pollination where the flower opens.
- Cleistogamy:** Self-pollination where the flower does not open.

### STB27 : Double Fertilization

#### Double Fertilization

The process of double fertilization involves the joining of a female gametophyte with two male gametes (sperm). A pollen grain pushes its pollen tube through the micropyle to release the two sperms. One sperm fertilizes the egg cell to form a diploid zygote and the other sperm combines with the two polar nuclei to form a triploid nucleus (some plants may form polyploid nuclei).

**Megasporogenesis (egg development)**

**Microsporogenesis (sperm development)**

Four haploid megaspores, Four haploid microspores, Embryo sac, Pollen grain, Pollen tube, Zygote, Endosperm, Embryo.

### STB28 : Artificial Vegetative Propagation

#### Artificial Vegetative Propagation

**Tissue Culture:** The scientific propagation of plants in vitro. It involves the principle that plant cells can regenerate.

**Cuttings:** Parts of plants removed from a parent plant and rooted in a growing medium to form new plants are called cuttings.

**A. Leaf cutting**  
**B. Stem cutting**

**Layering:** Method of rooting a new plant from the stem of a plant attached to the parent plant.

**A. Simple layering**  
**B. Air layering**

**Grafting:** Joining two plant parts together. The cambium of the upper part must line up with the cambium of the lower part and should make good contact. This union must be kept firm during the graft union.

**Preparing the stock and scion**, **Filling the stock and scion**, **Protecting the graft**, **Ring of bark removed**, **Covered to prevent drying**, **Polystyrene foam over it**.

### STB29 : Stem Modification

#### Stem Modification

**UNDERGROUND STEM MODIFICATION**

- Tuber (Potato):** A swollen part of an underground stem which stores food.
- Bulb (Onion):** A cluster of modified leaves with swollen bases.
- Rhizome (Ginger):** A horizontal stem that grows underground.
- Runner (Ginger):** A horizontal stem that grows above ground.

**STEM MODIFICATION FOR SUPPORT**

- Stilt roots (Mangrove):** Roots that grow from the stem to support the plant.
- Prop roots (Mango):** Roots that grow from the stem to support the plant.
- Support roots (Cucumber):** Roots that grow from the stem to support the plant.

### STB30 : Root Modification

#### Root Modification

**MODIFICATION OF TAP ROOT**

- Carrot:** Tap root modified for storage.
- Radish:** Tap root modified for storage.
- Turnip:** Tap root modified for storage.

**MODIFICATION OF ADVENTITIOUS ROOT**

- Stilt roots (Mangrove):** Roots that grow from the stem to support the plant.
- Prop roots (Mango):** Roots that grow from the stem to support the plant.
- Support roots (Cucumber):** Roots that grow from the stem to support the plant.

### STB31 : Hydrophytes

#### Hydrophytes

**External Features:**

- Roots are completely absent or poorly developed.
- Stem is long, slender, spongy and flexible.
- Leaves are large, floating, and have long petioles.
- Flowering stems are long, erect, and arise from the leaf axils.
- The leaves are large and have long petioles.

**Anatomical Characters:**

- All hydrophytes are prostrate or have a very short stem.
- Hydrophytes are prostrate or have a very short stem.
- Stems are spongy and have aerenchyma tissue.
- Stems are spongy and have aerenchyma tissue.

### STB32 : Mesophytes

#### Mesophytes

**GENERAL DESCRIPTION:**

- Mesophytes are the plants that grow under average conditions of temperature and moisture.
- The soil in which they grow is neither very wet nor very dry.
- The temperature of the soil is neither too high nor too low.
- Mesophytes are plants that grow under average conditions of temperature and moisture.

**EXTERNAL FEATURES:**

- The root system is well developed.
- Leaves are large and have long petioles.
- Stems are spongy and have aerenchyma tissue.
- Stems are spongy and have aerenchyma tissue.

**ANATOMICAL CHARACTERS:**

- Mesophytes are plants that grow under average conditions of temperature and moisture.
- Leaves are large and have long petioles.
- Stems are spongy and have aerenchyma tissue.
- Stems are spongy and have aerenchyma tissue.

**STB33 : Xerophytes**

### Xerophytes

Xerophytes occur in regions where the amount of water in the soil is very less.

**External Features of Xerophytes**

- The root system is well developed, primarily based on deep root system.
- The root reach to a great depth.
- The leaves are generally small and fleshy.
- The xylem vessels have small diameter.
- There may also be fleshy and green succulent stems.
- Some plants have modified stems, for example, in Opuntia stem forms a leaf and the stem is called phylloclad. In Asparagus and Phoradendron the leaf is transformed into leaf-like cladodes.
- Leaves may fall out in Xerophytes.
- Leaves covered with hairs in *Trichodesia*.
- Leaves are smaller in size and reduced in *Mesquites*.
- Leaves are reduced to *Miktoophytes*.

**Anatomical Characters of Xerophytes**

- Reduction in the rate of transpiration.
- Presence of leaves which contain more water.
- Presence of thick cuticular leaf and stem cuticle.
- Reduced transpiration.
- Stomachostomium.
- A thick covering of hair on epidermis and several water storage.
- Indivisible spine are only a few and also very small.
- Reduced leaves like cladodes and stem leaves are well developed.
- Stomachostomium are present in large amount.
- Stomachostomium are present in large amount.

**STB34 : Insectivorous Plants**

### Insectivorous Plants

The autotrophic plants growing in nitrogen deficient conditions and fulfilling their nitrogen requirement by digesting insects. They are divided into four groups on the basis of insect trapping mechanism.

**Plants with sensitive glandular hairs on the surface of leaves secreting sweet sticky liquid.**

**Plants having sensitive trigger hairs on the leaf surface.**

**Plants with leaves modified into pitchers.**

**Plants having segmented leaves with some of the segments modified into blades.**

**STB35 : Fungi**

### Fungi

Fungi is a unique group of organisms that includes moulds, yeasts, rusts, smuts, mushrooms and lichens.

**Classification of Fungi**

Trunk fungi, Sea Fungi, Club Fungi, Imperfect Fungi

**Symbiotic Relationships**

Amoeba (symbiont) with Paramecium (host) - mutualism. Lichen (symbiont) with Fungus (host) - mutualism.

**Economic Importance**

**Beneficial:** Penicillin, Cheese, Bread, Beer, Wine, Antibiotics, Enzymes, Fertilizers, Biogas, Biopesticides, Bioremediation, Biotechnology, Bioremediation, Bioremediation, Bioremediation.

**Harmful Effects:** Fungal diseases in plants (Rust, Smut, Blight, etc.), Fungal diseases in animals (Ringworm, Athlete's foot, etc.), Fungal diseases in humans (Malaria, Dengue, etc.).

**STB36 : Algae**

### Algae

Algae are chlorophyll bearing the food plants. The study of algae is known as Algology. Professor M.O.P. Yenker is known as father of Modern Indian Algology.

**Classification**

Unicellular, Multicellular

**Uses**

Food, Medicine, Biofertilizer, Biopesticide, Bioenergy, Bioremediation, Biotechnology, Bioremediation, Bioremediation, Bioremediation.

**Harms**

Algal bloom, Red tide, Green tide, etc.

**STB37 : Viruses**

### Viruses

Dr. W. Stanley: He was the first one to isolate virus from infected tobacco leaf.

**Classification Based on Shape**

Helical, Spherical, Polyhedral, Complex

**Classification Based on Composition**

RNA containing, DNA containing

**Classification Based on their hosts**

Animal, Plant, Bacteriophage

**Classification Based on covering**

Enveloped, Non-enveloped

**Virus Diseases**

Animal: Influenza, Measles, Mumps, AIDS, etc.

Plant: Tobacco Mosaic, etc.

**STB38 : Bacteria**

### Bacteria

Prokaryotes, most healthfully known as bacteria, being a Kingdom Bacteria. The bacteria added to almost every part of our life.

**Classification of Bacteria**

Gram Positive, Gram Negative

**Cell Shape**

Cocci, Bacilli, Spirilla, Vibrios

**Respiration in Bacteria**

Aerobic, Anaerobic

**Chemical Nature of Cell Wall**

Gram Positive, Gram Negative

**Bacterial Growth and Reproduction**

Binary Fission, Conjugation, Spore Formation

**Useful Activities**

Yeast, Lactobacillus, etc.

**Some Bacterial Diseases**

Typhoid, Cholera, etc.

**STB39 : Life Cycle of Fern**

### Life Cycle of Fern

Ferns are spore producing plants that alternate generations.

**SPOROPHYTES** (2n): Sporangia or spore cases, appear on the back of leaf (the fern fronds).

**COMMON BRACKEN**: Common bracken forms dense growths in woods and fields.

**SPORES**: Spores are blown away from spore cases.

**GAMETOPHYTE** (n): The spores grow into heart-shaped gametophytes called prothallia.

**FERTILIZATION**: Sperm from the antheridium swim to the archegonium. The archegonium and antheridium grow from the gametophyte.

**SPOROZYTES**: Sporangia or spore cases, appear on the back of leaf (the fern fronds).

**STB40 : Life Cycle of Moss**

### Life Cycle of Moss

The life cycle of a moss is dominated by the green, leafy gametophyte (haplophase). The sporophyte (diplophase) consists only of the ascending stalk and capsule.

**SPOROZYTES** (2n): Sporangia or spore cases, appear on the back of leaf (the fern fronds).

**SPORES**: Spores are blown away from spore cases.

**GAMETOPHYTE** (n): The spores grow into heart-shaped gametophytes called prothallia.

**FERTILIZATION**: Sperm from the antheridium swim to the archegonium. The archegonium and antheridium grow from the gametophyte.

**SPOROZYTES**: Sporangia or spore cases, appear on the back of leaf (the fern fronds).



### STB41 : Spirogyra

#### Spirogyra

Spirogyra is a filamentous freshwater green alga having spiral arrangement of the chloroplast. There are more than 400 species of Spirogyra in the world.

Kingdom	— Plantae
Sub-Kingdom	— Thallophyta
Class	— Chlorophyceae
Order	— Zygomatales
Family	— Zygnemataceae
Genus	— Spirogyra

**Structure**

**Reproduction**

Vegetative reproduction takes place by the process of fragmentation.

**Asexual**

Known only in some species.

**Sexual**

**Lateral Conjugation**

**Scalariform Conjugation**

**Germination of Zygospore**

### STB42 : Life Cycle of a Mushroom

#### Life Cycle of a Mushroom

Mushrooms are unable to photosynthesize. Mushrooms feed off decaying matter, such as rotting logs, fallen leaves, and wilted grass. Some, however, grow on live plants, and others thrive on nutrient-rich animal droppings. They develop in all sorts of environments, especially damp and poorly lit places. They reproduce by means of spores. Mushrooms have relatively simple structures with no roots, stems or leaves. Their cell walls contain the polysaccharide chitin. The fruiting body consists of a stalk (pedicel) made of closely packed hyphae which are attached to a fused mycelium and crowned with a broad cap (pileus). The cap protects the delicate spore-bearing layer.

The death cap is a beautiful but poisonous mushroom that grows in open woods. Poisonous mushrooms such as the death cap are commonly called.

**Baby mushroom**

Secondary mycelia form a vesicle, which grows.

Secondary mycelia of different sexes fuse to form Primary mycelia.

When the spores germinate, they form primary mycelia.

Spores + and - strains germinate if the temperature

### STB43 : Leaf Modifications

#### Leaf Modifications

Leaves are the most important vegetative organs borne on the stems for photosynthesis. However, some plant species have leaves with adaptations to perform various functions other than photosynthesis.

<b>TENDRILS</b> Modified for climbing	<b>SPINES</b> Modified to decrease water loss	<b>THORNS</b> Modified to defend
<b>BRACTS</b> Modification with coloured pigmentation to attract pollinators	<b>FLESHY LEAVES</b> Modified to store food, water and vitamins	<b>ADHESIVE DISC</b> Modified for attachment to other foliage
<b>REPRODUCTIVE LEAF</b> Modification for asexual reproduction to occur on these leaves	<b>PHYLLODE</b> Petioles are modified into flattened green leaf structures to synthesize food	<b>INSECTIVORY</b> Modified to catch insects to fulfil the plant's need for nitrogenous compounds

### STB44 : Parasitic Plants

#### Parasitic Plants

Parasitic plants are vascular plants with specialised organs (haustorium) that penetrate the tissues of other vascular plants (hosts) and absorb water, minerals and sometimes products of photosynthesis.

**HOLOPARASITES**

These are also known as 'obligate parasites' because of their obligation to find a host to order to survive. Holoparasites are total or partial dependants of the host plant.

<b>RAFFLESIA</b>	<b>IVY BROODMOP</b>	<b>CUSCUTA</b>	
<b>HEMIPARASITES</b> <p>These are also known as 'facultative parasites' because they are not completely parasitic. They are capable of both heterotrophic and photosynthetic modes of nutrition.</p>	<b>INDIAN PAINTBRUSH</b>	<b>MISTLETOE</b>	<b>OWL'S CLOVER</b>

### STB45 : Mucor Structure & Reproduction

#### Mucor - Structure & Reproduction

Mucor is a saprophytic fungus which grows on stale moist bread, rotten fruits, decaying vegetables, animal dung and other organic matter. It is composed of a mass of white, delicate, cottony threads known as mycelium. It is always very much branched but is coenocytic (aseptate and multinucleate). Each individual thread of the mycelium is known as the hypha (pl. hyphae).

**Asexual Reproduction**

Development of Sporangium and Formation of Spores

**Sexual Reproduction**

Development of Zygospore

### STB46 : Regions of the Root

#### Regions of the Root

Root is the descending organ of the plant. Primary root is the direct prolongation of the radicle. Root ends in and is protected by the root cap. Root bears uniaxillary hairs in a sheath all over the tender part of the young root. Lateral roots are endogenous. Nodes and inter nodes are absent in the root.

**Region of Maturation**

**Region of Elongation**

**Region of Cell Division**



STZ01 : Animal Kingdom

### Animal Kingdom

Animals are classified into several phyla on the basis of their levels of cell organization and presence or absence of a body cavity.

<b>Phylum Porifera</b> They are the simplest animals. They have no definite shape. They are found in both fresh water and sea water.	<b>Phylum Cnidaria</b> They have two types of cells called nematocytes. They are found in both fresh water and sea water.	<b>Phylum Mollusca</b> They have a muscular foot and a mantle. They are found in both fresh water and sea water.	<b>Phylum Annelida</b> They have a segmented body. They are found in both fresh water and sea water.
<b>Phylum Arthropoda</b> They have a jointed body. They are found in both fresh water and sea water.	<b>Phylum Mollusca</b> They have a muscular foot and a mantle. They are found in both fresh water and sea water.	<b>Phylum Chordata</b> They have a notochord and a dorsal fin. They are found in both fresh water and sea water.	<b>Phylum Mollusca</b> They have a muscular foot and a mantle. They are found in both fresh water and sea water.

STZ02 : Animal Cell

### Animal Cell

The cell is the smallest unit of life. It is the basic structural and functional unit of an organism. It is the smallest unit of life that can exist on its own.

**Plasma Membrane:** It is the outermost layer of the cell. It is made up of phospholipids and proteins. It is selectively permeable.

**Nuclear Envelope:** It is the double membrane layer that surrounds the nucleus. It has nuclear pores.

**Nucleus:** It is the control center of the cell. It contains the cell's genetic material (DNA).

**Mitochondria:** They are the powerhouses of the cell. They generate energy for the cell's metabolic needs.

**Golgi Apparatus:** It is a series of flattened membrane-bound sacs. It is involved in the transport and processing of proteins.

**Endoplasmic Reticulum:** It is a network of membranes. It is involved in the synthesis and transport of proteins.

**Cilia and Flagella:** They are hair-like structures that extend from the cell surface. They are used for movement.

**Centrioles:** They are cylindrical structures. They are involved in cell division.

**Lysosomes:** They are small organelles. They are involved in the breakdown of waste materials.

**Cytoskeleton:** It is a network of fibers. It provides structural support to the cell.

**Mitochondria:** They are the powerhouses of the cell. They generate energy for the cell's metabolic needs.

STZ03 : Animal Cell Organelles

### Animal Cell Organelles

This chart details the structure and function of various organelles within an animal cell.

- Nucleus:** Contains DNA, nucleolus, nuclear envelope, nuclear pores.
- Endoplasmic Reticulum:** Rough ER (with ribosomes), Smooth ER (without ribosomes).
- Golgi Apparatus:** Composed of flattened sacs (cisternae).
- Mitochondrion:** Bean-shaped organelle with internal folds (cristae).
- Lysosome:** Membrane-bound organelle containing digestive enzymes.
- Centrioles:** Two cylindrical structures at right angles to each other.
- Cytoskeleton:** Includes microtubules, microfilaments, and intermediate filaments.
- Plasma Membrane:** Phospholipid bilayer with embedded proteins.
- Cell Wall:** Not present in animal cells.
- Chloroplasts:** Not present in animal cells.
- Large Central Vacuole:** Not present in animal cells.

STZ04 : Animal Tissues

### Animal Tissues

Tissues are the groups of cells having a common origin and performing similar functions. Animal tissues are classified into four groups - Epithelial, Connective, Muscular and Nervous tissues.

**Epithelial Tissues:** Epithelial tissue is the covering tissue. It is made up of cells closely packed and arranged in one or more layers. It is separated from the underlying connective tissue by a thin layer of basement membrane.

- Squamous Epithelium
- Cuboidal Epithelium
- Columnar Epithelium
- Stratified Epithelium
- Transitional Epithelium
- Glandular Epithelium

**Connective Tissues:** Connective tissues join different parts of the body. They also protect different tissues and other structures of the body. They are widely distributed throughout the body.

- Bone
- Blood
- Ligament
- Tendon

**Muscular Tissues:** Muscular tissues make the movement of all parts of our body, including the movement of the heart and alimentary canal. In some, there is contact between one cell and one another to increase length.

- Striated Muscle Tissue
- Smooth Muscle Tissue
- Cardiac Muscle Tissue

**Nervous Tissues:** Nervous tissues are the basic constituents of brain, spinal cord and nerves. They carry the messages from one part of the body to another. They are found in the brain, spinal cord and nerves.

- Nerve Tissue

STZ05 : Animal Cell Mitosis

### Animal Cell Mitosis

Mitosis is the process of cell division in which the mother cell divides into two daughter cells. This is a type of asexual reproduction. It is a process of cell division in which the mother cell divides into two daughter cells. This is a type of asexual reproduction. It is a process of cell division in which the mother cell divides into two daughter cells. This is a type of asexual reproduction.

**I. INTERPHASE:** The cell grows in size. It synthesizes proteins. Replication of DNA takes place.

**II. EARLY PROPHASE:** Chromatin material condenses to form chromosomes. Nuclear membrane disappears. Nucleolus disappears.

**III. LATE PROPHASE:** Spindle fibers form. Chromosomes align in the equatorial plane. Centrioles move to opposite poles.

**IV. METAPHASE:** Chromosomes align in the equatorial plane. Spindle fibers attach to the centromeres.

**V. ANAPHASE:** Sister chromatids separate. Centrioles move to opposite poles.

**VI. TELOPHASE:** Chromosomes reach the poles. Nuclear membrane and nucleolus reappear.

**VII. CYTOKINESIS:** The cell membrane and cell wall pinch inward to form two daughter cells.

STZ06 : Animal Cell Meiosis

### Animal Cell Meiosis

Meiosis is a type of cell division in which the mother cell divides into four daughter cells. This is a type of sexual reproduction. It is a process of cell division in which the mother cell divides into four daughter cells. This is a type of sexual reproduction.

**MEIOSIS I:**

- Prophase I:** Chromosomes condense. Nuclear membrane disappears. Spindle fibers form.
- Metaphase I:** Homologous chromosomes align in the equatorial plane.
- Anaphase I:** Homologous chromosomes separate.
- Telophase I:** Chromosomes reach the poles. Nuclear membrane and nucleolus reappear.

**MEIOSIS II:**

- Prophase II:** Chromosomes condense. Nuclear membrane disappears. Spindle fibers form.
- Metaphase II:** Chromosomes align in the equatorial plane.
- Anaphase II:** Sister chromatids separate.
- Telophase II:** Chromosomes reach the poles. Nuclear membrane and nucleolus reappear.

STZ07 : Gametogenesis in Animals

### Gametogenesis in Animals

Gametogenesis is the process of formation of gametes. It involves two types of cell division: Meiosis I and Meiosis II.

**OOGENESIS:** The process of formation of female gametes (ova). It occurs in the ovary. It involves two types of cell division: Meiosis I and Meiosis II.

**SPERMATOGENESIS:** The process of formation of male gametes (sperm). It occurs in the testis. It involves two types of cell division: Meiosis I and Meiosis II.

STZ08 : Fertilization in Animals

### Fertilization in Animals

Fertilization is the process of fusion of male and female gametes to form a zygote. It involves the fusion of the nuclei of the sperm and the egg.

**Gametes in Animals:** Male gametes (sperm) are small and motile. Female gametes (ova) are large and non-motile.

**Fertilization Process:** The sperm penetrates the egg. The nuclei of the sperm and the egg fuse to form a zygote. The zygote develops into an embryo.



### STZ09 : Protozoa

## Protozoa

The term Protozoa was coined by Goldfuss in 1820. The phylum protozoa includes the unicellular organisms that have animal-like characteristics. The word protozoa literally means 'first animals' or 'primitive animals'. The phylum Protozoa is divided, according to the structures they possess, for locomotion into four classes.

#### Rhizopoda

Protozoa that move by means of pseudopodia are classified as Rhizopoda.

For e.g., amoeba. Amoeba is a single celled protozoa that can constantly change its shape. Some of them also cause amoebiasis/dysentery in humans.

#### Mailigophora

Protozoa that move by means of flagella are classified as Mailigophora.

For e.g., Euglena, Giardia, etc. Euglena is considered as the connecting link between the plant kingdom and the animal kingdom. Giardia causes dysentery in human beings.

#### Ciliophora

Protozoa that move by means of cilia are classified as Ciliophora.

For e.g., paramecium.

#### Sporozoa

Protozoa that do not possess locomotory organs are classified as Sporozoa.

For e.g., plasmodium vivax.

### STZ10 : Amoeba

## Amoeba

Amoeba is one of the simplest living animals, consisting of a single cell and belonging to the protozoa group.

#### Cell Membrane

is a thin layer of fat and protein that surrounds the body of the amoeba. It controls the entry and exit of various substances into and out of the body.

#### Pseudopodiums

Projections or false feet like structures that extend from the body of the amoeba. It is used for locomotion and feeding. The false feet are also used to engulf food particles. This is called phagocytosis.

#### Cytoplasm

is present inside the cell membrane. It is a fluid-like substance. It contains various organelles and is the site of various metabolic activities.

#### Contractile Vacuole

is the most prominent organelle in the body of the amoeba. It is used to expel excess water and maintain osmotic balance.

#### Nutrition in Amoeba

#### Reproduction in Amoeba

### STZ11 : Malaria Parasite

## Malaria Parasite

The life cycle of the malaria parasite, plasmodium, takes place in two hosts - an anopheles mosquito and a human being.

#### SCHIZOGONY IN MAN

#### SPOROGONY IN MOSQUITO

### STZ12 : Paramecium

## Paramecium

#### Paramecium caudatum

#### Muller's

#### Reproduction in Paramecium

#### Sexual Reproduction (Conjugation)

### STZ13 : Hydra

## Hydra

Hydra is a simple coelenterate, commonly found in freshwater ponds and streams.

#### Parts of Hydra Cut Away and Sectioned to Show Structure

#### Longitudinal Section of the Body Wall

#### Asexual Reproduction

#### Sexual Reproduction

#### Developmental Stages of the Hydra

### STZ14 : Liver Fluke

## Liver Fluke

### Liver Fluke (Opisthorchis sinensis) Anatomy

### Life Cycle of Liver Fluke (Opisthorchis sinensis)

### STZ15 : Tapeworm

## Tapeworm

### Morphology of Taenia Solium

### Scolex and Hook

### T. S. of Mature Proglottis

### Reproductive Organs in Mature Proglottis

#### Excretory System

#### Arrangement of Reproductive Ducts

#### Gravid Proglottis

### STZ16 : Roundworm (Ascaris)

## Roundworm (Ascaris)

#### Side View

#### Female ASCARIS

#### Male ASCARIS

#### Cross-section of Female ASCARIS

#### Alimentary Canal

#### Posterior End of Male

#### Excretory System

#### Nervous System

### STZ17 : Hookworm

#### Hookworm

**Characteristics of Hookworm**

- The intestinal nematode parasites attach to the intestinal epithelium of mammalian host blood.
- Females are 12 to 15 mm long and bear four to six eggs.
- They possess a pair of suckers or mouthparts for feeding on the host's blood.
- There is a large buccal capsule with 2 pairs of large teeth (dorsal and ventral) and a pair of sharp teeth (dorsal and ventral) for penetrating the host's skin.
- Eggs passed with human feces and latrine soil.
- The proventriculus (stomach) comes to the surface and penetrates the human skin through the skin.
- Anthelmintic parasites cause itching and inflammation of the skin, which primarily infection or worm parasites.
- They cause severe anemia in adults and retard physical and mental development in children.

**Hookworms Embryo (Four cells)**

**Hookworm (Male)**

**Bursa of Male**

**Long Passage of Hookworm**

### STZ18 : Life History of Mosquito

#### Life History of Mosquito

Mosquitoes complete their life cycle in stagnant water. The life cycle of a mosquito consists of four stages – egg, larva, pupa and adult.

A female mosquito has needle like parts of its mouth. It feeds on blood to develop her eggs. Mosquitoes are seen as nuisance in the house.

A female mosquito lays her eggs in or around water. It can deposit several hundred eggs in each round meal.

Wider 7-10 days, larvae change to pupa. The growing mosquito stays on still water for a few minutes to dry its wings are then fly away.

The eggs hatch within 24-48 hours and release larvae. Larvae are commonly known as 'wigglers'. Larvae lay white eggs and swim on the surface of water.

### STZ19 : Life Cycle of Butterfly

#### Life Cycle of Butterfly

##### Metamorphosis of a Monarch Butterfly

Coloured patterns on the wings help the butterfly to find a mate and food predators.

**Adult Butterfly**  
Adults live for only a short time. They cannot eat. They only drink through their straw-like upper proboscis. They will fly, mate, and reproduce.

**Egg**  
The adult female lays an egg that will be fertilized by the male.

**Pupa (Chrysalis)**  
Inside the pupa, the caterpillar changes into a butterfly. Pupae are often camouflaged to hide from predators.

**They Larva (Caterpillar)**  
The egg hatches into a tiny larva (Caterpillar).

**Green Pupa**  
The caterpillar attaches itself to a twig and forms a hard outer shell.

**Caterpillar**  
The caterpillar eats and grows to a tremendous amount.

### STZ20 : Life History of Housefly

#### Life History of Housefly

**Adult**  
A housefly has reached its full size when it comes out of the pupal case. In about 2-3 days, the adult housefly is able to reproduce. Houseflies ingest only liquid food. They regurgitate saliva onto solid food to dissolve it.

**Eggs**  
Adult female lays many eggs that allow production of many eggs (100-250). After mating, eggs are laid in protein rich site such as damp manure or decaying grain under.

**Puparium**  
The pupa does not feed and remains inactive. Inside the pupal case, the larva continues to change and takes on the shape of the adult housefly. In another 3-6 days, the adult housefly becomes.

**Full Grown Larva**  
Larvae thus produced feed on protein diet & grow rapidly. At the end of growth phase,

### STZ21 : Life History of Frog

#### Life History of Frog

Frogs are amphibians meaning that they can live both in water and on land. There are 24 different families of frogs which entails more than 5000 species.

**ADULT FROG**  
An adult frog jumps easily to avoid its enemies and uses its webbed feet, an adult frog can swim easily.

**EGGS**  
Frogs lay their eggs in large masses called clumps, in various situations.

**1 DAY 2-3 EGGS**  
The tadpoles hatch from the eggs within 24-48 hours.

**YOUNG FROG**  
Over a period of 2 weeks, the tadpoles metamorphose and finally disappear. The froglets now have the water.

**ADULT FROG**  
The tadpoles are hatching into the eggs start swimming. Their tails help them to swim.

**EGG CLUMP**  
Within 24-48 hours, the eggs start hatching and the internal organs develop. Later the tadpoles start swimming.

**ADULT FROG**  
Tadpoles develop external gills and a long swimming tail as well as internal respiratory system.

### STZ22 : Human Blood

#### Human Blood

**FUNCTIONS OF BLOOD**

- Transportation of oxygen, carbon dioxide, nutrients, hormones, heat, and wastes.
- Regulation of pH, body temperature, and water content of cells.
- Protection against blood loss through clotting and against disease through phagocytic white blood cells and antibodies.

**BLOOD FLOWING IN BLOOD VESSEL**

**COMPONENTS OF BLOOD**

**Plasma (55-60%)**  
Water (90%)  
Proteins (7-8%)  
Electrolytes (1%)  
Other solutes (1-2%)

**Buffy Coat (1-2%)**  
Leucocytes  
Erythrocytes  
Platelets

**RBC STRUCTURE**

**BLOOD GROUP**

System	Antigen	Antibody	Can Receive Blood From	Can Donate Blood To
A	A	B, AB, O	A, O	A, AB
B	B	A, AB, O	B, O	B, AB
AB	A, B	O	A, B, AB, O	AB
O	None	A, B, AB, O	O	A, B, AB, O

**BLOOD CLOTTING**

### STZ23 : Body's Defence

#### Body's Defence

Ability of the body to fight against disease causing organisms is called **immunity**. **White Blood Cells** or **Leucocytes** are the cells of the immune system defending the body against both infectious diseases and foreign materials. White blood cells are produced in the bone marrow known as **Haematopoietic Stem Cell**. Leucocytes are found throughout the body including the blood and lymphatic system.

**Vaccination** is the administration of antigenic material (the vaccine) to produce immunity to a disease. Vaccines can prevent from the effects of infection by a pathogen.

**VACCINATION**  
Vaccination is most effective method of preventing infectious diseases.

**STRUCTURE OF AN ANTIBODY MOLECULE**

**BOY'S IMMUNE MECHANISM (ACQUIRED IMMUNITY)**

### STZ24 : Harmful Insects

#### Harmful Insects

**Locust**  
Locusts devastate crops and cause major agricultural damage.

**Head Lice**  
Responsible for itchy scalp leading to discomfort and infection.

**Aphid**  
Quite destructive as it feeds plant sap & spreads viruses.

**Bedbug**  
Causes skin rashes, allergic & psychological effects.

**Female Anopheles Mosquito**  
Transmits malaria.

**Flea**  
Causes flea allergy dermatitis. Also transmits bubonic plague, typhus, typhoid fever and other diseases.

**Termites**  
Can cause great damage to ungrouted wooden buildings and wooden structures.

**Rice Weevil**  
Causes damage to harvested and stored grains. It's larvae eat the kernel of the grain kernels.

**Silverfish**  
Can damage books, documents, sugary products, carpet, clothes, leatherware etc.

**Sandfly**  
Vector of Leishmaniasis. Also source of the typhus virus.

**Female Aedes Mosquito**  
Transmits Dengue and yellow fever.

**Housefly**  
Dangerous carrier of pathogens like typhoid, cholera, dysentery, salmonellosis etc.



### STZ25 : Beneficial Insects

#### Beneficial Insects

- Praying Mantis**: Used for biological pest control.
- Dragonfly**: Feeds on harmful insects like mosquitoes, flies, bees and ants.
- Bumble Bee**: An important pollinator.
- Ladybird**: Feeds on aphids and leaf insects.
- Cactus Moth**: Feeds on cactus species.
- Green Lacewing**: Larvae (called 'lacewing bugs') kill pests of fruit crops, vegetables and green houses.
- Fig Wasp**: Pollinates figs.
- Honey Bee**: Produces products of honey, beeswax and propolis.
- Lair Insect**: Producer of lac resin.
- Silkworm**: Primarily producer of silk.

### STZ26 : Food Habits of Birds

#### Food Habits of Birds

Birds eat assorted foods that are rich in energy and proteins. Many species eat more than one type of food whereas some birds feed entirely on a single kind of food. Birds also have seasonal changes in their diet to guarantee their survival.

- Feeding on Ploy (Raptorial)**: They hunt and catch their prey using their talons. Many birds, especially raptors, feed almost exclusively on other animals. *Example: Hawk, Eagle, Osprey, Falcon, Kestrel, Crow.*
- Feeding on Carrion (Scavengers)**: They eat corpses. They tear apart dead garbage waste, if allowed they consume animal waste like excrement. *Example: Vulture, Raven, Crow, Magpie, Starling.*
- Feeding on Insects (Insectivorous)**: They primarily feed on insects. *Example: Swift, Hummingbird, Kingfisher, Kingfisher, Kingfisher.*
- Feeding on Fish (Piscivorous)**: They feed on fish. *Example: Kingfisher, Osprey, Cormorant, Pelican, Kingfisher, Kingfisher.*
- Feeding Mainly on Fruits (Fruvorous)**: They eat fruits. *Example: Parrot, Toucan, Parrot, Parrot.*
- Feeding on Grains & Seeds (Granivorous)**: They eat grains and seeds. *Example: Pigeon, Dove, Sparrow, Crow, Parrot, Parrot.*
- Feeding on Nectar/ Pollen/ Sap (Nectarivorous)**: They feed on nectar. *Example: Hummingbird, Honeycreeper, Kingfisher, Kingfisher.*
- Feeding on Green Vegetation**: They feed on green vegetation. *Example: Parrot, Parrot, Parrot, Parrot.*
- Unrestricted feeding (Omnivorous)**: Omnivorous birds eat a wide range of things including insects, fish, seeds, plants, and other animals. *Example: Crows, Starling, Parrot, Parrot, Parrot.*
- Filter Feeding**: Filter feeders strain food from water. *Example: Pelican, Parrot, Parrot.*

### STZ27 : Fish Anatomy

#### Fish Anatomy

**Bony Fish**

**General Anatomy**

**Skeletal System**

**Cartilaginous Fish**

**Gill Structure**

### STZ28 : Birth of a Bird's Chick

#### Birth of a Bird's Chick

- 1. Fertilization**: The egg and sperm fuse to form a zygote.
- 2. Cleavage**: The zygote divides into many cells.
- 3. Blastoderm**: The cells form a protective layer called the blastoderm.
- 4. The yolk**: The yolk provides nutrients for the developing chick.
- 5. Hatching**: The chick is ready to break the shell.
- 6. CHICKEN**: The chick is fully developed and ready to hatch.

### STZ29 : Earthworm - I (External Morphology & Reproduction)

#### Earthworm - I (External Morphology & Reproduction)

**Cross Section of Earthworm**

**Anterior End of Earthworm**

**REPRODUCTIVE SYSTEM**

**POPULATION IN EARTHWORM**

### STZ30 : Earthworm - II (Blood Circulation, Respiratory & Nervous System)

#### Earthworm - II (Blood Circulation, Respiratory & Nervous System)

**Circulatory System of First 14 Segments**

**Circulatory System of 15th Segment Onwards**

**Anterior End Showing Cerebral Ganglion & Larger Nerves**

**Sensory & Motor Nerves of Ventral Nerve Cord**

**Structure of Valve Between Dorsal and Typhlosole Vessels**

**T.S. of Ventral Nerve Cord Ganglion**

**Respiration Through Moist Skin**

**Epidermis Showing Sense Organs**

### STZ31 : Earthworm - III (Digestion, Skin & Excretion)

#### Earthworm - III (Digestion, Skin & Excretion)

**Alimentary Canal**

**T.S. Through Gizzard**

**T.S. of Body Wall**

**Excretory System**

### STZ32 : Cockroach - I (Morphology & Reproduction)

#### Cockroach - I (Morphology & Reproduction)

**EXTERNAL FEATURES**

**HEAD (posterior view)**

**LEG**

**ABDOMEN SEGMENTS (posterior end side view)**

**REPRODUCTIVE SYSTEM**

STZ33 : Cockroach - II (Blood Circulation, Respiratory & Nervous System)

### Cockroach-II (Blood Circulation, Respiratory & Nervous System)

**Circulatory System of Cockroach**

- Heart (dorsal vessel)
- Ventral blood vessel
- Heart valves
- Working of the Valves

**Respiratory System of Cockroach**

- Spiracle
- Tracheal Sprinkle of Cockroach

**A Central & Peripheral Nervous System**

STZ34 : Cockroach - III (Digestion, Excretory, Skin & Muscles)

### Cockroach-III (Digestion, Excretory, Skin & Muscles)

**Digestive System**

**Excretory System**

**Structure of Integument**

**Ultrastructure of Epicuticle**

**Muscles**

STZ35 : Vertebrate Classes

### Vertebrate Classes

Principal classes of vertebrates having living representation are :-

- CLASS - FISHES**
  - Cardinal vertebrate class
  - First class of vertebrates
  - Cardinal class with respect to evolution
  - Cardinal class with respect to evolution
- CLASS - AMPHIBIANS**
  - Cardinal vertebrate class
  - First class of vertebrates
  - Cardinal class with respect to evolution
  - Cardinal class with respect to evolution
- CLASS - REPTILES**
  - Cardinal vertebrate class
  - First class of vertebrates
  - Cardinal class with respect to evolution
  - Cardinal class with respect to evolution
- CLASS - BIRDS**
  - Cardinal vertebrate class
  - First class of vertebrates
  - Cardinal class with respect to evolution
  - Cardinal class with respect to evolution
- CLASS - MAMMALS**
  - Cardinal vertebrate class
  - First class of vertebrates
  - Cardinal class with respect to evolution
  - Cardinal class with respect to evolution

STZ36 : Sense Organs

### SENSE ORGANS

Human sense organs contain receptors that relay information through sensory neurons to the appropriate places within the nervous system.

Receptors found in Sense Organs

- EYE - "SIGHT"**
- EAR - "SOUND"**
- TONGUE - "TASTE"**
- SKIN - "TOUCH"**
- NOSE - "SMELLING"**

STZ37 : General Dissection of Rabbit

### General Dissection of Rabbit

Rabbits are mammals in the family Leporidae of the order Lagomorpha. There are eight different genera in the family.

**Dissection of a Female Rabbit (a mammal)**

STZ38 : Neuron

### Neuron

The basic parts of a neuron are:

- Structure of Neuron**
- Bipolar Neuron**
- Unipolar Neuron**
- Multipolar Neuron**

**The Synapse**

STZ39 : Early Development of the Frog

### Early Development of the Frog

**1. 2-Cell Stage**

**2. 4-Cell Stage**

**3. 8-Cell Stage**

**4. Late Blastula**

**5. Early Gastrula in Section**

**6. Early Gastrula**

**7. Gastrula in Section**

**8. Late Gastrula**

STZ40 : Frog's Morphology & Internal Structure

### Frog's Morphology & Internal Structure

**Dorsal View**

**Ventral View**

**Internal Structure of Frog**

SCIENCE AND TECHNOLOGY  
Charts on Zoology  
Laminated Art, Size 58 x 90 cm (In English only)

**STZ41 : Frog's Urogenital System** NEW

**Frog's Urogenital System**

Urogenital system of the frog consists of organs of excretion and reproduction. They are considered together because they share some common ducts and they work together quite often, especially in male frog.

**Urogenital System of Male Frog**

Labels: Fat body, Testis, Adrenal gland, Urinary duct, Large intestine, Seminal vesicle, Cloaca opening, Penis, Vas deferens, Uterus, Ovary, Oviduct, Uterine duct, Large intestine, Cloaca opening.

**Urogenital System of Female Frog**

Labels: Fat body, Ovary filled with eggs, Large intestine, Bladder, Part of excretory system, Pituitary gland, Dorsal vein, Kidney, Urinary duct, Uterus, Cloaca opening.

**STZ42 : Frog's Circulatory System** NEW

**Frog's Circulatory System**

The circulatory system of the frog consists of a heart, arteries, veins, capillaries and lymphatics.

**Circulatory System of the Bullfrog in Ventral View**

**Frog's Heart**

Labels: Dorsal vein, Pulmonary vein, Pulmonary artery, Aorta, Ventricle, Atrium, Sinus, etc.

The heart is the central pumping station of the frog's circulatory system. It is composed of a ventral muscular ventricle, two thin-walled atria, one on the right and the other on the left, a thick-walled aorta for the main outflow which arises from the base of the ventricle and a thin-walled truncus aorta: the latter ventricle on the dorsal side.

**STZ43 : Frog's Nervous System** NEW

**Frog's Nervous System**

Frogs have a highly developed nervous system. The nervous system is divided into:

- Central Nervous System
- Peripheral Nervous System
- Autonomic Nervous System

**BRAIN OF FROG**

Labels: Cerebrum, Cerebellum, Brain stem, etc.

**STZ44 : Frog's Muscular System** NEW

**Frog's Muscular System**

Muscular structure of a frog is very different from that of a human. The difference is in the relative power of some of the muscle groups.

Frogs use leg muscles to jump and can jump 6-8 times their own body length. In frog, a muscular system acts as a spring.

**ADAPTATION**

Adaptation and movement of frog leg forward and back. In jumping, adductor and abductor pull it back.

**STZ45 : Life Cycle of a Cockroach** NEW

**Life Cycle of a Cockroach**

The life cycle of cockroach begins with the egg. After mating, cockroach female produces resilient egg cases known as oothecae.

Under favourable conditions, immature cockroaches known as nymphs will emerge.

Adult cockroaches have an average lifespan of around a year but it depends on species.

Initially nymphs are whitish and soft. Once their exoskeleton hardens they will darken and appear in their normal colour.

Nymphs undergo a series of molts before becoming fully mature adults.

Nymphs resemble adults in appearance and behaviour, although they are smaller in size and do not have wings.

**STZ46 : Skeleton of a Bird** NEW

**Skeleton of a Bird**

The skeleton of a bird is adapted for flight. It is light and strong. The bones are hollow and have a porous structure. The skull is fused to the vertebral column. The wings are supported by the pectoral girdle and forelimbs.

**Anatomy of Hyla**

**Birds Have Pneumatic Bones**

Many of a bird's bones are pneumatic. They are filled with air. This makes them very light. The air enters the bones through small openings called foramina.

**STZ47 : Skeleton of a Rabbit** NEW

**Skeleton of a Rabbit**

Skeleton of rabbit, like that of any other vertebrate, is divided into:

- Skull
- Vertebral column
- Rib cage
- Pectoral girdle
- Forelimbs
- Pelvic girdle
- Posterior limbs

**Lower Vertebrae of Rabbit**

**Upper Vertebrae of Rabbit**

**STC01 : Atoms and Atomic Structure**

### Atoms and Atomic Structure

Atoms are the building blocks of matter.

Atoms have a positively charged central nucleus. The nucleus has positively charged protons and neutral neutrons. Electrons revolve around the nucleus. The number of electrons in an atom is equal to the number of protons in the atom.

In 1932, James Chadwick discovered the presence of neutrons in an atom. Goldstein shows the existence of protons in an atom.

Rutherford suggested a fixed circular path of an electron in the nucleus.

According to classical electromagnetic theory, electrons will lose energy continuously while revolving around the nucleus. This, however, does not happen.

Bohr's Atomic Model suggested that electrons revolve around the nucleus in different energy levels or shells. Energy levels are shells or represented by numbers 1, 2, 3, 4, 5 and so on. Electrons do not lose their energy as long as they keep moving in their energy levels.

The electrons orbiting the nucleus of an atom can absorb energy and move from a lower orbit to a higher one.

Mass number = protons + neutrons. It is represented by A.

Atomic mass is the average of mass number of naturally occurring isotopes of an atom.

In 1913, Niels Bohr introduced atomic number called atomic number. It is equal to the number of protons present inside the nucleus of an atom. It is represented by Z.

The mass number and atomic number are shown as superscript and subscript respectively on the left side of the symbol of that element.

**STC02 : Chemical Reactivity of An Element**

### Chemical Reactivity of An Element

The metals, which can lose electrons more readily to form positive ions are more reactive. The more reactive metals displace the less reactive metal from its salt solution. The less reactive metals do not lose electrons easily. Potassium is the most reactive metal. Gold is the least reactive metal.

**Relative Reactivity of Metals**

K	Potassium	Most reactive
Na	Sodium	
Mg	Magnesium	
Al	Aluminium	
Zn	Zinc	
Fe	Iron	
Pb	Lead	
H	Hydrogen	
Cu	Copper	
Hg	Mercury	
Ag	Silver	
Au	Gold	Least reactive

When 10 ml of dilute HCl is added to each piece of magnesium, aluminium, zinc, iron and copper, the rate of bubble formation decreases in the order: Mg > Al > Zn > Fe > Cu.

$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

When a piece of zinc is placed in copper sulphate solution, reddish brown particles of copper settle at the bottom of the container.

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$

$2Al + 3H_2SO_4 \rightarrow 2Al_2(SO_4)_3 + 3H_2$

When a piece of copper is placed in silver nitrate solution, a greyish white precipitate of silver forms.

$Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$

$Pb + 2HCl \rightarrow PbCl_2 + H_2$

No reaction takes place when a piece of copper is placed in the zinc sulphate solution.

No reaction takes place. Therefore there is no bubble formation in the case of copper.

**STC03 : Chemical Reaction and its Characteristics**

### Chemical Reaction and its Characteristics

A chemical reaction is a phenomenon of formation of new substances.

The interconversion of atoms of the reactants gives rise to the formation of new substances. Heating sodium chloride and sodium hydroxide gives sodium chloride.

$CaCl_2 + NaOH \rightarrow CaO + NaCl$

**1. Evolution of Gas**

When sodium hydroxide is added to an aqueous solution of hydrochloric acid, a brown coloured precipitate is formed.

$FeCl_3 + 3NaOH \rightarrow Fe(OH)_3 + 3NaCl$

**2. Change of Colour**

Colours change due to the formation of new products. When some iron filings are placed in a blue coloured solution of copper sulphate, a grey coloured residue of iron sulphate is formed along with copper.

$CuSO_4(aq) + Fe(s) \rightarrow Cu(s) + FeSO_4(aq)$

**3. Formation of Precipitates**

When sodium hydroxide is added to an aqueous solution of calcium chloride, a white precipitate is formed.

$CaCl_2 + 2NaOH \rightarrow Ca(OH)_2 + 2NaCl$

**4. Change of State**

Electrolysis of water gives hydrogen and oxygen gases.

$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$

**5. Release of Heat**

Reaction which involves release of heat is called exothermic reaction.

$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$

**6. Absorption of Heat**

Reaction which involves absorption of heat is called endothermic reaction.

$C(s) + 2H_2O(l) \rightarrow CO_2(g) + 2H_2(g)$

**STC04 : Classification of Chemical Reactions**

### Classification of Chemical Reactions

**Combination Reaction**

In a combination reaction two or more substances combine to give a single substance.

$Mg + O_2 \rightarrow 2MgO$

**Decomposition Reaction**

A compound splits up into two or more substances in a decomposition reaction.

$2KClO_3 \rightarrow 2KCl + 3O_2$

**Displacement Reaction**

In a displacement reaction, the more reactive element displaces the less reactive element.

$Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$

**Double Displacement Reaction**

In a double displacement reaction, two compounds exchange their ions to give two new compounds.

$Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$

**Redox Reaction**

In redox reaction, both oxidation and reduction take place at the same time.

**Oxidation Reaction**

Oxidation involves loss of electrons or an increase in oxidation number.

$Cu \rightarrow Cu^{2+} + 2e^-$

**Reduction Reaction**

Reduction involves gain of electrons or a decrease in oxidation number.

$Cu^{2+} + 2e^- \rightarrow Cu$

**Exothermic Reaction**

The reaction of an acid with a metal is an exothermic reaction, as it releases heat.

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$

**Endothermic Reaction**

Decomposition of an acid is an endothermic reaction, as it absorbs heat.

$2H_2O \xrightarrow{\text{Heat}} 2H_2 + O_2$

**STC05 : Valencies of Elements**

### Valencies of Elements

**Valency** - Capacity of a single atom or radical to combine with other atoms or radicals to form a stable molecule. Valency of an element depends on the number of valence electrons.

Z	Element	Sym.	Valency
1	Hydrogen	H	+1, -1
2	Helium	He	0
3	Lithium	Li	+1
4	Beryllium	Be	+2
5	Boron	B	+3, -5
6	Carbon	C	+2, +4, -4
7	Nitrogen	N	+3, -2, +1, +2, -3, +4, -5
8	Oxygen	O	+2, -2
9	Fluorine	F	-1, +1
10	Neon	Ne	0
11	Sodium	Na	+1
12	Magnesium	Mg	+2
13	Aluminium	Al	+3
14	Silicon	Si	+4, -4
15	Phosphorus	P	+3, +5, -3, -5
16	Sulphur	S	+2, +4, +6, -2
17	Chlorine	Cl	+1, +3, +5, +7, -1
18	Argon	Ar	0
19	Potassium	K	+1
20	Calcium	Ca	+2
21	Scandium	Sc	+3
22	Titanium	Ti	+2, +3, +4
23	Vanadium	V	+2, +3, +4, +5
24	Chromium	Cr	+2, +3, +6
25	Manganese	Mn	+2, +3, +4, +6, +7
26	Iron	Fe	+2, +3, +6
27	Cobalt	Co	+2, +3, +4
28	Nickel	Ni	+2, +3, +4
29	Copper	Cu	+1, +2, +3
30	Zinc	Zn	+2
31	Gallium	Ga	+3
32	Germanium	Ge	+2, +4
33	Arsenic	As	+3, +5, -3, -5
34	Selenium	Se	+2, +4, +6
35	Bromine	Br	+1, +3, +5, +7
36	Krypton	Kr	0
37	Rubidium	Rb	+1
38	Strontium	Sr	+2
39	Yttrium	Y	+3
40	Zirconium	Zr	+2, +3, +4
41	Niobium	Nb	+2, +3, +4, +5
42	Molybdenum	Mo	+2, +3, +4, +5, +6
43	Rhenium	Re	+3, +4, +5, +6, +7
44	Ruthenium	Ru	+2, +3, +4, +5, +6, +7, +8
45	Rhodium	Rh	+1, +3, +4, +5, +6
46	Palladium	Pd	+2, +3, +4, +5, +6

**Valence Mechanism**

The way by which the elements combine with each other to obtain a stable electronic configuration.

- By forming ionic bond.
- By forming covalent bond.
- By forming co-ordinate bond.

**STC06 : Chemical Bonding**

### Chemical Bonding

The attractive force which holds various constituents (atoms, ions etc.) together in different chemical species is a chemical bond.

**COVALENT BONDING**

In covalent bonding, atoms share their electrons with other atoms. When only one electron pair is shared, a single covalent bond is formed. Similarly a double bond or triple bond is formed when two pairs or three pairs of electrons are shared respectively.

**IONIC BONDING**

When an atom loses or gains electron it becomes electrically charged ion. An ionic bond is formed when ions with opposite charges are held together by electrical attraction and form an ionic solid. In common salt (NaCl), sodium atom loses an electron to form a positive ion, while the chlorine atom gains an electron to form a negative ion.

**METALLIC BONDING**

Metals atoms have relatively free electrons in their outer shells. In metallic bonding, a lattice is formed where all the metal atoms share their outer electrons to form a sea of delocalised metal electrons.

**HYDROGEN BONDING**

In polar covalent molecules involving hydrogen, the slightly positive hydrogen ends of these molecules tend to attract the slightly negative ends of their neighbours. The type of attraction is hydrogen bonding. It is a very weak sort of chemical bond.

**STC07 : Combustion**

### Combustion

Combustion is the process of burning of a substance in the presence of oxygen to liberate energy in the form of heat and light. A substance which helps in burning of combustible substances is known as a supporter of combustion. Oxygen is a supporter of combustion while nitrogen is a non-supporter.

Substances which burn in air to produce heat and light are called **Combustible Substances**.

Substances that do not burn easily are called **Non Combustible Substances**.

**Types of Combustion**

- 1. Rapid Combustion**: Combustion in which a large amount of heat and light are produced for a short period of time.
- 2. Slow Combustion**: Combustion at a very slow speed and at a low temperature is called slow combustion.
- 3. Spontaneous Combustion**: Combustion in which a very large amount of energy is released in the form of heat, light and sound in a very short period of time is called spontaneous combustion.
- 4. Controlled Combustion**: Combustion in the presence of excess oxygen to burn the highest part of the substance is called controlled combustion. e.g. incomplete combustion of carbon produces carbon monoxide.
- 5. Incomplete Combustion**: Combustion in the presence of insufficient supply of oxygen is called incomplete combustion. e.g. incomplete combustion of carbon produces carbon monoxide.

**Ignition Temperature**

A combustible substance starts burning only when it is heated to a certain minimum temperature called the ignition temperature. These temperatures for different substances are as follows:

1. A combustible substance.
2. A supporter of combustion such as oxygen.
3. Heat to raise the temperature of the combustible substance to the ignition temperature.

**STC08 : Separation of Substances**

### Separation of Substances

Separation of substances is required to get a pure and clean substance for our use. Substances can be purified through various means. Some of them have been discussed below.

**Dissolution**: Dissolution means to separate a liquid from a solid substance. This is called dissolution.

**Filtration**: We use the process of filtration while making tea or coffee. The tea leaves and coffee grounds are separated from the liquid.

**Fractional Distillation**: Two miscible liquids having different boiling points are separated by this method.

**Evaporation and Crystallization**: Evaporation and crystallization are used to separate salt from sea water.

**Sublimation**: We can separate the mixture of two substances, one of which sublimates by this method.

**Magnetic Separation**: A magnet is used to separate iron, nickel or cobalt from a mixture.

**Solvent Extraction and Decantation**: A mixture of immiscible liquids is separated by solvent extraction and decantation.

**Distillation**: In the process of distillation, a mixture is heated to separate a liquid and a solid.

**Sieving**: Sieving is used to separate components of different sizes from a mixture.

**Winnowing**: Winnowing is used to separate lighter particles from the heavier ones in a mixture.

**Separating Funnel**: Immiscible liquids of different densities are separated using a separating funnel.

**Centrifugation**: Two immiscible liquids are separated using a centrifugation.

### STC09 : Atmosphere and Composition of Air

#### Atmosphere and Composition of Air

The atmosphere is a thin layer of air that surrounds the Earth. It is composed of various gases and is essential for life on Earth.

**Composition of Air**

Major gases in air:

- Nitrogen: 78.08%
- Oxygen: 20.95%
- Argon: 0.93%
- Carbon Dioxide: 0.04%

**Carbon Dioxide**

It is a colorless, odorless gas that is essential for photosynthesis in plants. It is also a greenhouse gas.

**Water Vapor**

It is a colorless, odorless gas that is essential for life. It is also a greenhouse gas.

**Other Gases**

Trace amounts of neon, helium, methane, krypton, hydrogen, and ozone are also present in the atmosphere.

### STC10 : Occurrence and Forms of Carbon

#### Occurrence and Forms of Carbon

Carbon is a non-metallic element that occurs in various forms in nature.

**In Free State**

- Graphite: Found in lead pencils and as a lubricant.
- Diamond: A hard, transparent crystal used in jewelry and industry.

**In Combined Form**

- Carbonates: Found in rocks and minerals.
- Bicarbonates: Found in some minerals and in the blood.

**In Atmosphere**

- Carbon Dioxide: A greenhouse gas.
- Carbon Monoxide: A poisonous gas.

**Different Forms of Carbon**

Graphite, Diamond, Fullerenes, Nanotubes, and Graphene.

**Properties of Carbon**

- Graphite: Conducts electricity, used in electrodes.
- Diamond: Hardest natural material, used in cutting tools.

### STC11 : Carbon Dioxide and Carbon Monoxide

#### Carbon Dioxide and Carbon Monoxide

**CARBON DIOXIDE (CO<sub>2</sub>)**

**Release of CO<sub>2</sub> in Atmosphere**

- Burning of fossil fuels.
- Respiration of animals and plants.
- Volcanic eruptions.
- Decomposition of organic matter.

**Properties of CO<sub>2</sub>**

- Colorless and odorless gas.
- Slightly heavier than air.
- Turns limewater (calcium hydroxide solution) milky.
- Extinguishes a burning candle.

**Uses of CO<sub>2</sub>**

- Carbonated drinks.
- Fire extinguishers.
- Greenhouse gas.
- Refrigerant.

**Laboratory Preparation of CO<sub>2</sub>**

CaCO3 + 2HCl -> CaCl2 + H2O + CO2

**CARBON MONOXIDE (CO)**

Carbon monoxide is a poisonous gas, which is formed when carbon is oxidized in a limited supply of air.

**Uses of CO**

- Reduction of metal oxides.
- Welding.

**Laboratory Preparation of CO**

C + H2O -> CO + H2

**Properties of CO**

- Colorless and odorless gas.
- Lighter than air.
- Burns with a blue flame.
- Reduces metal oxides.

### STC12 : Carbonates and Bicarbonates

#### Carbonates & Bicarbonates

Carbonates and bicarbonates are the salts of carbonic acid.

**CARBONATES**

**Sodium Carbonate (Na<sub>2</sub>CO<sub>3</sub>)**

It is used in the manufacture of glass, paper, and soap.

**Calcium Carbonate (CaCO<sub>3</sub>)**

It is found in nature as limestone and marble.

**BICARBONATES**

**SODIUM BICARBONATE (NaHCO<sub>3</sub>)**

It is used in baking powder and as an antacid.

**Preparation of Sodium Bicarbonate**

Na2CO3 + CO2 + H2O -> 2NaHCO3

**Uses of Sodium Bicarbonate**

- Baking powder.
- Antacid.
- Fire extinguisher.

### STC13 : Sulphur

#### Sulphur

**Extraction of Sulphur (Frasch Process)**

Sulphur is extracted from underground deposits using super-heated water and compressed air.

**Structure of Sulphur Molecule**

Sulphur exists as S<sub>8</sub> rings and S<sub>2</sub> molecules.

**Rhombic Sulphur**

It is the most stable form of sulphur at room temperature.

**Monoclinic Sulphur**

It is formed from rhombic sulphur by heating.

**Effect of Heat on Sulphur**

Sulphur changes from a solid to a liquid and then to a gas as temperature increases.

**Vulcanisation of Rubber**

Rubber is vulcanised by heating it with sulphur to form cross-links, making it stronger and more elastic.

### STC14 : Mole Concept

#### Mole Concept

The word 'mole' is derived from the Latin word 'moles', which means pile, heap or mass.

**THE AVOGADRO NUMBER, N**

$N = 6.0221415 \times 10^{23}$

**THE AVOGADRO NUMBER, N**

ELEMENT	ATOMIC MASS (amu)	1 MOLE (GRAM ATOM)
Al	27.0	27.0 g
O	16.0	16.0 g
C	12.0	12.0 g
H	1.008	1.008 g

**AVOGADRO'S HYPOTHESIS**

Equal volumes of all gases, under the same conditions of temperature and pressure, contain the same number of molecules.

**CHARGE ON AN ELECTRON**

$e = 1.6 \times 10^{-19}$  coulombs

**1 MOLE OF ELECTRONS**

$1 \text{ mole} = 6.022 \times 10^{23} \text{ electrons} = 96,500 \text{ coulombs}$

### STC15 : Composition of Water by Weight

#### Composition of Water by Weight

**Method used by Berzelius, Dalton and Dumas to find Composition of Water by Weight**

They used a setup where hydrogen gas was passed over heated copper oxide, and the water formed was collected and weighed.

**Results:**

- Weight of water formed = 236.36 g
- Oxygen gas left by the copper oxide = 214.04 g
- Weight of hydrogen present in water = 22.32 g

**Ratio of weights:** 236.36 : 214.04 : 22.32 = 8 : 1

**Berzelius's Method of Direct Synthesis to find Composition of Water by Weight**

Hydrogen and oxygen gases were mixed in a eudiometer tube and exploded.

**Results:**

- Volume of hydrogen = 10 c.c.
- Volume of oxygen = 5 c.c.
- Volume of water vapor = 5 c.c.

**Ratio of volumes:** 2 : 1

**Dalton's Method for Demonstrating the Volume Composition of Steam**

Steam was passed over a red-hot iron wire, and the hydrogen gas produced was collected.

**Results:**

- Volume of steam = 10 c.c.
- Volume of hydrogen = 10 c.c.
- Volume of oxygen = 5 c.c.

**Ratio of volumes:** 2 : 1

**WELL WATER, SPRING WATER, SEA WATER, RAIN WATER, RIVER WATER, CLOUD, ICE**

All these are different states of water, but they all have the same composition by weight: 8 parts hydrogen and 1 part oxygen.

**2 Hydrogen atoms combine with 1 Oxygen atom to form 1 molecule of Water.**

2H2 + O2 -> 2H2O

**Thus, Oxygen makes up 8/9 of Weight of any sample of Pure Water, while Hydrogen makes up the remaining 1/9 of the Weight.**

### STC16 : Different Kinds of Cells

#### Different Kinds of Cells

**Galvanic Cell**

It is a cell that converts chemical energy into electrical energy.

**Dry Cell**

It is a common type of galvanic cell used in household appliances.

**Car Battery**

It is a series of galvanic cells used in automobiles.

**Rechargeable Cell**

It is a cell that can be used repeatedly by recharging.

**Solar Cell**

It is a cell that converts solar energy into electrical energy.

**Fuel Cell**

It is a cell that converts the chemical energy of a fuel into electrical energy.

**Mercury-Zinc Button Cell**

It is a small, compact cell used in watches and calculators.



**STC17 : Electroplating and Corrosion**

### Electroplating and Corrosion

**Electroplating** is the coating of an electrically conductive object with a layer of metal using electrical current. The result is a thin, smooth, even coat of metal on the object. The layer of deposited metal is usually from  $5 \times 10^{-4}$  cm to  $1 \times 10^{-1}$  cm thick.

**Basic rules for electroplating an object with metal M:**

- The object must be made the cathode.
- The electrolyte must be a solution of a salt of metal M.
- The anode is made of a strip of metal M.

**EXAMPLES OF CORROSION**  
The breaking down of essential properties in a material due to chemical reactions with its surroundings is called Corrosion.

**Mechanism of Rusting**  
Rust is formed when iron reacts with oxygen and water. The reaction is:  
 $4Fe + 3O_2 + 6H_2O \rightarrow 4Fe(OH)_3$   
The  $Fe(OH)_3$  further reacts with water to form hydrated iron(III) oxide, commonly known as rust.

**Factors Involved in Rusting**  
1. Presence of oxygen.  
2. Presence of water.  
3. Presence of electrolytes (e.g., NaCl).  
4. Presence of impurities in iron.

**STC18 : Cement and Concrete**

### Cement and Concrete

**Preparing Portland Cement**  
The limestone (provides calcium oxide) and Clay (provides silica, alumina and ferric oxide) are ground, mixed with water and carbonated. Heat the material in a large rotary kiln at 2,500°C. The clinker is formed in three cooled and granulated to a fine powder in a ball mill. Gypsum ( $CaSO_4 \cdot 2H_2O$ ) is added during the grinding process to delay setting time of cement. Finally the powdered cement is packed in waterproof bags.

CaO	80 - 70%
SiO <sub>2</sub>	20 - 25%
Al <sub>2</sub> O <sub>3</sub>	5 - 10%
Fe <sub>2</sub> O <sub>3</sub>	2 - 3%

**Concrete**  
Concrete is a hardened building material created by combining sand, gravel, cement, chemical additives and water.

**Connecting Concrete With Water**  
When water is added into cement, hydration occurs. The hydrated cement surrounds the aggregate particles and hardens to provide maximum strength.

**Types of Reinforced Concrete Foundations**  
1. **Raft Foundations**: Used for soft soil conditions.  
2. **Pile Foundations**: Used for deep soil conditions.  
3. **House Foundations**: Used for residential buildings.  
4. **Column Foundations**: Used for industrial structures.

**Applications of Cement & Concrete**  
1. Reinforced Concrete Pipes  
2. Concrete Road  
3. Masonry Wall  
4. Bridge

**STC19 : Manufacture of Glass**

### Manufacture of Glass

**Manufacturing of Standard Soda-Lime-Silica Glass**  
Raw materials are introduced into the furnace. The temperature around 1400°C melts the raw materials which form a molten glass. This molten glass is made to float on a sheet of molten water. The molten glass is kept in contact with the atmosphere to prevent the formation of bubbles. The glass is carried forward by rollers which take it through different temperature zones until final cooling is completed.

**Glass Moulding**  
To make glassware, an amount of molten glass is dropped into moulds. Compressed air blows the molten glass into the shape of the mould and acquires its shape. The air is removed to prevent mould sticking to the finished glass.

**Raw Materials**

Sand	72.8%
Soda Ash	13.0%
Limestone	6.4%
Dolomite	4.0%
Alumina	2.8%

**Coloured Glass**  
Cobalt Glass, Chrome Glass, Olive Green, Red Glass.

**Lead Crystal Glass**  
Photochromatic Glass.

**Laminated Glass**  
Glass, Polyethylene, Glass, Polyethylene, Glass.

**STC20 : Alkanes**

### Alkanes

**ALKANES** are the chemical compounds that consist only of the elements carbon (C) and hydrogen (H). They are also called saturated hydrocarbons because the carbon atoms in them are linked by single bonds.

**General Formula: C<sub>n</sub>H<sub>2n+2</sub>**

**Methane** is the simplest alkane. It has a tetrahedral structure with all H-C-H bond angles of 109.5°.

**Methane Molecule**

**NOMENCLATURE**  
Names of alkane series of hydrocarbons end in 'ane'. The prefix tells the number of carbon atoms in the chain.

Name	Molecular Formula	No. of Carbon Atoms	Boiling Point (°C)	Physical State at Room Temp.
Methane	CH <sub>4</sub>	1	-164	gas
Ethane	C <sub>2</sub> H <sub>6</sub>	2	-87	gas
Propane	C <sub>3</sub> H <sub>8</sub>	3	-42	gas
Butane	C <sub>4</sub> H <sub>10</sub>	4	0	gas
Pentane	C <sub>5</sub> H <sub>12</sub>	5	+30	Liquid

**Applications of Alkanes**  
1. Petroleum Refinery  
2. LPG  
3. CNG Station  
4. Vehicle Run on Petrol  
5. Cooking Gas  
6. CNG Bus

**STC21 : Alkenes**

### Alkenes

Alkenes are unsaturated hydrocarbons containing at least one double bond. They are also known as olefins (oil forming).

**General Formula: C<sub>n</sub>H<sub>2n</sub> (n ≥ 2)**

**Functional group: C=C**

**Ethene is the simplest alkene commonly known as ethylene.**

Molecular Formula	Structure	IUPAC Name
C <sub>2</sub> H <sub>4</sub>	CH <sub>2</sub> =CH <sub>2</sub>	Ethene
C <sub>3</sub> H <sub>6</sub>	CH <sub>2</sub> =CH-CH <sub>3</sub>	Propene
C <sub>4</sub> H <sub>8</sub>	CH <sub>2</sub> =CH-CH <sub>2</sub> -CH <sub>3</sub>	But-1-ene
C <sub>4</sub> H <sub>8</sub>	CH <sub>3</sub> -CH=CH-CH <sub>3</sub>	But-2-ene
C <sub>5</sub> H <sub>10</sub>	CH <sub>2</sub> =CH-CH <sub>2</sub> -CH <sub>2</sub> -CH <sub>3</sub>	Pent-1-ene
C <sub>5</sub> H <sub>10</sub>	CH <sub>3</sub> -CH=CH-CH <sub>2</sub> -CH <sub>3</sub>	Pent-2-ene
C <sub>6</sub> H <sub>12</sub>	CH <sub>2</sub> =C(CH <sub>3</sub> ) <sub>2</sub> -CH <sub>2</sub> -CH <sub>2</sub> -CH <sub>3</sub>	2-Methylprop-1-ene

**Preparation**

- From partial reduction of alkynes
- Acidic dehydration of alcohols
- Dehydrohalogenation
- Dehalogenation of vicinal dihalides

**Application of Alkenes**  
1. Ultraviolet  
2. Squash bottles, Water bottles  
3. PVC insulation tapes  
4. Detergent  
5. Buckets  
6. Egg cartons, disposable plastic glass

**STC22 : Alkynes**

### Alkynes

Alkynes are unsaturated hydrocarbons containing at least one triple bond.

**Functional Group: C≡C**

**General Formula: C<sub>n</sub>H<sub>2n-2</sub>**

**>D Structure of Simplest Alkyne: Ethyne (Acetylene)**

**NOMENCLATURE:** In common system, alkynes are named as derivatives of acetylene. In IUPAC system they are named as derivatives of corresponding alkenes replacing 'ene' by suffix 'yne'. The position of the triple bond is indicated by the first triply bonded carbon.

Value of n	Mol. Formula	Structure	Common Name	IUPAC Name
2	C <sub>2</sub> H <sub>2</sub>	H-C≡C-H	Acetylene	Ethyne
3	C <sub>3</sub> H <sub>4</sub>	CH <sub>3</sub> -C≡C-H	Methylacetylene	Propyne
4	C <sub>4</sub> H <sub>6</sub>	CH <sub>3</sub> -C≡C-CH <sub>3</sub>	Ethylacetylene	But-1-yne

**Preparation**

- From Calcium Carbide:  $CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$
- From Vicinal Dihalides:  $H_2C-CH_2 + KOH \xrightarrow{-HX} HC \equiv CH$

**Applications of Alkynes**  
1. Alkynes are used as a starting material for drugs and dyes.  
2. Acetylene is used in welding of steel and metal.  
3. Used as starting material for manufacturing large number of organic compounds such as chloroprene, vinyl chloride and acrylic polymers.

**STC23 : Alcohols**

### Alcohols

Alcohols are organic compounds in which a hydroxyl group (-OH) is bound to a carbon atom of an alkyl or substituted alkyl group. In common terms alcohol refers to ethanol found in alcoholic beverages.

**General Formula: C<sub>n</sub>H<sub>2n+2</sub>O**

**Nomenclature:** Alcohols are named by substituting 'ol' of alkane with the suffix 'ol'. Position of substituents is indicated by numerals.

Formula	Common Name	IUPAC Name
CH <sub>3</sub> -OH	Methyl alcohol	Methanol
CH <sub>3</sub> -CH <sub>2</sub> -CH <sub>2</sub> -OH	n-Propyl alcohol	Propan-1-ol
CH <sub>3</sub> -CH(OH)-CH <sub>3</sub>	Isopropyl alcohol	Propan-2-ol
CH <sub>3</sub> -CH <sub>2</sub> -CH <sub>2</sub> -CH <sub>2</sub> -OH	n-Butyl alcohol	Butan-1-ol
CH <sub>3</sub> -CH(OH)-CH <sub>2</sub> -CH <sub>3</sub>	tert-Butyl alcohol	2-Methylpropan-2-ol

**PREPARATION**

- From Alkenes:  $CH_2=CH_2 + H_2O \xrightarrow{H^+} CH_3-CH_2-OH$
- Reduction of Aldehydes and Ketones:  $RCHO + H_2 \xrightarrow{Ni} RCH_2OH$
- Reduction of Carboxylic Acids:  $RCOOH \xrightarrow{LiAlH_4} RCH_2OH$

**USES OF ALCOHOL (ETHANOL)**  
1. In Alcoholic Beverages  
2. In Digestive Syrups  
3. In Cough Syrups  
4. In Antiseptic Lotions

**STC24 : Esters**

### Esters

Esters are sweet smelling chemical compounds derived from an alcohol (one containing an -OH) and a hydroxyl compound such as an alcohol or phenol. Most common esters used to derive esters are carboxylic acids (R-COOH).

**GENERAL FORMULA**  
 $R-C(=O)-OR'$   
(R and R' are any alkyl or aryl group)

**NOMENCLATURE**  
1. Name the alkyl from the alcohol - O-  
2. Name the acid with the COO with -ate

NAME	FORMULA	ODOR
Ethyl methanoate	HCOOC <sub>2</sub> H <sub>5</sub>	Raspberries
Methyl propylacetate	CH <sub>3</sub> COOC <sub>3</sub> H <sub>7</sub>	Peony
Ethyl acetate	CH <sub>3</sub> COOC <sub>2</sub> H <sub>5</sub>	Pineapple
Ethyl benzoate	C <sub>6</sub> H <sub>5</sub> COOC <sub>2</sub> H <sub>5</sub>	Cherry
Octyl acetate	CH <sub>3</sub> COOC <sub>8</sub> H <sub>17</sub>	Orange

**PREPARATION**  
**Fischer Esterification:** Carboxylic acids react with alcohols in presence of a few drops of concentrated sulphuric acid to produce esters. For example:  
 $CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$

**Applications of Esters**  
1. Esters react with sodium hydroxide to form soaps (saponification).  
 $CH_3COOC_2H_5 + NaOH \rightarrow CH_3COONa + C_2H_5OH$   
2. Plexiglass (a transparent plastic) is a long chain ester.  
3. Esters are used for making perfumes.  
4. Esters give flowers and fruits their pleasant fragrances and flavours.  
5. Diacron, a long chain ester is used for making fabrics.

### STC25 : Organic Acids

## Organic Acids

Organic acids are organic compounds with acidic properties. Most common organic acids are carboxylic acids having  $\text{COOH}$  group.

#### NOMENCLATURE

Common names end with the suffix  $-\text{acid}$  and have been derived from Latin or Greek names of their natural sources. Example - Formic acid, Acetic acid, Citric acid, Oxalic acid.

In IUPAC system, aliphatic carboxylic acids are named by replacing the ending  $-\text{e}$  in the name of the corresponding alkane with  $-\text{anoic acid}$ .

Structure	Molecular Formula	Common Name	IUPAC Name
	$\text{HCOOH}$	Formic Acid	Methanoic Acid
	$\text{CH}_3\text{COOH}$	Acetic Acid	Ethanoic Acid
	$\text{C}_2\text{H}_5\text{COOH}$	Propionic Acid	Propanoic Acid
	$\text{C}_6\text{H}_5\text{COOH}$	Benzoic acid	Benzoic Acid

#### STRUCTURE OF CARBOXYL GROUP

$\text{R}-\text{C}(=\text{O})-\text{OH} \leftrightarrow \text{R}-\text{C}(\text{O}^-)=\text{OH}^+$

#### Applications of Organic Acids

- Medicines: Aspirin, Salicylic acid, Penicillin, etc.
- Food: Citric acid, Acetic acid, etc.
- Textiles: Dyes, Pigments, etc.
- Plastics: PVC, PET, etc.
- Polymers: Nylon, etc.

### STC26 : Soaps and Detergents

## Soaps and Detergents

#### SOAPS

Soaps are sodium or potassium salts of long chain fatty acids. E.g. sodium stearate, potassium oleate. Soaps containing sodium salt are formed by heating fat with an aqueous sodium hydroxide solution. This process is called saponification.

$$\text{CH}_3(\text{CH}_2)_{17}\text{COOH} + \text{NaOH} \rightarrow \text{CH}_3(\text{CH}_2)_{17}\text{COONa} + \text{H}_2\text{O}$$

#### DETERGENTS

Cleaning agents which have all properties of soap, but actually do not contain any soap.

**Anionic detergents:** Sodium alkyl sulphate, sodium alkyl sulphosuccinate, sodium alkyl benzene sulphonate, sodium linear alkyl sulphonate.

**Cationic detergents:** Quaternary ammonium salt of stearic acid, cetyltrimethyl ammonium bromide, benzalkonium chloride.

**Non-ionic Detergents:** Form of alkyl alcohol with one or more hydrophilic groups.

#### CLEANSING ACTION

Soaps remove dirtiness of water by forming micelles. The hydrophobic part of the soap molecule is attracted to the dirt particles, while the hydrophilic part is attracted to water.

#### PROBLEM WITH HARD WATER

Hard water contains calcium or magnesium salts. These replace the sodium of the soap and magnesium forming a scum. Synthetic detergents do not form insoluble hard water.

### STC27 : Plastics

## Plastics

#### Thermoplastics

Arrangement of molecular units is linear or slightly branched.

**PVC (Polyvinyl chloride):** Prepared by polymerization of vinyl chloride.

**Polythene:** Prepared by polymerization of ethene.

**Thermosetting plastics:** Arrangement of molecular units is cross-linked or heavily branched.

**Bakelite:** Prepared by condensation polymerization of phenol and formaldehyde.

**Melamine:** Prepared by condensation polymerization of melamine and formaldehyde.

### STC28 : Synthetic Fibres

## Synthetic Fibres

Synthetic fibre is a chain of molecules known as monomers which form polymers.

#### Characteristics

- Dry up quickly
- Durable
- Less expensive
- Easy to maintain

#### Nylon

Strong, elastic, light, lustrous and easy to wash.

Prepared by condensation polymerization of hexamethylenediamine with adipic acid under high pressure & temperature.

When mixed with cotton, it is used to make bed sheets.

When mixed with wool, it is used to make carpets.

#### Rayon

Obtained by chemical treatment of wood pulp. Similar to that of silk (also called artificial silk).

When mixed with cotton, it is used to make bed sheets.

#### Polyester

Polyester Fabrics (A) do not get wrinkled easily (B) are crisp (C) are easy to wash.

Example: Terylene

Prepared by heating a mixture of ethylene glycol and terephthalic acid at 420 to 480 K in presence of zinc acetate as catalyst.

#### Acrylic

Resembles natural wool.

Example: Polyacrylate

Prepared by addition polymerization of acrylonitrile in presence of peroxide catalyst.

### STC29 : Blast Furnace (Extraction of Iron)

## BLAST FURNACE (EXTRACTION OF IRON)

The main ore of iron is hematite ( $\text{Fe}_2\text{O}_3$ ). The iron is obtained by reduction in blast furnace. The furnace is loaded with the charge consisting of iron ore, coke and limestone. The charge is stirred to make sure the solids mix well. Blasts of hot air are sent in through holes near the bottom of the furnace.

Following are the significant reactions occurring within the blast furnace:

$$\text{Fe}_2\text{O}_3 + \text{CO} \rightarrow \text{Fe} + \text{CO}_2$$

$$\text{Fe}_2\text{O}_3 + \text{C} \rightarrow \text{Fe} + \text{CO}_2$$

$$\text{Fe}_2\text{O}_3 + \text{CO} \rightarrow \text{Fe} + \text{CO}_2$$

$$\text{Fe}_2\text{O}_3 + \text{C} \rightarrow \text{Fe} + \text{CO}_2$$

$$\text{Fe}_2\text{O}_3 + \text{C} \rightarrow \text{Fe} + \text{CO}_2$$

$$\text{Fe}_2\text{O}_3 + \text{C} \rightarrow \text{Fe} + \text{CO}_2$$

#### MANUFACTURE OF STEEL

The iron produced by the blast furnace is known as pig iron. Most of the pig iron produced is used to make steel.

**BASIC OXYGEN PROCESS:** Oxygen is blown through the molten pig iron. The carbon is oxidized to carbon monoxide and carbon dioxide. The silicon, manganese, phosphorus and sulphur are also oxidized.

**ELECTRIC ARC PROCESS:** An alternative process, known as the Electric Arc Furnace, is used to make steel from scrap metal. Currently about 25% of the world's steel is produced by this method.

### STC30 : Aluminium Metallurgy

## Aluminium Metallurgy

Aluminium extraction is done in two phases: Bayer's process of refining bauxite ore to obtain alumina & Hall-Heroult process of smelting the alumina to get pure aluminium.

#### BAYER'S PROCESS

- LEACHING:** Bauxite ore is leached with sodium hydroxide.
- SOLUBLE ALUMINA:** The soluble alumina is separated from the insoluble impurities.
- PRECIPITATION:** The soluble alumina is precipitated as aluminium hydroxide.
- WASHING:** The precipitate is washed to remove sodium hydroxide.
- DRYING:** The precipitate is dried to obtain alumina.

#### HALL-HEROULT PROCESS

Purified  $\text{Al}_2\text{O}_3$  is mixed with  $\text{Na}_2\text{CO}_3$  and  $\text{CaF}_2$  to lower the melting point.

The molten mixture is electrolysed in a cell consisting of carbon anodes and a steel cathode.

$\text{Al}_2\text{O}_3 + 3\text{C} \rightarrow 2\text{Al} + 3\text{CO}$

#### Uses of Aluminium

Packaging, Aircraft Industry, Construction, Utensils.

### STC31 : Copper Metallurgy

## Copper Metallurgy

#### IMPORTANT ORES OF COPPER

- Copper pyrite or chalcocite ( $\text{Cu}_2\text{S}$ )
- Chalcocite or copper glance ( $\text{Cu}_2\text{O}$ )
- Malachite green ( $\text{Cu}_2(\text{OH})_2\text{CO}_3$ )

#### CONCENTRATION

The truly coated ore is concentrated by froth-flotation process.

**ROASTING:** Sulphur is oxidized to  $\text{SO}_2$  and impurities of arsenic and antimony are removed as volatile oxides.

**SMELTING:** The roasted ore is mixed with coke and silica ( $\text{SiO}_2$ ) and is introduced into a blast furnace. The hot air is blown and  $\text{FeO}$  is removed as slag.

**REFINING OF COPPER:** Electrolysis of copper.

**ELECTROLYSIS OF COPPER:** Impure copper is used as anode and pure copper as cathode.

**ELECTROCHEMICAL CORROSION:**  $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$

#### Uses of Copper

Computer Chip, Music Wire, Copper Tubing & Pipes, Copper Coins, Hardware.

### STC32 : Extraction of Zinc

## Extraction of Zinc

Worldwide, 60% of the zinc is mined from sulphide ore deposits mainly  $\text{ZnS}$ . After grinding the ore, hot flotation is used to get an ore concentrate. Lead is simultaneously extracted along with zinc.

#### Zinc is Extracted Using Two Processes

- Roasting:** which involves the preparation of zinc oxide from ore concentrate.
- Pyrometallurgical Process:** which further reduces zinc oxide with carbon or carbon monoxide at  $950^\circ\text{C}$  into the metal, which is distilled as zinc vapour. The zinc vapour is collected in a condenser.

$\text{ZnS} + \text{O}_2 \rightarrow \text{ZnO} + \text{SO}_2$

$\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$

$\text{ZnO} + \text{CO} \rightarrow \text{Zn} + \text{CO}_2$

$\text{ZnO} + \text{CO} \rightarrow \text{Zn} + \text{CO}_2$

**STC33 : Preparation of Sodium Hydroxide (NaOH)**

### Preparation of Sodium Hydroxide (NaOH)

**Preparation of NaOH in Castner Kellner Cell**

NaOH is commercially prepared by the electrolysis of sodium chloride in Castner Kellner Cell which has mercury as cathode and carbon as anode. A sodium amalgam is formed which is treated with water to give sodium hydroxide and hydrogen gas.

$$2\text{Na-Amalgam} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + 2\text{H}_2 + \text{H}_2$$

**At cathode:**  
 $\text{Na}^+ + e^- \rightarrow \text{Na-amalgam}$

**At anode:**  
 $\text{Cl}^- \rightarrow \frac{1}{2} \text{Cl}_2 + e^-$

**Preparation of Sodium Carbonate (Ammonia Soda or Solvay Process)**

Solvay process produces soda ash ( $\text{Na}_2\text{CO}_3$ ) from brine and limestone. Calcium chloride is its major by product.

1. Brine is saturated with  $\text{CO}_2$  gas.  
2.  $\text{NH}_3$  gas is added to form  $\text{NH}_4\text{Cl}$ .  
3.  $\text{Na}_2\text{CO}_3$  is precipitated as  $\text{NaHCO}_3$ .  
4.  $\text{NaHCO}_3$  is heated to produce  $\text{Na}_2\text{CO}_3$ .

**STC34 : Preparation of Nitrogen & Nitric Acid**

### Preparation of Nitrogen & Nitric Acid

**LABORATORY PREPARATION OF NITROGEN**

Nitrogen is prepared by heating a mixture of ammonium chloride and sodium nitrate in the ratio 4:3 by mass with a small quantity of water. The presence of water prevents ammonium chloride from subliming when heated.

$$4\text{NH}_4\text{Cl} + 3\text{NaNO}_3 \rightarrow 4\text{H}_2\text{O} + 3\text{N}_2 + 4\text{NaCl}$$

**MANUFACTURE OF NITROGEN**

Commercially nitrogen is prepared by compression of air, a process known as Cryogenic (cold temperature) Distillation.

**LABORATORY PREPARATION OF NITRIC ACID**

In laboratory nitric acid is prepared by heating copper metal with concentrated nitric acid ( $\text{HNO}_3$ ) or sodium nitrate ( $\text{NaNO}_3$ ) with  $\text{H}_2\text{SO}_4$  and distilling the mixture. Nitric acid boils at  $83^\circ\text{C}$ .

$$\text{Cu} + 4\text{HNO}_3 \rightarrow \text{Cu(NO}_3)_2 + 2\text{H}_2\text{O} + 2\text{NO}_2$$

**MANUFACTURE OF NITRIC ACID (OSTWALD'S PROCESS)**

- Primary Oxidation:** Catalytic oxidation of  $\text{NH}_3$  takes place by atmospheric oxygen.  
 $4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$
- Secondary Oxidation:** Oxidation of nitrogen monoxide.  
 $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$
- Formation of  $\text{HNO}_3$ :** Nitrogen dioxide from secondary oxidation chamber is introduced into a special absorber tower to dissolve water analysis into acid.  
 $3\text{NO}_2 + \text{H}_2\text{O} \rightarrow 2\text{HNO}_3 + \text{NO}$

Vapours of  $\text{HNO}_3$  are passed over conc.  $\text{H}_2\text{SO}_4$ , which absorbs water from  $\text{HNO}_3$  and conc.  $\text{HNO}_3$  is obtained.

**STC35 : Prep. of Chlorine and Hydrochloric Acid**

### Prep. of Chlorine and Hydrochloric Acid

**Laboratory Preparation of Chlorine**

Chlorine is prepared in laboratory by heating manganese dioxide with a mixture of common salt and conc. sulphuric acid.

$$4\text{NaCl} + \text{MnO}_2 + 4\text{H}_2\text{SO}_4 \rightarrow \text{MnCl}_2 + 4\text{NaHSO}_4 + 2\text{H}_2\text{O} + \text{Cl}_2$$

**Large Scale Manufacture of Chlorine**

Chlorine is mostly obtained as a by product during the manufacture of caustic soda, by the electrolysis of brine or molten sodium chloride.

**Preparation of Hydrochloric Acid**

Glauber prepared hydrogen chloride in 1648 by heating common salt with sulphuric acid. This also serves as a laboratory method to prepare it.

$$\text{NaCl} + \text{H}_2\text{SO}_4 \rightarrow \text{NaHSO}_4 + \text{HCl}$$

$$\text{NaHSO}_4 + \text{NaCl} \rightarrow \text{Na}_2\text{SO}_4 + \text{HCl}$$

Industrially hydrogen chloride gas is made by burning hydrogen in chlorine.

$$\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{HCl}(\text{g})$$

Hydrogen chloride gas so formed is dissolved in water to form hydrochloric acid.

To dissolve the Hydrogen Chloride gas safely in water a filter funnel is placed in water instead of delivery tube.

**STC36 : Prep. of Sulphur Dioxide & Sulphuric Acid**

### Prep. of Sulphur Dioxide & Sulphuric Acid

**PREP. OF SULPHUR DIOXIDE**

**IN LABORATORY**

$\text{SO}_2$  is readily generated by treating a sulphite with dil. sulphuric acid.

$$\text{SO}_3^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{SO}_2(\text{g})$$

**INDUSTRIAL PRODUCTION**

Industrially it is produced as a by-product of the roasting of sulphide ores. The gas so produced is dried, liquefied under pressure and stored in steel cylinders.

$$4\text{FeS}_2(\text{s}) + 11\text{O}_2(\text{g}) \rightarrow 2\text{Fe}_2\text{O}_3(\text{s}) + 8\text{SO}_2(\text{g})$$

**USES OF SULPHUR DIOXIDE**

- Used to bleach wood, silk and wool pulp.
- Used as a food preservative and disinfectant.
- Used in the manufacture of sulphuric acid.
- Liquid  $\text{SO}_2$  is used as a solvent to dissolve chemicals.

**PRODUCTION OF SULPHURIC ACID**

The above flow chart shows the production of sulphuric acid through a series of sulphur dioxide which is added to the sulphur dioxide to make sulphuric acid.

**USES OF SULPHURIC ACID**

- Manufacture of Fertilizers
- Metallurgical Applications
- Tanning Leather
- Paints and Pigments

**STC37 : Preparation of Ammonia & Haber Process**

### Preparation of Ammonia & Haber Process

**Natural Occurrence**

Ammonia ( $\text{NH}_3$ ) is produced by the natural decomposition of animal and plant matter in nature. It also occurs in the soil in the form of ammonium salts.

**Laboratory Preparation of Ammonia**

Ammonia gas is usually prepared in the laboratory by gently heating ammonium chloride ( $\text{NH}_4\text{Cl}$ ) and slaked lime ( $\text{Ca(OH)}_2$ ).

$$2\text{NH}_4\text{Cl}(\text{s}) + \text{Ca(OH)}_2(\text{s}) \xrightarrow{\text{heat}} \text{CaCl}_2(\text{s}) + 2\text{NH}_3(\text{g}) + 2\text{H}_2\text{O}(\text{g})$$

**Manufacture of Ammonia by Haber Process**

**STEPS IN THE HABER PROCESS**

- Hydrogen is obtained from methane and steam.
- Nitrogen is obtained from air.
- The two gases ( $\text{N}_2$  &  $\text{H}_2$ ) are mixed in ratio 1:3.
- Mixture is compressed to about 200 bar and heated to high temperature.
- Methane is then goes to reactor containing beds of hot iron. The iron catalyzes the reaction.  
 $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$
- Mixture of  $\text{N}_2$ ,  $\text{H}_2$  &  $\text{NH}_3$  leaves the converter. It is cooled to condense ammonia. The  $\text{N}_2$  and  $\text{H}_2$  are pumped back to the converter.
- Ammonia is stored as liquid under pressure.

**STC38 : Preparation of  $\text{O}_2$  and Liquefaction of Air**

### Preparation of $\text{O}_2$ and Liquefaction of Air

**Laboratory Preparation of Oxygen**

**BY HEATING COMPOUNDS CONTAINING OXYGEN**

$2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2$

**BY ELECTROLYSIS OF WATER**

$2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$

Oxygen is usually collected over water because the solubility of the gas.

**Manufacture of Oxygen by Liquefaction of Air**

The air is distilled into fractions in the tower which is cooled at the top.

**MAJOR STEPS IN THE PROCESS**

- Air is filtered to remove dust.
- Methane &  $\text{CO}_2$  are removed.
- Air is compressed to about 200 atmospheres.
- Compressed air is cooled & passed into coils contained in a chamber.
- Compressed air is allowed to expand in the chamber cooling the coils.
- Expanded gas is returned to the compressor with multiple recycling and expansion steps resulting finally in liquefaction of the compressed air at a temperature of  $-196^\circ\text{C}$ .
- Liquid air is allowed to warm to distil the light two gases, from the nitrogen, leaving liquid oxygen.
- Multiple fractionations will produce 99.5 percent pure oxygen.

**STC39 : Preparation of  $\text{H}_2$  and  $\text{CO}_2$**

### Preparation of $\text{H}_2$ and $\text{CO}_2$

**HYDROGEN**

**Laboratory Preparation**

Laboratory preparation involves reaction

$$\text{Metal} + \text{Acid} \rightarrow \text{Salt} + \text{Hydrogen}$$

$$\text{Zn}(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{ZnCl}_2(\text{aq}) + \text{H}_2(\text{g})$$

**Commercial Manufacture**

**Steam Re-forming of Natural Gas**

Methane in natural gas is reacted with steam in a reversible reaction to produce hydrogen.

$$\text{CH}_4(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons 3\text{H}_2(\text{g}) + \text{CO}(\text{g})$$

$\text{CO}$  produced is used to reduce unreacted steam to produce more hydrogen.

$$\text{CO}(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2(\text{g}) + \text{CO}_2(\text{g})$$

**CARBON DIOXIDE**

Complete combustion of carbon and carbon containing fuels in excess of air produces most of the carbon dioxide.

$$\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$$

$$\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$$

**Laboratory Preparation**

In the laboratory it is conveniently prepared by the

$$\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$$

**Commercial Manufacture**

$\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$

$\text{CO}_2$  is produced as a by-product in a lime kiln where limestone (calcium carbonate) is decomposed to produce lime.

**STC40 : Manufacture of Bleaching Powder**

### Manufacture of Bleaching Powder

Bleaching powder is a dirty white amorphous solid with a pungent smell of chlorine.

**CHEMICAL COMPOSITION**

Bleaching powder is actually a mixture of Calcium Hypochlorite, Calcium Chloride, Water and some Slaked Lime.

$$\text{Ca(OCl)}_2 \cdot \text{CaCl}_2 \cdot \text{Ca(OH)}_2 \cdot 2\text{H}_2\text{O}$$

**INDUSTRIAL PRODUCTION**

On industrial scale, it is manufactured in Hasenclever Plant or in Bachmann's Plant.

**Raw Materials**

- Slaked Lime
- Chlorine Gas

**Reactions Involved**

$$2\text{Ca(OH)}_2 + 2\text{Cl}_2 \rightarrow \text{Ca(OCl)}_2 + \text{CaCl}_2 + 2\text{H}_2\text{O}$$

**Manufacture of Bleaching Powder - HASENCLEVER PLANT**

The plant consists of a number of horizontal cylinders provided with rotating shafts with blades. Slaked lime is dropped into the topmost cylinder. The rotating blades allow the downward movement of slaked lime into the other cylinders. Chlorine gas is introduced into the bottommost cylinder. The counter currents allow a thorough mixing of the raw materials and complete conversion into bleaching powder.

**Manufacture of Bleaching Powder - BACHMANN'S PLANT**

Bachmann's plant consists of vertical tower made of cast iron. The tower is provided with a hopper at the top, two inlets near the base (one for chlorine and other for hot air) and an exit for slaked lime near the top.

- The tower is fitted with eight shelves at different heights each equipped with rotating blades.
- The slaked lime is introduced through the hopper.
- Slaked lime comes in contact with chlorine.
- Bleaching powder is collected in a band at the base.

### STC41 : Manufacture of Phosphorus

#### Manufacture of Phosphorus

##### Production of White Phosphorus

Phosphate rock is heated to 1200-1500°C with sand and coke to produce vaporized  $P_4$ , which is subsequently condensed into a white powder under water.

The main reactions involved are:-  
 $Ca_3(PO_4)_2 + 3CO \rightarrow 3CaO + 3CO_2 + 2P_4$   
 $Ca_3(PO_4)_2 + 5C \rightarrow 3CaO + 5CO + 2P_4$   
 $Ca_3(PO_4)_2 + 3C \rightarrow 3CaO + 3CO + 2P_4$

Sand acts as a flux, converting CaO formed into slag:  $CaO + SiO_2 \rightarrow CaSiO_3$  (slag)

Labels: Phosphate rock & coke, Conveyor, Phosphorus vapor & CO to condenser from where white phosphorus is distilled by condensing with water, Carbon electrode, Electrothermal reactor, Furnace, Hopper, Phosphate rock & coke, Conveyor, Phosphorus vapor & CO to condenser from where white phosphorus is distilled by condensing with water, Carbon electrode, Electrothermal reactor, Furnace.

##### Converting White Phosphorus into Red Phosphorus

Red phosphorus is formed by heating white phosphorus to 250°C.

Labels: Alcohol lamp, Valve, Mercury and Water, Metal bath, Sandbath, Furnace, Phosphate rock & coke, Conveyor, Phosphorus vapor & CO to condenser from where white phosphorus is distilled by condensing with water, Carbon electrode, Electrothermal reactor, Furnace.

### STC42 : Crystal Lattices

#### Crystal Lattices

A regular three dimensional arrangement of points in space at which the atoms, molecules or ions of a crystal occur, is a crystal lattice.

Unit cell is the smallest portion of a crystal lattice which, when repeated in different directions, generates the entire lattice. A unit cell is characterized by:  
 1. Its dimensions along the three edges, a, b and c. These edges may or may not be mutually perpendicular.  
 2. Angles between the edges,  $\alpha$  (between a and b),  $\beta$  (between a and c) and  $\gamma$  (between b and c). Thus, a unit cell is characterized by six parameters, a, b, c,  $\alpha$ ,  $\beta$ , and  $\gamma$ .

Examples of crystal systems and their unit cells:

Crystal System	Primitive Unit Cells	Possible Variations	Examples
Cubic	Simple Cubic, Face-Centered Cubic, Body-Centered Cubic	NaCl, ZnS, Diamond	
Tetragonal	Simple Tetragonal, Body-Centered Tetragonal	KNO <sub>3</sub> , SnO <sub>2</sub> , CaTiO <sub>3</sub>	
Orthorhombic	Simple Orthorhombic, Base-Centered Orthorhombic, Face-Centered Orthorhombic	Monoclinic sulphur, KNO <sub>3</sub> , BaSO <sub>4</sub>	
Hexagonal	Simple Hexagonal	Graphite, ZnO, CdS	
Trigonal	Simple Trigonal	Carbon, Silica	
Monoclinic	Simple Monoclinic	Monoclinic sulphur, Na <sub>2</sub> SO <sub>4</sub> , TiO <sub>2</sub>	
Triclinic	Simple Triclinic	K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> , CaSO <sub>4</sub> .2H <sub>2</sub> O, H <sub>2</sub> O	

### STC43 : Close Packed Structures

#### Close Packed Structures

Close packing of particles leave minimum vacant space in solids.

##### Close Packing in Two Dimensions

**Square Close Packing (AAA)**  
Coordination number is 4.

**Hexagonal Close Packing (ABAB)**  
Coordination number is 6.

##### Close Packing in Three Dimensions

Three dimensional close packing from two dimensional square close packed layers.

Three dimensional close packing from two dimensional hexagonal close packed layers.

##### Tetrahedral Voids

Top view, Exploded side view, Tetrahedron (geometrical shape).

##### Octahedral Voids

Top view, Exploded side view, Octahedron (geometrical shape).

##### Covering Tetrahedral Voids Hexagonal Close Packed Structures

Regulated view showing stacking of layers of spheres, Geometry of Beag, 4 layers stacked in Beag.

##### Covering Octahedral Voids Cubic Close Packed Structures

Regulated view showing stacking of layers of spheres, Geometry of Beag, 4 layers stacked in Beag.

### STC44 : Sodium Chloride Crystal

#### Sodium Chloride Crystal

Formation of sodium chloride involves transfer of electron from chlorine atom to sodium atom. Chloride anions and Sodium cations thus formed are arranged in a regular lattice occupying all the octahedral holes. Each ion is surrounded by six ions of the other kind. This arrangement is known as cubic close packed (ccp).

Labels: Sodium ion, Chloride ion, Chloride atom (Cl) gains one electron, Sodium atom (Na) loses one electron, NaCl, The arrangement of the positive and negative ions in a sodium chloride crystal.

##### Crystal Structure

Pushing one layer against another is an ionic crystal brings ions of the same charge next to each other. The repulsive force the layers apart.

##### FCC Arrangement

Each face-centered lattice point gives exactly one half contribution, in addition to the corner lattice points, giving a total of 4 atoms per unit cell  $(8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4)$ .

##### NaCl Statistics

Formula	NaCl
Crystal System	Cubic
Lattice Type	Face-Centered
Space Group	Fm $\bar{3}m$ , No. 225
Cell Parameters	a = b = c = 0.357 nm, z = 4
Atomic Positions	Cl: 8(a) Na: 8(b), (c), (d), (e)
Density	2.167 g/cm <sup>3</sup>
Melting Point	801°C
Boiling Point	1413°C
Electronegativity	Na: 0.93, Cl: 3.16
Standard Enthalpy of Formation	NaCl(s): -411 kJ/mol, NaCl(aq): -407 kJ/mol

### STC45 : Acids, Bases and Salts

#### Acids, Bases and Salts

##### ACIDS

Acids are the substances that are sour in taste, change blue litmus to red and give H<sup>+</sup> (hydrogen ion) when dissolved in water. Acids have a pH less than 7.

##### BASES

Bases are substances that are bitter to taste, soapy to touch, change red litmus blue and give OH<sup>-</sup> (hydroxide ion) when dissolved in water. An aqueous solution of a base is referred to as an alkali. Bases have a pH greater than 7.

##### SALTS

Salt is produced because of neutralization. Salt is produced because of neutralization. Salt is produced because of neutralization.

### STC46 : Electrolysis

#### Electrolysis

Electrolysis refers to the decomposition of a substance (electrolyte) by an electric current.

##### Electrolysis of molten NaCl

Electrolysis of molten NaCl involves the decomposition of NaCl into Na and Cl<sub>2</sub>. The cathode reaction is  $Na^+ + e^- \rightarrow Na$  and the anode reaction is  $2Cl^- \rightarrow Cl_2 + 2e^-$ .

##### Displacement Aspects of Electrolysis

$M = Q$  or  $M = 2Q$  or  $M = ZIT$

##### Using Electrolysis

**Plating Metals:** The object to be plated is made the cathode. The metal to be plated is made the anode. The electrolyte is a solution of the metal salt.

**Electroplating:** The object to be plated is made the cathode. The metal to be plated is made the anode. The electrolyte is a solution of the metal salt.

### STC47 : Atoms and Molecules

#### Atoms and Molecules

Atomic number (Z): Number of protons in an atom is equal to the number of electrons in an atom. Represented as subscript 'x'.

Mass number (A): Sum of the number of protons and neutrons in an atom. Represented as superscript 'X'.

**Isotopes:** Atoms having same atomic number but different mass number are called isotopes.

**Isobars:** Atoms having the same mass number but different atomic number are called isobars.

**Isotones:** Atoms having the same number of neutrons but different atomic number are called isotones.

##### Molecules

**Molecules of Same Element:** Diatomic molecules (H<sub>2</sub>, O<sub>2</sub>), Polyatomic molecules (P<sub>4</sub>, S<sub>8</sub>).

**Molecules of Different Elements:** H<sub>2</sub>O, CO<sub>2</sub>, CH<sub>4</sub>.

##### Chemical Formulae

**Empirical Formula:** A formula which represents the simplest whole number ratio of atoms in a molecule.

**Molecular Formula:** A formula which represents the actual number of atoms in a molecule.

**Explaining the Formulae:**  $2NaCl$  (two sodium ions and two chloride ions),  $H_2SO_4$  (two hydrogen ions, one sulphate ion).

### STC48 : Solids, Liquids & Gases

#### Solids, Liquids & Gases

All Matter Occurs in Three Forms - Solid, Liquid and Gas. The three states of matter differ from one another because of the difference in the packing and secondary forces acting between the particles.

**Molecular Arrangement of Solids:** Particles are closely packed in a regular pattern. They have strong intermolecular forces and are held together by these forces.

**Molecular Arrangement of Liquids:** Particles are closely packed but not in a regular pattern. They have moderate intermolecular forces and can move past each other.

**Molecular Arrangement of Gases:** Particles are far apart and move randomly. They have very weak intermolecular forces.

##### Change of State

**Solid to Liquid (Melting):** Heating a solid provides energy to overcome the strong intermolecular forces, allowing particles to move past each other.

**Liquid to Gas (Evaporation/Boiling):** Heating a liquid provides energy to overcome the intermolecular forces, allowing particles to escape into the air.

**Gas to Liquid (Condensation):** Cooling a gas provides energy to overcome the kinetic energy of the particles, allowing them to come closer together.

**Liquid to Solid (Freezing):** Cooling a liquid provides energy to overcome the kinetic energy of the particles, allowing them to form a regular pattern.

# MOTION

An object is said to be in motion with respect to certain other objects if its position continuously changes with respect to these objects.

## LINEAR MOTION

All parts of a body move with the same speed in a straight or curved line.

### Rectilinear Motion

Body changes its position in a straight line with respect to time.



Motion of Child Along Slide



Motion of Athlete Running on Track



Motion of Ball Hit by Player



Motion of Writing Fountain Pen

### Curvilinear Motion

Body Changes its position with respect to time on a curved path.

## ROTATIONAL MOTION

Distance of the moving object remain constant from a fixed point which lies on its axis.



Motion of Potter's Wheel



Motion of Spinning Top



Motion of Merry Go Round



Motion of Wheels of Bicycle

## OSCILLATORY MOTION

To and fro movement along the same path is known as oscillatory motion or simply oscillation.



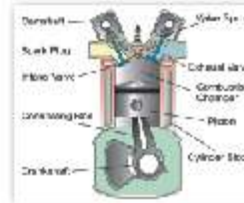
Motion of Pendulum



Motion of Strings of Guitar



Motion of Taut Membrane of Tabla



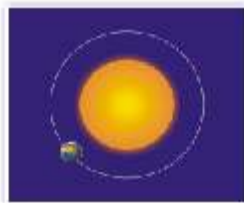
Motion of Piston in Engine

## PERIODIC MOTION

Motion which repeats itself after regular interval of time is known as periodic motion.



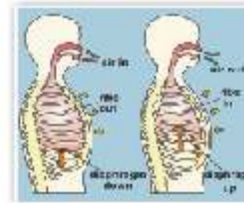
Motion of Moon Around Earth



Motion of Earth Around Sun



Motion of Hands in Watch



Motion of Lungs During Breathing

# CHANGES AROUND US

**SLOW CHANGE**

Changes which take place over a long period.

- 1) Plants growing taller over time.
- 2) Melting of glaciers.
- 3) Formation of mountains.
- 4) Folding of rocks of mountains.

**FAST CHANGE**

Changes which take place over a short period.

- 1) Bursting of the balloon.
- 2) Burning of the paper.
- 3) Heating of the water.
- 4) Breaking of the glass.

**REVERSIBLE CHANGE**

Process in which a substance changes its state but can be brought back to its original state.

- 1) Melting of ice.
- 2) Dissolving of sugar.
- 3) Heating of wax.
- 4) Boiling of water.

**IRREVERSIBLE CHANGE**

Process in which a substance changes its state and cannot be brought back to its original state.

- 1) Burning of wood.
- 2) Ripening of fruit.
- 3) Heating of milk.
- 4) Breaking of glass.

**PERIODIC CHANGE**

Changes which occur after fixed intervals of time.

- 1) Seasonal change.
- 2) Day and night.
- 3) Revolution of Earth.
- 4) Rotation of Earth.

**NON-PERIODIC CHANGE**

Changes which do not occur after a fixed interval of time.

- 1) Earthquake.
- 2) Landslide.
- 3) Storm.
- 4) Fire.

**DESIRABLE CHANGE**

Those changes which are beneficial to us.

- 1) Growth of plants.
- 2) Ripening of fruit.
- 3) Melting of ice.
- 4) Boiling of water.

**NON-DESIRABLE CHANGE**

Those changes which are harmful to us.

- 1) Earthquake.
- 2) Landslide.
- 3) Storm.
- 4) Fire.

**PHYSICAL CHANGE**

Changes where the physical properties of substances remain unchanged.

- 1) Melting of ice.
- 2) Ripening of fruit.
- 3) Boiling of water.
- 4) Dissolving of sugar.

**CHEMICAL CHANGE**

Changes where the chemical properties of substances are changed.

- 1) Burning of wood.
- 2) Ripening of fruit.
- 3) Boiling of water.
- 4) Dissolving of sugar.

## Measurements

Comparing unknown quantities with some known fixed quantities of same kind are measurements. Measurement is expressed in two parts.

**Weight of a Sack of Wheat is** 98 kg

98 - numerical indicating the magnitude  
kg - name of the unit

### Parts of Body Used For Measurements



### Standard System of Units of Measurements

Standard ways of measurements always give exact results.

System	Length	Mass (Weight)	Time
IPS	Foot	pound	second
CGS	centimetre	gram	second
MKS	metre	kilogram	second
SI	metre	kilogram	second

**Measuring Length**

Properly place the scale along the length to be measured.

**Measuring Mass**

Standard weights and balances are used to measure mass of an object.

**Measuring Small Thickness**

Stacking, measuring height, averaging height to know thickness.

**Measuring Time & Temperature**

Clocks are used to measure time. Thermometers are used to measure temperature.

**Measuring Irregular Surface Area**

Superimpose a grid of squares over the irregular shape. Count number of squares to find area of the surface.

**Measuring Volume of Irregular Objects**

Water displacement method.

# Metric Weights & Measures

Metric system is a decimalized system of measurement now and is known as the International System of Units (abbreviated as SI).

**SI Base Units**

Unit	Symbol	Quantity
metre	m	length
kilogram	kg	mass
second	s	time
ampere	A	electric current
kelvin	K	temperature
candela	cd	luminous intensity
mole	mol	amount of substance

**Standard Prefixes For the Units of Measure**

Prefix	Symbol	Prefix	Symbol	Sub-multiples
deca	da	deci	dc	10 <sup>-1</sup>
hecto	h	centi	cm	10 <sup>-2</sup>
kilo	k	milli	m	10 <sup>-3</sup>
mega	M	micro	μ	10 <sup>-6</sup>
giga	G	nano	n	10 <sup>-9</sup>
tera	T	pico	p	10 <sup>-12</sup>
petta	P	femto	f	10 <sup>-15</sup>
exa	E	atto	a	10 <sup>-18</sup>
zetta	Z	zepto	z	10 <sup>-21</sup>
yotta	Y	yocto	y	10 <sup>-24</sup>

**Multiples and Submultiples of Units**

**Length**

- 1 kilometre = 1000 metres
- 1 centimetre = 0.01 metre
- 1 decimetre = 0.1 metre
- 1 metre = 1000 millimetres
- 1 kilometre = 1000 metres

**Weight (Mass)**

- 1 tonne = 1000 kilograms
- 1 quintal = 100 kilograms
- 1 gram = 0.001 kilogram
- 1 milligram = 0.001 gram
- 1 kilogram = 1000 grams
- 1 metric ton = 1000 kilograms

**Time**

- 1 second = 1000 milliseconds
- 1 minute = 60 seconds
- 1 hour = 60 minutes
- 1 day = 24 hours
- 1 year = 365 days
- 1 decade = 10 years
- 1 century = 100 years
- 1 millennium = 1000 years

**Area**

- 1 square centimetre = 0.0001 square metre
- 1 square decimetre = 0.01 square metre
- 1 square metre = 100 square decimetres
- 1 hectare = 10,000 square metres
- 1 square kilometre = 1,000,000 square metres

**Volume and Capacity (Liquid and Dry)**

- 1 cubic centimetre = 0.000001 cubic metre
- 1 cubic decimetre = 0.001 cubic metre
- 1 cubic metre = 1000 litres
- 1 litre = 1000 millilitres
- 1 kilolitre = 1000 litres
- 1 hectolitre = 100 litres
- 1 decalitre = 10 litres
- 1 dekalitre = 10 litres

## Sound

Sound is a vibration transmitted through solid, liquid or gas medium. It is a mechanical energy which produces a sensation of hearing. Ears are the receiver of sound. Sound is measured in decibels.

**Measurement of different sounds on a decibel scale (dB)**

**Characteristics of Sound**

- Amplitude: Loudness
- Frequency: Pitch
- Waveform: Quality

**Sonic Boom**

**Ultrasound & Echo**

### STP06 : Wave Motion

#### Wave Motion

Transference of energy in a medium or through a vacuum due to the oscillation caused by a disturbance is called wave motion.

##### Transverse Wave

Particles of a medium oscillate at right angle to the direction of propagation of a wave.

Electromagnetic waves are non-mechanical transverse waves.

Transverse waves produced in a string.

Transverse waves produced in a slinky or a rope are mechanical waves.

##### Longitudinal Wave

All longitudinal waves are mechanical waves.

Particles of a medium oscillate in the direction of propagation of the wave.

Longitudinal wave in spring.

##### Examples of Wave Motion

- Ripples on the surface of water
- Sunlight propagating in sky
- Sound
- P waves waves are longitudinal
- S waves waves are transverse

### STP07 : Simple Machine

#### Simple Machine

Simple machine is a device that changes the amount, distance, or direction of the force needed to do work in order to gain a Mechanical Advantage.

##### Lever

A lever is a simple machine that is used to push, pull, or in things pulled from a fixed point called the fulcrum.

##### Pulley

Pulley is used to change the direction of an applied force or to gain a mechanical advantage. Fixed pulley system does not create a mechanical advantage.

##### Wedge

A wedge is a triangular shaped tool. It can be used to separate two objects or portions of an object. All an object, or hold an object in place.

##### Inclined Plane

The inclined plane is a flat surface whose endpoints are at different heights. The inclined plane allows the same work to be done with a smaller force exerted over a greater distance.

##### Screw

A screw is a shaft with threads formed on its surface. A screw can convert a rotational force (torque) to a linear force and vice versa.

##### Wheel & Axle

A wheel and axle is a modified lever of the first class in which larger wheel (or cylinder) rotates around the smaller wheel (axle).

### STP08 : Lever

#### LEVER

A lever is a simple machine. Three main components of a lever are:

- Fulcrum:** A point on which the lever rests or around which the lever can rotate.
- Load or Resistance:** It is the object to be moved or the object on which force is applied.
- Effort:** It is the force which is applied on lever or on load to move it.

##### Lever Of The First Class

In lever of the first kind the fulcrum lies between the effort and the load.

##### Lever Of The Second Class

In lever of the second class the load comes between the effort and the fulcrum.

##### Lever Of The Third Class

In lever of the third class the effort comes between the load and the fulcrum.

### STP09 : Principle of Archimedes

#### Principle of Archimedes

Body immersed in a fluid is buoyed up by a force equal to the weight of the displaced fluid. This force enables the object to float or at least seem lighter.

##### Examples of Archimedes Principle

- Floating Log:** Log floats because its density is less than water. It weighs less and hence floats.
- Sinking Rock:** The rock sinks because its density is greater than water.
- Floating Ship:** The ship floats because the average density of ship is less than that of water.
- Balloons Rise High:** Hot air balloons rise because the balloon's density is less than density of surrounding air.

### STP10 : Pascal's Law

#### Pascal's Law

Pascal's law, established by French mathematician Blaise Pascal, states that pressure exerted anywhere in a confined incompressible fluid is transmitted equally in all directions throughout the fluid such that the pressure ratio remains the same.

$$\Delta P = \rho g(\Delta h)$$

Where:

- $\Delta P$  is the hydrostatic pressure (in pascal).
- $\rho$  is the fluid density (in  $\text{kg/m}^3$ ).
- $g$  is acceleration due to gravity (in  $\text{m/s}^2$ ).
- $\Delta h$  is the height of fluid above the point of

##### APPLICATIONS

- Used in Artesian Wells, Water Towers, and Dams
- Hydraulic Press
- Used for Amplifying the Force of the Driver's Foot in the Braking System

### STP11 : Reflection of light

#### Reflection of light

##### Laws of Reflection

- The incident ray, the reflected ray and the normal ray, all lie in the same plane.
- The angle of incidence is equal to the angle of reflection.
- The reflected ray and the incident ray are on the opposite sides of the normal ray.

##### Image Formation by Plane Mirrors

- Image produced is upright.
- Image is virtual.
- Size of image & object is same.
- Distance of the image and the object from the mirror is same.
- Image is laterally inverted.

##### Image Formation by Spherical Mirrors

Concave Mirror and Convex Mirror diagrams showing focal points and image formation.

### STP12 : Refraction Through a Glass Slab

#### Refraction Through a Glass Slab

Lateral Displacement of a Light Ray

Refractive index of a glass slab

Refractive index of glass ( $\mu$ ) =  $\frac{\text{Speed of light in air}}{\text{Speed of light in glass}}$

##### Refraction of Light Through Different Mediums

Laws of Refraction

Mathematically:  $n_1 \sin i = n_2 \sin r$

##### Total Internal Reflection

When light passes from an optically denser medium to a rarer medium, beyond critical angle, it undergoes total internal reflection instead of refraction.

### STP13 : Refraction Through Prisms

#### Refraction Through Prisms

##### Dispersion of White Light Through a Prism

DISPERSION: The phenomenon due to which white light splits into seven colours i.e. violet, indigo, blue, green, yellow, orange and red (VIBGYOR), when passed through an equilateral prism, is called dispersion.

SPECTRUM: The band of seven colours obtained on screen, when white light splits into seven colours, is called a spectrum.

NORMAL DISPERSION: Dispersion through a prism follows the order given by VIBGYOR, it is said to be normal dispersion.

ABNORMAL DISPERSION: If dispersion through a prism fails to follow the order given by VIBGYOR, it is said to be abnormal dispersion.

##### Re-Combination of Spectrum Colours

The seven coloured rays of the spectrum can be recombined to give back white light. A triangular glass prism is placed on its base. Alongside it, in the reverse direction on its vertex, another glass prism of the same material and same refractive index is placed, so that its refracting surface is in the opposite direction. When a beam of white light passes through the first glass prism, it is dispersed into seven coloured rays. The second prism recombines these and recombines them to form the original white beam of light. This phenomenon was discovered by Newton.

##### Rainbow

A rainbow is produced by the dispersion of sunlight by tiny raindrops which act as many small prisms in the air. When the sun shines on the raindrops, during or after a shower, they disperse light by refraction and deviate its component colours by internal reflection to the eye of the observer.

**STP14 : Refraction of Light Through Lenses**

### Refraction of Light Through Lenses

**Lens:** A part of a transparent medium bounded by two spherical surfaces.

**Refraction:** bending of ray when it passes from one transparent medium to another transparent medium.

**Some Definitions:**

- Optical Axis:** The imaginary line joining the centres of the two spheres of which the lens is made is called the optical axis.
- Optical Centre:** Optical Centre is that point on the principal axis which when a ray of light is passed through it, it goes straight through without deviation.
- Principal Focus:** For convex lens, it is a point on the principal axis from which all parallel rays of light converge after refraction through the lens. For concave lens, it is a point on the principal axis from which all parallel rays of light appear to diverge after refraction through the lens.
- Focal Length:** The distance between the optical centre and the focus of lens is called the focal length.

**Image Formation by a Convex Lens:**

**Image Formed by a Convex Lens:**

- Object Beyond 2F:** The rays of light coming from an object placed at 2F are parallel to each other. The image will be real and inverted. Magnification is 1.
- Object Between 2F and F:** The image is real, inverted and smaller than the object. Magnification is less than 1.
- Object at 2F:** The image is real, inverted and of the same size as the object. Magnification is 1.
- Object Between F and 2F:** The image is real, inverted and larger than the object. Magnification is more than 1.
- Object at F:** The rays are parallel after refraction. The image is formed at infinity.
- Object Between F and O:** The image is virtual, erect and highly magnified. It is formed behind the lens.

**Image Formation by Concave Lens:**

- Object at infinity:** The rays are parallel after refraction. The image is formed at the optical centre.
- Object at F:** The image is virtual, erect and highly magnified. It is formed behind the lens.

**STP15 : Optical Instruments**

### OPTICAL INSTRUMENTS

**SLIDE PROJECTOR:** A device used to project an enlarged image of a slide onto a screen.

**TELESCOPE:** An optical instrument used to observe distant objects by increasing their apparent angle, thereby making them appear closer to the observer.

**COMPOUND MICROSCOPE:** An instrument used to see small objects with the help of an eyepiece lens and an objective lens.

**MAGNIFYING GLASS:** A simple lens used to magnify small objects.

**CAMERA:** A device that captures and records images by projecting light onto a light-sensitive surface.

**PERISCOPE:** An instrument that allows a person to see over an obstacle by using two mirrors.

**STP16 : Microscope**

### MICROSCOPE

In a Compound Microscope, two lenses are used for larger magnification, one compounding the effect of the other. The objective lens forms a real, inverted and magnified image of the object. This serves as the object for the second lens, the eyepiece, which produces the final image, which is enlarged and virtual.

**Compound Microscope:** Shows the objective lens, eyepiece, stage, and other components.

**Electron Microscope:** Shows the electron gun, condenser lens, objective lens, and eyepiece.

**RAY DIAGRAM FOR COMPOUND MICROSCOPE:** Illustrates the path of light rays through the objective and eyepiece lenses.

**STP17 : Telescope**

### TELESCOPE

The Telescope is used to provide angular magnification of distant objects. It has an objective lens and an eyepiece lens. The objective has a large focal length and a much larger aperture than the eyepiece. Light from a distant object enters the objective and a real image is formed at its second focal point. The eyepiece magnifies this image producing a final inverted image.

**A Refracting Telescope:** Shows the objective lens, eyepiece, and the telescope tube.

**A Reflecting Telescope (Cassegrain):** Shows the primary mirror, secondary mirror, and eyepiece.

**STP18 : Eye and its Defects**

### Eye and its Defects

**TRANSVERSE SECTION OF EYEBALL:** Shows the cornea, iris, lens, retina, and other parts of the eye.

**Presbyopia:** A defect of vision where the eye cannot focus on nearby objects.

**Cataract:** A clouding of the lens in the eye that blocks light rays from entering the eye.

**Myopia:** A defect of vision where the eye can see nearby objects clearly but cannot see distant objects clearly.

**Hypermetropia:** A defect of vision where the eye can see distant objects clearly but cannot see nearby objects clearly.

**Astigmatism:** A defect of vision where the eye cannot focus light rays on the retina, resulting in blurred vision.

**STP19 : Electric Current - Sources - Effects**

### Electric Current - Sources - Effects

Electric current is defined as the rate at which charge flows.

**SOURCES:** Includes cells, batteries, and power sources.

**EFFECTS:** Includes heating, magnetic effects, and chemical effects.

**CELLS:** Shows the Daniell Cell and Dry Cell.

**MAGNETIC EFFECT:** Shows the deflection of a magnetic needle by a current-carrying wire.

**CHEMICAL EFFECT:** Shows the electrolysis of water.

**STP20 : Static Electricity**

### Static Electricity

Electrical charge at rest on a body is termed as Static Electricity. Two kinds of electric charges are there - Positive (+) and Negative (-).

**Charging by Friction:** Shows how objects become charged by rubbing.

**Electroscope:** A device used to detect the presence of electric charge.

**Van de Graaff Generator:** A device used to produce high voltages.

**Electrostatic Induction:** Shows how charges are induced on a conductor.

**Lightning Spark:** Shows the discharge of static electricity.

**STP21 : Current Electricity**

### Current Electricity

Flow of electric charges through a conductor constitutes current electricity.

**Mobile Electrons are Responsible for Current:** Shows the movement of electrons in a wire.

**Wiring of a Plug:** Shows the internal wiring of a standard electrical plug.

**Conventional Current:** Shows the direction of current flow.

**Electric Circuit Inside a Torch:** Shows the circuit components of a torch.

**Transmission of Electricity:** Shows the power lines and transformers.

**Electric Circuit in a House:** Shows the wiring in a typical household.

### STP22 : Ohm' Law & Electrical Resistance

#### Ohm's Law & Electrical Resistance

**Ohm's Law**

Georg Simon Ohm found out the relationship between the current flowing in a metallic wire and the potential difference across its terminals. This relationship is called Ohm's Law. He stated that the current flowing through a metallic conductor is directly proportional to the voltage across its ends if the temperature and other conditions are constant.

i.e.  $V \propto I$  where  $V$  = Potential Difference  
 $I$  = Current

or  $V/I = \text{Constant}$   
 or  $V/I = R$

Where  $R$  is a constant called Resistance. Its SI unit is  $\Omega$  (ohm).

**Factors Affecting Resistance**

**LENGTH**: Resistance of the conductor is directly proportional to its length.

**CROSS-SECTIONAL AREA**: Resistance of the conductor is inversely proportional to its area of cross-section.

**MATERIAL**: Resistance of the conductor depends upon the nature of its material.

**TEMPERATURE**: Resistance also depends upon the temperature of the conductor.

**Resistance of a System of Resistors**

**Series Combination**

The combination of resistors in series is called series combination. In this combination, the total resistance is the sum of individual resistances.

$R_{\text{total}} = R_1 + R_2 + R_3 + \dots$

**Parallel Combination**

The combination of resistors in parallel is called parallel combination. In this combination, the total resistance is less than the smallest individual resistance.

$\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$

### STP23 : Electric Circuit's Component Symbols

#### Electric Circuit's Component Symbols

<b>Electric Cell</b>	<b>Battery</b>	<b>Bulb</b>	<b>Resistor</b>
<b>Switch (Open)</b>	<b>Switch (Close)</b>	<b>Variable Resistance (Rheostat)</b>	<b>Ammeter</b>
<b>A Wire Joiner</b>	<b>Wires Crossing Without Joining</b>	<b>Fuse</b>	<b>Voltsmeter</b>

### STP24 : Magnetism

#### Magnetism

Thousands of years ago, people discovered that some minerals attract iron. These minerals are called magnets. The force of attraction between a magnet and a piece of iron is called magnetic force.

**Natural Magnet**: A magnet which occurs naturally is called a natural magnet. It is made of a mineral called magnetite.

**Artificial Magnet**: A magnet which is made by a person is called an artificial magnet.

**Types of Artificial Magnets**

- Bar Magnet**: A magnet in the shape of a bar.
- Disc Magnet**: A magnet in the shape of a disc.
- Ring Magnet**: A magnet in the shape of a ring.
- U-Magnet**: A magnet in the shape of the letter 'U'.

**Temporary and Permanent Magnets**

**Temporary Magnets**: Magnets which lose their magnetic property when the magnetizing force is removed.

**Permanent Magnets**: Magnets which retain their magnetic property even after the magnetizing force is removed.

**Theory of Magnetism**

Magnets are made of tiny particles called magnetic domains. These domains are tiny regions where the magnetic atoms are aligned in the same direction.

**Attraction and Repulsion**

Like poles repel each other, and unlike poles attract each other.

**Magnetic Field**

The region around a magnet where its magnetic force can be felt is called its magnetic field.

### STP25 : Properties of a Magnet, Making a Magnet

#### Properties of a Magnet, Making a Magnet

**Making an Electromagnet**

By passing an electric current through a coil of wire, we can make an electromagnet. The strength of the electromagnet can be increased by increasing the number of turns in the coil or by increasing the current.

**Properties of Magnet**

- Every magnet has two poles, North and South.
- Like poles repel each other, and unlike poles attract each other.
- Like poles repel each other, and unlike poles attract each other.
- Like poles repel each other, and unlike poles attract each other.

**Proper Storage and Handling of Magnet**

Magnets should be stored in a safe place, away from other magnets and ferrous materials.

**Magnets Interaction**

Magnets attract iron, nickel, and cobalt.

**Repulsion**

Like poles of magnets repel each other.

### STP26 : Electromagnetism

#### Electromagnetism

Electric current through a wire generates a magnetic field which is called electromagnetism. It describes the relationship between electricity and magnetism.

**Oersted's Experiment**

In 1820, Hans Christian Oersted discovered that an electric current through a wire produces a magnetic field around it.

**Magnetic Field of a Current Carrying Conductor**

**STRAIGHT CONDUCTOR**: The magnetic field lines are concentric circles around the conductor.

**SOLENOID**: The magnetic field lines are parallel to the axis of the solenoid.

**CIRCULAR LOOP**: The magnetic field lines are concentric circles around the loop.

**Maxwell's Right Hand Grip Rule**

If you grip the conductor with your right hand such that the thumb points in the direction of the current, the fingers will curl in the direction of the magnetic field.

**Fleming's Left Hand Rule (motor effect)**

If the forefinger, middle finger, and thumb of the left hand are extended at right angles to each other, the forefinger indicates the direction of the magnetic field, the middle finger indicates the direction of the current, and the thumb indicates the direction of the motion of the conductor.

**Applications**

- ELECTRIC BELL**
- ELECTRIC MOTOR**
- SIMPLE ELECTROMAGNET**

### STP27 : Electromagnetic Induction

#### Electromagnetic Induction

Faraday and Henry discovered that a magnetic field can be used to produce a current.

**Faraday's Experiment**

Faraday discovered that a changing magnetic field induces an electric current in a coil.

**Primary Circuit**

The circuit containing the primary coil and the magnet is called the primary circuit.

**Secondary Circuit**

The circuit containing the secondary coil and the galvanometer is called the secondary circuit.

**Mutual Induction**

When the current in the primary coil changes, it induces a current in the secondary coil.

**Fleming's Right Hand Rule (Induced current direction)**

If the thumb, forefinger, and middle finger of the right hand are extended at right angles to each other, the thumb indicates the direction of the motion of the conductor, the forefinger indicates the direction of the magnetic field, and the middle finger indicates the direction of the induced current.

**Applications**

- Generators**
- Transformers**
- Induction Motors**

### STP28 : Electric Motor

#### Electric Motor

An electric motor converts electrical energy to mechanical energy.

**Working of a Simple DC Motor**

- Current flows through the coil, and the coil starts to rotate.
- The coil continues to rotate, and the current in the coil reverses.
- On passing the vertical position, the commutator reverses the current in the coil, and the coil starts to rotate in the opposite direction.
- The coil continues to rotate, and the current in the coil reverses again.

**Commercial Electric Motor**

Commercial electric motors are used in many applications. They are more efficient and powerful than simple DC motors.

**Simple AC Motor**

A simple AC motor is used in many household appliances.

**Applications of Electric Motor**

- Guitar**
- Fan**
- Washing Machine**

### STP29 : Electric Bell

#### Electric Bell

There are various types of electric bells, including the single-stroke bell, the trembler bell, the buzzer and a continuously ringing bell, but all depend on the attraction exerted by the electromagnet on a soft iron armature.

**Working of a Single Stroke Bell**

When the switch is pressed, the current begins to flow. The solenoid gets magnetised and attracts the armature due to which the hammer strikes the gong and the bell rings.

**Working of a Trembler Bell**

When the switch is pressed, the current begins to flow. The solenoid gets magnetised and attracts the armature. The movement of the armature breaks the contact and the current stops flowing. The electromagnet loses its magnetism and the armature returns back to its original position. This completes the circuit once again and the action is repeated. As a result, the bell continues to ring as long as the push-button is pressed.



### STP30 : Electric Generator

#### Electric Generator

In an electric generator, mechanical energy is used to rotate a conductor coil in a magnetic field to produce electricity. It is based on the principle of electromagnetic induction explained by the Faraday's law.

##### A.C. Generator

The simplest A.C. Generator consists of a rectangular coil rotating between the poles of a permanent magnet. The ends of the coil are joined to two slip rings on the shaft and against which carbon brushes pass. The rotating coil cuts the magnetic field lines and a voltage is induced in it. The induced current that produced reverses every half turn due to the slip rings.

The induced current flows out only as the coil passes the permanent magnet's slip rings.

The current reverses at each end of the coil every half turn, repeating each end of the permanent magnet.

##### D.C. Generator

An A.C. Generator becomes a D.C. Generator if its slip rings are replaced by a splitting ring commutator. As the coil rotates the commutator changes the connections every half turn, so the current that is generated flows in one direction only.

Commutator changes direction of current to supply.

Induced current in this coil will change direction.

### STP31 : Dynamo

#### Dynamo

##### Dynamo Principle

Dynamo works on electromagnetic principles. It converts mechanical rotation into pulsed DC through the use of a commutator. It consists of a stationary magnet to provide a constant magnetic field, and a set of rotating windings which turn within that field to produce the electric current.

##### Bicycle Bottle Dynamo

Bottle dynamo operates using a roller placed on the sidewall of a bicycle tyre. The movement of the bicycle tyre turns the roller which spins a magnet inside a coil. Electricity is generated in the coil by electromagnetic induction.

##### The First Dynamos

###### FARADAY'S DISC DYNAMO

The first dynamo invented by Michael Faraday in 1831 was a copper disk that rotated between the poles of a magnet.

###### PIXI'S COMMUTATED DC DYNAMO

In 1832, Hippolyte Pixii built a dynamo based on Faraday's principle. He used a spinning permanent magnet whose north and south poles passed by a piece of iron wrapped with insulated wire. To convert the AC to DC, Pixii invented a commutator.

### STP32 : Force

#### Force

A force is a push or pull that changes the motion, size or shape of an object.

##### Effects of Force

- Change the direction of motion
- Stop motion
- Change speed
- Change direction
- Change of shape or size
- Set a stationary object in motion
- Combining Forces

Combining Forces: Two constant forces acting on the same object by combining the force according to parallelogram law.

### STP33 : Friction

#### Friction

Friction is the component of the contact force parallel to the surfaces in contact, which opposes impending or actual relative motion between the two surfaces.

##### STATIC FRICTION

Opposes impending relative motion  
 $f_s \leq \mu_s N$

##### KINETIC FRICTION

Opposes relative motion  
 $f_k = \mu_k N$

##### ROLLING FRICTION

Opposes relative motion during rolling  
 $f_r = \mu_r N$

Where  $\mu_s$ ,  $\mu_k$ , and  $\mu_r$  are respectively the coefficients of static friction, kinetic friction & rolling friction.  $N$  is the normal force. Also,  
 $\mu_r < \mu_k < \mu_s$

##### ADVANTAGES

- Helps to Write
- Helps to Apply Brakes
- Helps to Walk

##### DISADVANTAGES

- Causes Wear and Tear
- Causes Skin Abrasions

##### INCREASING FRICTION

- Spiking the Shoes
- Grooving the Tyres

##### REDUCING FRICTION

- Using Ball Bearing
- Using Powder
- Lubricating With Oil

### STP34 : Gravitation

#### Gravitation

##### Universal Law of Gravitation

Everybody in the universe attracts every other body with a force which is directly proportional to the product of their masses & inversely proportional to the square of the distance between them.

$$F_g = \frac{GM_1M_2}{r^2}$$

Where,  $G$  is the universal gravitational constant,  $M_1$  and  $M_2$  are masses of two objects,  $r$  is the distance between two masses.

##### Gravitational Constant G

Heavy Cavendish Torsion balance provided the first measurement of the gravitational constant  $G$ .  
Currently accepted value of  $G$  is  $6.67 \times 10^{-11} \text{ Nm}^2/\text{Kg}^2$ .

##### Acceleration Due To Gravity

Gravitational acceleration at a point in space is given as  
 $g = \frac{GM}{r^2}$

Acceleration due to gravity of the earth,  $g = 9.8 \text{ m/s}^2$

##### Weight

Weight is a force caused by the gravitational attraction.  
 $W = mg$   
Weight equals mass times gravitational acceleration.  
Also, Weight of the object on the moon =  $\frac{1}{6}$  Weight of the object on the earth.

##### Weightlessness

When an object is in free fall, it is weightless.

### STP35 : Moment and Couple

#### Moment and Couple

##### Moment (Torque)

The turning effect of a force is called a moment. The moment of a force is also called a Torque. It depends on  
(i) the magnitude of the force (bigger force means greater moment),  
(ii) the perpendicular distance of the force from the Pivot (further the force acts from the pivot, the greater is its moment).

##### Moment of Force (Torque) = Force x Moment Arm (d)

SI Unit of Moment is Newton meter (Nm)      Dimension  $[ML^2T^{-2}]$

##### The Principles of Moment

Example 1:  $T = F \times d$   
Example 2:  $T = 0$   
Example 3:  $T = F \times d \cos \theta$   
Example 4: Equilibrium (Balanced)  
 $T_1 = T_2$   
 $F_1 \times d_1 = F_2 \times d_2$

##### Couple

A special case of moments where two anti-parallel forces ( $F_1$  &  $F_2$ ) separated by a distance 'd' cause an object to rotate.

##### Applications of a Couple

- Turning of a Steering Wheel
- Turning of a Wheel Nut
- Turning of a Screw Driver
- Turning of a Nut
- Turning of a Bolt
- Turning of a Nut

### STP36 : Work and Power

#### Work and Power

##### WORK

If a body is displaced with a given force, a certain amount of work is done.  
 $W = (F \cos \theta) d = f \cdot d$

Unit: joule (J)      Dimension:  $[ML^2T^{-2}]$

Amount of work is greater when displacement is greater for the same force applied.  
Amount of work is greater when force applied is greater for the same displacement.

##### SPECIAL CASES FOR WORK DONE

- When  $\theta = 0^\circ$ , Maximum work is done.
- When  $\theta = 90^\circ$ , No work is done.
- When  $\theta = 180^\circ$ , No work is done.
- When  $f = 0$ , No work is done.

##### POWER

Rate at which work is done.  
 $P = \frac{W}{t} = \frac{f \cdot d}{t} = f \cdot v$

Unit: watt (W)      1 horsepower = 746 watt

### STP37 : Nuclear Fusion

#### Nuclear Fusion

##### ASTROPHYSICAL NUCLEAR FUSION

###### Proton-Proton (pp) Chain in Sun

Four hydrogen nuclei combine to form a nucleus with a release of 26.7 MeV of energy.  
 $4^1_1\text{H} + 2e^- \rightarrow ^4_2\text{He} + 2\nu + 6\gamma + 26.7\text{MeV}$

###### CNO Cycle in Massive Stars

C-12 acts as a nuclear catalyst.

##### CONTROLLED FUSION

**TOKAMAK**: The most researched device for producing controlled thermonuclear fusion.

##### HYDROGEN BOMB

Detonation of small atomic bomb creates the temperatures to trigger the hydrogen bomb explosion. The inward travelling shock waves thus produced compress deuterium & tritium. These nuclei undergo fusion at temperatures over  $5 \times 10^7$  °C.

### STP38 : Nuclear Fission

## Nuclear Fission

When a massive nucleus ( $A > 230$ ) breaks apart into smaller nuclei, there is a slight loss of mass, which occurs in the form of enormous energy according to Einstein's equation  $E = mc^2$ . Such process is called Nuclear Fission. Uncontrolled nuclear fission chain reaction releases enormous energy as in atom bombs.

**NUCLEAR FISSION**

Neutron + Uranium-235 → Barium-142 + Krypton-91 + Neutron

**NEUTRON INDUCED NUCLEAR FISSION**

When a neutron hits a fissionable nucleus, the nucleus splits into two nearly equal fragments releasing enormous amount of energy.

**CONTROLLED NUCLEAR FISSION**

The source of energy in nuclear reactors is controlled nuclear fission.

**BREEDING PLUTONIUM-239**

U-238 is first transformed into a neutron capture U-239, which decays to Pu-239.

**SPONTANEOUS FISSION**

Radioactive decay of Uranium-238 and Thorium-234.

**ENRICHMENT OF THE NUCLEAR FUEL**

Uranium hexafluoride → Gaseous hexafluoride → Pellets of enriched uranium → Fuel rods containing uranium pellets.

### STP39 : Nuclear Reactor

## Nuclear Reactor

Pressurized water reactor (see ordinary water under high pressure (superheated water)) is coolant to remove heat generated, and to be recirculated to the reactor to be heated. The primary coolant loop is kept under high pressure to prevent the water from boiling, hence the name. PWRs are the most common type of power producing nuclear reactors.

**Pressurized Water Reactor**

Containment Structure, Fuel Rods, Control Rods, Steam Generator, Pump, Primary Loop, Secondary Loop, Heat Exchanger, Condenser, Cooling Water, Turbine, Generator, Moderator, Reflector, Pressure Vessel, Isolation Valve, Diverter, Containment Dome.

**Fast Nuclear Reactor**

The fast reactor has no moderator and therefore water cannot be used as a coolant. Also the heat to drive conventional steam is a coolant such as liquid sodium is suitable which does not require a pressure vessel. Coolant rods are sodium or calcium.

### STP40 : Radioactivity

## Radioactivity

The atoms of unstable chemical elements try to rearrange themselves to make more stable atoms. In the process, they give off tiny bursts of radiations. This process is called radioactivity. Radioactivity is both harmful (damages or destroys the tissues) and useful (used to make nuclear energy, preserve food and in the treatment of cancer) to us in everyday life.

**Types of Radioactive Radiations**

- Alpha Decay:**  ${}^4_2\text{He} \rightarrow {}^2_1\text{H} + {}^2_1\text{H}$
- Beta Minus Decay:**  ${}^0_{-1}\text{e} \rightarrow {}^0_0\text{e} + {}^0_{-1}\text{e}$
- Beta Plus Decay:**  ${}^0_{+1}\text{e} \rightarrow {}^0_0\text{e} + {}^0_{+1}\text{e}$
- Gamma Decay:**  ${}^0_0\gamma$

**Constraining Power of Radioactive Radiations**

Alpha particles are a source of genetic damage. Alpha radiation is 10 times as damaging as beta radiation. Beta particles are a source of genetic damage. Beta radiation is 10 times as damaging as gamma radiation. Gamma rays are a source of genetic damage. Gamma radiation is 10 times as damaging as alpha radiation.

**Radioactive Carbon Dating**

Archaeologists find the age of fossils by measuring amount of radioactive isotope of carbon-14 in it. When an organism dies, its stores of carbon-14 decrease because of radioactive decay. A period termed half life of carbon-14 element, by comparing the amount of carbon-14 in a modern sample with that of fossilized counterparts and knowing the rate of carbon-14 decay, scientists can calculate with fair accuracy the age of the fossil.

**Decay of Uranium-238**

Uranium-238 decays through a series of steps to form stable lead-206.

### STP41 : Radio Telescope

## Radio Telescope

Radio Telescope is an astronomical instrument consisting of a radio receiver and an antenna system that is used to detect radio frequency radiations emitted by extraterrestrial sources. Because radio wavelengths are much longer than those of visible light, radio telescopes must be very large in order to attain the resolution of

Primary focal room, secondary reflector, receiver, parabolic reflector, support structure, rotating track, laboratory, antenna track, ground focal room, upper laboratory, counterweight, IT, lower track.

**Astronomical Interferometers**

Interferometers combine images from several radio telescopes to make one image that looks like it was taken from one large dish.

**Orbit (Pune)**

**Only Radio Telescope (ORT)**

**Largest Radio Telescope (Arecibo, Puerto Rico)**

### STP42 : X-Rays

## X-Rays

Stream of high energy photons having wavelength in the range from 0.01 to 10 nanometers are X-rays. X-rays are also called as Roentgen Radiations.

**CHARACTERISTICS**

- They are electromagnetic waves.
- They are not deflected by magnetic and electric fields.
- They affect photographic plates.
- They ionize the gases through which they pass.
- Depending on their wavelengths, X-rays penetrate through different depths.

**PRODUCTION OF X-RAYS**

**X-ray Tube**

In an X-ray tube, the electrical potential (up to 100 kV) between the cathode and the anode heats the filament to several thousand °C to release a stream of free electrons. Electrons from the cathode are accelerated towards the anode. X-rays are generated when free electrons give up some of their energy when they interact with the anode.

**USES**

- Medical Imaging:** X-ray crystallography, security scanners.
- Security Scanners:** X-ray crystallography.
- X-ray Crystallography:** X-ray crystallography.

### STP43 : Television

## Television

**Picture Tube**

Deflector Coils, Evacuated Tube, Electron Gun, Phosphor Coating on Screen.

Guided by a magnetic field and fired out of three electron guns, electron beams that correspond to colours in a TV image strike millions of dots of fluorescent compound on inside of the screen.

**Color Triplet**

Arranged in lines, green, red, or blue on the electron beams strike them out. A grid between the screen keeps the beams from hitting the other side.

**Phosphors**

The small dots on the screen are called phosphors. The signal to them sets off three parts. The three signals are sent as beams of electrons to the screen, where they are focused on coloured phosphors. The phosphors give light when a signal hits them.

### STP44 : Multistage Rocket

## Multistage Rocket

Multistage rockets can be used to increase efficiency and acceleration.

**The Stage Principle**

To propel a significant payload into the earth's orbit, staging is generally employed. In staging, the propellant is used up and the stage is discarded. The stage is discarded once its fuel has been used up, when and the next stage is ignited. This has the effect of reducing the weight of the rocket, meaning that it gets faster acceleration than the first stage.

**Chemical Rocket Types**

- Liquid
- Solid
- Hybrid

**Components of Rocket System**

- Payload
- Propellant
- Engine
- Structure
- Guidance
- Control

**Engine Operation**

Before the fuel is ignited, the oxidizer gas is pumped into the combustion chamber. The oxidizer gas and fuel are then ignited. The main engine is usually a liquid engine. The main engine is usually a liquid engine.

### STP45 : Windmill

## Windmill

**A TYPICAL WINDMILL**

Windmill converts wind energy into rotational motion by means of adjustable blades.

**The Principle of Windmill**

When the wind strikes across the blades of a windmill, it exerts a force on them. This rotates the shaft of the windmill to do a variety of works.

**USES OF WINDMILL**

- Wind Power in Mills
- Wind Power in Pumps
- Wind Power in Sails
- Wind Power in Generators
- Electricity Generation

**MODERN ERA WINDMILL - A WIND TURBINE**

**Horizontal Axis Wind Turbine**

**Vertical Axis Wind Turbine**

STP46 : Petrol Engine

### Petrol Engine

**FOUR STROKE PETROL ENGINE**

Four stroke petrol engine (Internal combustion engine) is used in cars, motorcycles, trucks, aircrafts, construction machinery and many others. The four stroke engine refers to intake, compression, combustion (power), and exhaust strokes.

The cycle begins at Top Dead Center, when the piston is farthest away from the axis of the crankshaft. A stroke refers to the full travel of the piston from Top Dead Center to Bottom Dead Center.

**1 INTAKE STROKE**  
The piston descends from the top of the cylinder to the bottom of the cylinder, reducing the pressure inside the cylinder. A fuel and air mixture is forced by atmospheric pressure into the cylinder through the intake valve. The intake valve then closes.

**2 COMPRESSION STROKE**  
With both intake and exhaust valves closed, the piston returns to the top of the cylinder compressing the fuel-air mixture.

**3 POWER STROKE**  
While the piston is close to top dead center, the compressed air-fuel mixture is ignited by a spark plug. The resulting massive pressure from the combustion of the compressed fuel-air mixture drives the piston back down toward bottom dead center with tremendous force.

**4 EXHAUST STROKE**  
During the exhaust stroke, the piston once again returns to the dead center while the exhaust valve is open. This action forces out the combustion products from the cylinder by pushing the spent fuel-air mixture through the exhaust valve.

STP47 : Steam Engine

### Steam Engine

A practical device which transforms heat energy of steam

**Simple Steam Engine Working**

**Principle** — Steam occupies a larger space than occupied by the same amount of water. Therefore, it exerts greater pressure on the walls of the cylinder. Steam when expands, pushes the piston back with the cylinder. The motion of the piston can now be made to move any object by suitably connecting it to the piston.

The expanding steam loses its heat energy and condenses to water. The piston then falls back. Letting the cooled steam out of the cylinder and reintroducing fresh hot steam into it, entire cycle could be made to repeat as long as desired.

**STAGE 1**  
Fresh hot steam enters the cylinder from the boiler. The piston is pushed back.

**STAGE 2**  
The steam expands, pushing the piston further back.

**STAGE 3**  
The steam is exhausted into the condenser, and the piston returns to its original position.

**One of The First Steam Locomotives (1825)**

STP48 : Diode

### Diode

Diode is a two-terminal electronic component that conducts electric current in only one direction. Diode is usually made from semiconductor materials. Silicon and Germanium are the most common semiconductors used to make diodes.

**TYPES OF DIODES & SYMBOLS**

**DIODE SYMBOL**

**p-n JUNCTION DIODE**

**Silicon Diode**  
Allows current to flow in one direction. It has a low forward voltage drop.

**Schottky Diode**  
A diode with low voltage drop.

**Varactor / Varicap Diode**  
Variable capacitance diode.

**Photodiode**  
Allows current flow when exposed to light.

**Zener Diode**  
Allows current to flow in both directions. It has a specific breakdown voltage.

**Light Emitting Diode (LED)**  
Emits light when current flows through it.

**Laser Diode (a type of photodiode)**  
Emits a narrow beam of light.

STP49 : Universe - I (Life Cycle of a Star)

### Universe-I (Life Cycle of a Star)

**1. PROTOSTAR**  
A protostar is a dense, glowing ball of gas and dust. It is the first stage of a star's life.

**2. PROTOSTAR CONTRACTING**  
A protostar contracts as it gathers more gas and dust. The temperature and pressure inside increase.

**3. PROTOSTAR CONTRACTING**  
The star contracts to a smaller size. The temperature and pressure inside increase.

**4. PROTOSTAR CONTRACTING**  
The star contracts to a smaller size. The temperature and pressure inside increase.

**5. PROTOSTAR CONTRACTING**  
The star contracts to a smaller size. The temperature and pressure inside increase.

**6. PROTOSTAR CONTRACTING**  
The star contracts to a smaller size. The temperature and pressure inside increase.

**7. PROTOSTAR CONTRACTING**  
The star contracts to a smaller size. The temperature and pressure inside increase.

**8. PROTOSTAR CONTRACTING**  
The star contracts to a smaller size. The temperature and pressure inside increase.

STP50 : Universe II (Comets & Meteors)

### Universe II (Comets & Meteors)

**Comets**  
A comet is an icy celestial body in solar system made of dust and ice mixed together.

**Formation of Comet's Tail and Head**  
The head of a comet is the solid nucleus. The tail is formed by dust and gas being blown away by the solar wind.

**Meteors**  
A meteoroid is a small celestial piece of dust, rock, ice or metal moving through space. A meteor is the streak of light caused by a meteoroid streaking through Earth's atmosphere. A meteorite is a meteor that has reached the Earth's surface.

**Types of Meteorites**  
Asteroidite, Chondrite, Iron, Meteorite, Murchisonite, Pallasite.

**Meteorite Strike**  
Most meteoroids have their origin in Asteroid Belt.

STP51 : Star Map

### Star Map

**MAP OF NORTHERN HEAVEN**

**MAP OF SOUTHERN HEAVEN**

STP52 : Newton's Laws of Motion

### Newton's Laws of Motion

**Newton's First Law of Motion**  
Every object continues to be in its state of rest or of motion unless acted upon by an external unbalanced force.

**Newton's Second Law of Motion**  
The rate of change of momentum of a body is directly proportional to the applied force and takes place in the direction in which the force acts.

**Newton's Third Law of Motion**  
Whenever one body exerts a force (action) on another body, the second body exerts an equal and opposite force (reaction) on the first body.

STP53 : Simple Electric Circuit

### Simple Electric Circuit

A circuit is a path along which an electric current can flow. A simple circuit consists of an electric source like battery, a wire, a switch and an output device like bulb. Each part of the circuit must be connected to the next, and each must be able to conduct electricity.

**Types of Circuits**

**Parallel Circuit**  
In a parallel circuit, each component is connected to the main circuit.

**Series Circuit**  
In a series circuit, the components are connected one after the other.

**STG01 : The Cell Theory**

# The Cell Theory

## Unicellular and Multicellular Organisms

As proposed by Schleiden (1804-1881) and Theodore Schwann (1810-1882) and modified by Rudolf Virchow (1855), 'The Cell Theory' may be summed up as:

1. All living things are composed of one or more cells.
2. All cells arise from pre-existing cells.
3. All cells are basically alike in chemical composition and metabolic activities.
4. The function of an organism as a whole is the outcome of the activities and interactions of the constituent cells.

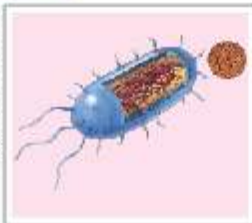
A cell represents the cellular level. In unicellular organisms (single-celled) it performs all the functions in a living organism whereas in multicellular organisms (many-celled), the cell constitutes the basic structural and functional unit of a living organism, like the bricks in a building.

### Types of Cells

In general, two types of cells are recognised. These are as follows:

#### 1. Prokaryotic

These are simple in structure. Their nucleus is simple. Even the DNA is simple and circular. All membrane-bound organelles are absent. The nuclear membrane, microtubules and cytoplasmic streaming are also absent.  
Example: Bacteria cell



#### 2. Eukaryotic

These have a membrane bound nucleus enclosed by jelly-like fluid mass called cytoplasm, which is further enclosed by cell membrane and cell wall (only in plants). Membrane bound organelles are present. The DNA is complex and linear.  
Example: All plant and animal cells.



### Unicellular Organisms

A unicellular organism is a unit structure of life, which is capable of leading an independent life. Each unicellular organism is capable of completing all life functions within the cell itself. Some of these unicellular organisms are given below.



**Amoeba** is a protozoa which locomotes by pseudopodia. It reproduces usually by binary fission.

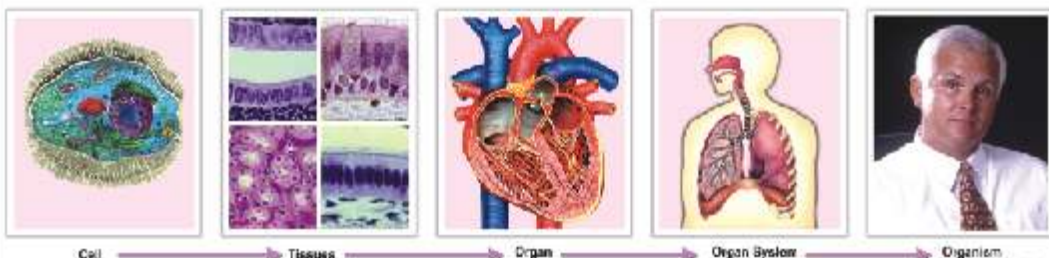
**Paramecium** reproduces by binary or multiple fission and conjugation. Locomotion is by cilia.

**Bacteria** is present in soil, air and water and in living beings as parasite.

**Plankton** is present in the upper layers of sea water. It is a source of food for large marine animals.

### Multicellular Organisms

These organisms which consist of aggregation of many cells and some of which become specialised to perform essential functions of life are called multicellular organisms. Levels of organisation in a multicellular organism are given below:



**STG02 : DNA**

## DNA

Deoxyribonucleic acid (DNA) is the most important constituent of chromosomes. DNA carries all genetic information.

DNA has a long chain of nucleotides.  
DNA structure was first suggested by James Watson and Francis Crick in 1953.

**Nucleotide DNA**  
Nucleotide is the structural unit of DNA. A nucleotide has a nitrogenous base, a phosphate group, and a phosphate group.

**Base pairing**  
Two polynucleotide chains are in the form of a double helix. Each strand has a backbone of sugar and phosphate. Complementary bases pair with each other. Nitrogenous bases are attached to sugar. Complementary bases pair with each other. If one has a weak base, the other has a strong base. A-C-G-T (Complementary base pairing).

**STG03 : RNA**

## RNA

Ribonucleic Acid (RNA) is a copy of the DNA strand. In RNA, the pentose sugar is ribose and not deoxyribose as in DNA. It carries a small piece of genetic information. RNA is responsible for protein synthesis in the cell. There are three major classes of cellular RNAs: Ribosomal RNA (rRNA), Messenger RNA (mRNA) and Transfer RNA (tRNA).

**Messenger RNA (mRNA)** is produced in the nucleus and carries information for the synthesis of proteins. For each protein there is specific mRNA.

**Transfer RNA (tRNA)** is a much smaller molecule than the mRNA. It carries amino acids from ribosomes for protein synthesis.

**rRNA** consists of a long chain of molecules. It usually forms a double strand.

**tRNA** consists of a short chain of molecules. It usually forms a single strand.

**mRNA** carries genetic information from DNA and uses this information to direct the synthesis of proteins.

**tRNA** carries genetic information from DNA and uses this information to direct the synthesis of proteins.

**rRNA** is the genetic material in all plant viruses and some animal viruses.

**STG04 : Levels of Organisation**

## Levels of Organisation

In the living world there are different levels of organisation. The highest level of organisation of the individual level is an organism. The biggest level of living organisation is biosphere (including all living beings in the world). Biosphere includes all the ecosystems which are large and small geographical regions.

**Atomic Level** → **Molecular Level** → **Cell Structure Level** → **Cellular Level** → **Organ Level** → **Organism Level** → **Population Level** → **Community** → **Ecosystem** → **Biosphere**

Different levels of organisation in the living world (atomic level to biosphere level)

**STG05 : Origin of Life**

## Origin of Life

Organic molecules from space → Organic polymers → Organic monomers → Inorganic molecules from Earth → Coacervates

In 1953, Miller and Urey set up a reaction chamber containing a mixture of gases namely hydrogen, methane, ammonia and water. For a week they kept the mixture circulating and bombarding it with continuous discharge of sparks. By the end of the week, they found organic molecules had formed including many kinds of amino acids. The results show that all the building blocks in living systems can form under abiotic conditions.

**Steps in Origin of Life**

1. Abiotic synthesis of organic molecules
2. Formation of coacervates
3. Origin of protobionts
4. Origin of cells

Various types of prokaryotes and then eukaryotes evolved eventually. Some prokaryotes became oxygen producing photosynthesizers.

**STG06 : Cellular Respiration**

### Cellular Respiration

#### 1. GLYCOLYSIS

#### 2. KREBS TCA CYCLE

#### 3. ELECTRON TRANSPORT CHAIN

**STG07 : Animal Husbandry**

### Animal Husbandry

Systematic rearing, caring and improvement of domestic animals is called Animal Husbandry.

#### Important Steps Involved in Animal Husbandry

- Breeding:** Breeding is the method of producing animals and their improvement. This includes the following methods:
  - Open Breeding:** A healthy male is mated with a healthy female of a better breed to yield young crossbreeds.
  - Close Breeding:** Breeding of closely related males is related into the class of the female through its genetic load during the long term period (inbreeding).
- Feeding:** Animals require a balanced diet for their health, growth and development. Different kinds of animals require different kinds of food. The different requirements are:
  - Food for Cattle:** Cereals, pulses, green fodder, etc.
  - Food for Poultry:** Grains, green fodder, etc.
  - Food for Sheep and Goats:** Grains, green fodder, etc.
- Weeding:** Removal of breeds with undesirable characters is known as weeding.
- Health Care:** Preparing and maintaining animals to maintain their health is known as health care.

#### Milk Cattle

Rearing with giving animals the care and health care is called milk cattle. These animals are called MILK CATTLE or MILK COWS. Cattle are reared for milk.

#### Poultry

Rearing of birds for food is called poultry. Chickens are the most common variety of poultry.

#### Apiculture

Rearing of honey bees is called apiculture. Honey bees are cultured for honey and wax.

#### Fisheries

Rearing of fish in a large scale is called fisheries. They are a major source of food.

#### Sericulture

Rearing of silkworms is known as sericulture. It is done to obtain silk from the silkworms.

**STG08 : Economic Plants**

### Economic Plants

Many plants are cultivated for their various economical values and are classified under the following categories:-

- Cereals:** Rice, wheat, maize, etc.
- Pulses:** Gram, lentil, etc.
- Vegetables:** Carrot, brinjal, etc.
- Fruits & Nuts:** Apple, banana, etc.
- Fibre Crops:** Cotton, jute, etc.
- Oil Seeds:** Mustard, sunflower, etc.
- Spices:** Pepper, cardamom, etc.
- Timber:** Teak, sal, etc.
- Beverages:** Tea, coffee, etc.
- Decorative Plants & Flowers:** Rose, marigold, etc.
- Sugar Crops:** Sugarcane, etc.
- Medicinal Plants:** Ashwagandha, etc.

**STG09 : Basic Agricultural Practices**

### Basic Agricultural Practices

Cultivation of plants is known as agriculture.

#### Preparation of Soil

- Ploughing:** To break up the soil and remove weeds.
- Leveling:** To make the soil surface smooth.
- Sowing:** To put seeds into the soil.

#### Sowing and Transplantation

- Sowing with Machine:** Using a sowing machine to plant seeds.
- Transplantation:** Moving young plants to their final location.

#### Irrigation of Fields and Nurseries

Water is given to the plants to help them grow. Methods include:
 

- Canal Irrigation:** Using a canal to bring water.
- Well Irrigation:** Using a well to bring water.
- Tube Well Irrigation:** Using a tube well to bring water.
- Overhead Irrigation:** Using a system of pipes and overhead tanks.

#### Weeding

The process of removing weeds is called weeding. It is done to prevent weeds from competing with the main crop for nutrients and water.

#### Protection of Crop

Plants are protected from pests and diseases using various methods:
 

- Biological Methods:** Using natural predators.
- Chemical Control:** Using pesticides.

#### Harvesting, Threshing, Winnowing, Storage

Harvesting is the process of gathering the crop. Threshing is the process of separating the grain from the chaff. Winnowing is the process of removing the chaff. Storage is the process of keeping the grain for a long time.

**STG10 : Medicinal Plants - 1**

### Medicinal Plants-1

<b>01. ALOE VERA</b> Aloe vera gel is used for skin ailments.	<b>02. MINT</b> Mint leaves are used for digestive problems.	<b>03. TURMERIC</b> Turmeric is used for its anti-inflammatory properties.
<b>04. GARLIC</b> Garlic is used for its antibacterial properties.	<b>05. GINGER</b> Ginger is used for its anti-nausea properties.	<b>06. CAYENNE PEPPER</b> Cayenne pepper is used for its pain-relieving properties.
<b>07. EGGPLANT</b> Eggplant is used for its antioxidant properties.	<b>08. CUCUMBER</b> Cucumber is used for its cooling properties.	<b>09. BROCCOLI</b> Broccoli is used for its cancer-fighting properties.
<b>10. SPINACH</b> Spinach is used for its iron and calcium content.	<b>11. KALE</b> Kale is used for its high vitamin K content.	<b>12. PARSLEY</b> Parsley is used for its diuretic properties.
<b>13. CELERY</b> Celery is used for its blood pressure-lowering properties.	<b>14. CILantro</b> Cilantro is used for its digestive properties.	<b>15. FENNEL</b> Fennel is used for its carminative properties.
<b>16. ANISE</b> Anise is used for its antispasmodic properties.	<b>17. DILL</b> Dill is used for its antispasmodic properties.	<b>18. CORIANDER</b> Coriander is used for its antispasmodic properties.
<b>19. CARAWAY</b> Caraway is used for its antispasmodic properties.	<b>20. FENUGREEK</b> Fenugreek is used for its blood sugar-lowering properties.	<b>21. FLAXSEED</b> Flaxseed is used for its heart-healthy properties.
<b>22. CHIA SEED</b> Chia seed is used for its omega-3 fatty acid content.	<b>23. SUNFLOWER SEED</b> Sunflower seed is used for its vitamin E content.	<b>24. PUMPKIN SEED</b> Pumpkin seed is used for its zinc and magnesium content.
<b>25. ALMOND</b> Almond is used for its heart-healthy properties.	<b>26. WALNUT</b> Walnut is used for its brain-boosting properties.	<b>27. PISTACHIO</b> Pistachio is used for its cholesterol-lowering properties.
<b>28. CASHEW</b> Cashew is used for its anti-inflammatory properties.	<b>29. PEANUT</b> Peanut is used for its protein content.	<b>30. COCONUT</b> Coconut is used for its medium-chain triglyceride content.

**STG11 : Medicinal Plants - 2**

### Medicinal Plants-2

<b>31. GINGER</b> Ginger is used for its anti-nausea properties.	<b>32. TURMERIC</b> Turmeric is used for its anti-inflammatory properties.	<b>33. GARLIC</b> Garlic is used for its antibacterial properties.
<b>34. MINT</b> Mint leaves are used for digestive problems.	<b>35. CUCUMBER</b> Cucumber is used for its cooling properties.	<b>36. SPINACH</b> Spinach is used for its iron and calcium content.
<b>37. KALE</b> Kale is used for its high vitamin K content.	<b>38. PARSLEY</b> Parsley is used for its diuretic properties.	<b>39. CELERY</b> Celery is used for its blood pressure-lowering properties.
<b>40. CILANTRO</b> Cilantro is used for its digestive properties.	<b>41. FENNEL</b> Fennel is used for its carminative properties.	<b>42. ANISE</b> Anise is used for its antispasmodic properties.
<b>43. DILL</b> Dill is used for its antispasmodic properties.	<b>44. CORIANDER</b> Coriander is used for its antispasmodic properties.	<b>45. FENUGREEK</b> Fenugreek is used for its blood sugar-lowering properties.
<b>46. FLAXSEED</b> Flaxseed is used for its heart-healthy properties.	<b>47. CHIA SEED</b> Chia seed is used for its omega-3 fatty acid content.	<b>48. SUNFLOWER SEED</b> Sunflower seed is used for its vitamin E content.
<b>49. PUMPKIN SEED</b> Pumpkin seed is used for its zinc and magnesium content.	<b>50. ALMOND</b> Almond is used for its heart-healthy properties.	<b>51. WALNUT</b> Walnut is used for its brain-boosting properties.
<b>52. PISTACHIO</b> Pistachio is used for its cholesterol-lowering properties.	<b>53. CASHEW</b> Cashew is used for its anti-inflammatory properties.	<b>54. PEANUT</b> Peanut is used for its protein content.
<b>55. COCONUT</b> Coconut is used for its medium-chain triglyceride content.	<b>56. GINGER</b> Ginger is used for its anti-nausea properties.	<b>57. TURMERIC</b> Turmeric is used for its anti-inflammatory properties.
<b>58. GARLIC</b> Garlic is used for its antibacterial properties.	<b>59. MINT</b> Mint leaves are used for digestive problems.	<b>60. CUCUMBER</b> Cucumber is used for its cooling properties.
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<b>73. SUNFLOWER SEED</b> Sunflower seed is used for its vitamin E content.	<b>74. PUMPKIN SEED</b> Pumpkin seed is used for its zinc and magnesium content.	<b>75. ALMOND</b> Almond is used for its heart-healthy properties.
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<b>79. PEANUT</b> Peanut is used for its protein content.	<b>80. COCONUT</b> Coconut is used for its medium-chain triglyceride content.	<b>81. GINGER</b> Ginger is used for its anti-nausea properties.
<b>82. TURMERIC</b> Turmeric is used for its anti-inflammatory properties.	<b>83. GARLIC</b> Garlic is used for its antibacterial properties.	<b>84. MINT</b> Mint leaves are used for digestive problems.
<b>85. CUCUMBER</b> Cucumber is used for its cooling properties.	<b>86. SPINACH</b> Spinach is used for its iron and calcium content.	<b>87. KALE</b> Kale is used for its high vitamin K content.
<b>88. PARSLEY</b> Parsley is used for its diuretic properties.	<b>89. CELERY</b> Celery is used for its blood pressure-lowering properties.	<b>90. CILANTRO</b> Cilantro is used for its digestive properties.
<b>91. FENNEL</b> Fennel is used for its carminative properties.	<b>92. ANISE</b> Anise is used for its antispasmodic properties.	<b>93. DILL</b> Dill is used for its antispasmodic properties.
<b>94. CORIANDER</b> Coriander is used for its antispasmodic properties.	<b>95. FENUGREEK</b> Fenugreek is used for its blood sugar-lowering properties.	<b>96. FLAXSEED</b> Flaxseed is used for its heart-healthy properties.
<b>97. CHIA SEED</b> Chia seed is used for its omega-3 fatty acid content.	<b>98. SUNFLOWER SEED</b> Sunflower seed is used for its vitamin E content.	<b>99. PUMPKIN SEED</b> Pumpkin seed is used for its zinc and magnesium content.
<b>100. ALMOND</b> Almond is used for its heart-healthy properties.	<b>101. WALNUT</b> Walnut is used for its brain-boosting properties.	<b>102. PISTACHIO</b> Pistachio is used for its cholesterol-lowering properties.
<b>103. CASHEW</b> Cashew is used for its anti-inflammatory properties.	<b>104. PEANUT</b> Peanut is used for its protein content.	<b>105. COCONUT</b> Coconut is used for its medium-chain triglyceride content.

**STG12 : Energy Needs**

### Energy Needs

Energy is required to perform different tasks.

#### Hydro Energy

Energy from water is used to generate electricity.

#### Solar Energy

Energy from the sun is used to generate electricity.

#### Wind Energy

Energy from wind is used to generate electricity.

#### Nuclear Energy

Energy from nuclear reactions is used to generate electricity.

#### Geothermal Energy

Energy from the earth's heat is used to generate electricity.

#### Bio Energy

Energy from biomass is used to generate electricity.

#### Light Energy

Energy from light is used to generate electricity.

**STG13 : Fossil Fuels**

### Fossil Fuels

The term 'fossil' refers to parts of dead plants and animals that have been preserved in nature for thousands of years. These fossils which are used to obtain energy in any form are called fossil fuels. For eg., coal, petroleum, etc.

#### Types of Fuels

- Solid Fuels:** Coal, wood, etc.
- Liquid Fuels:** Gasoline, diesel, etc.
- Gas Fuels:** Natural gas, etc.

#### Characteristics of a Good Fuel

- It should not have any waste products.
- It should have high calorific value.
- It should not produce any pollution.
- It should be easy to store, transport and handle.
- It should have a convenient ignition temperature.
- It should have a moderate combustion rate.

#### Calorific Value

Calorific value is the amount of heat energy released when 1 gram of fuel is burnt completely under standard conditions.

Fuel	Calorific Value (kJ/kg)
Coal	30
Wood	15
Gasoline	44
Diesel	42
Natural Gas	55
Hydrogen	142

#### Uses of Coal Products

Coal is used to generate electricity and to produce various chemicals.

#### Uses of Petroleum Products

Petroleum products are used for transport, power, and various industries.









PT03S : Modern Periodic Table of the Elements

### MODERN PERIODIC TABLE OF THE ELEMENTS LONG FORM

The modern periodic table shows elements arranged in 7 periods and 18 groups. It includes the lanthanide and actinide series at the bottom. Key features include:
 

- Groups:** IA to VIIA, plus IB and IIB.
- Periods:** 1 to 7.
- Blocks:** s-block (Groups 1-2), p-block (Groups 13-18), d-block (Groups 3-10), and f-block (lanthanides and actinides).
- Properties:** Atomic number increases from top-left to bottom-right.

PT07S : Mendeleev's Periodic Table

### MENDELEEV'S PERIODIC TABLE

**THE PROPERTIES OF ELEMENTS ARE A PERIODIC FUNCTION OF THEIR ATOMIC MASSES.**

**MERITS OF MENDELEEV'S CLASSIFICATION OF ELEMENTS**

- Mendeleev's periodic law predicted the existence of some elements that had not been discovered at that time.
- Over time, the periodic table could predict the properties of some elements on the basis of their position in the periodic table.
- Mendeleev's periodic table could successfully predict some elements when they were discovered.

**ANOMALIES OF MENDELEEV'S CLASSIFICATION OF ELEMENTS**

- The position of hydrogen could not be explained.
- Wrong order of atomic masses of some elements could not be explained.
- A correct position could not be assigned to hydrogen in the periodic table.

PERIOD	GROUP I R <sup>+</sup> O	GROUP II R <sup>+</sup> O	GROUP III R <sup>+</sup> O <sup>2</sup>	GROUP IV RH <sup>+</sup> RO <sup>2</sup>	GROUP V RH <sup>+</sup> R <sup>+</sup> O <sup>2</sup>	GROUP VI RH <sup>+</sup> R <sup>+</sup> O <sup>2</sup>	GROUP VII RH <sup>+</sup> R <sup>+</sup> O <sup>2</sup>	GROUP VIII R <sup>+</sup> O <sup>2</sup>
1	Hydrogen (H) = 1.008							
2	Lithium (Li) = 6.938	Beryllium (Be) = 9.012	Boron (B) = 10.81	Carbon (C) = 12.011	Nitrogen (N) = 14.007	Oxygen (O) = 15.999	Fluorine (F) = 18.998	
3	Sodium (Na) = 22.99	Magnesium (Mg) = 24.31	Aluminium (Al) = 26.98	Silicon (Si) = 28.09	Phosphorus (P) = 30.974	Sulphur (S) = 32.06	Chlorine (Cl) = 35.453	
4	Potassium (K) = 39.102	Calcium (Ca) = 40.08	Scandium (Sc) = 44.96	Titanium (Ti) = 47.88	Vanadium (V) = 50.94	Chromium (Cr) = 52.00	Manganese (Mn) = 54.94	Iron (Fe) = 55.85, Cobalt (Co) = 58.93, Nickel (Ni) = 58.71
5	Copper (Cu) = 63.54	Zinc (Zn) = 65.37	Gallium (Ga) = 69.72	Germanium (Ge) = 72.58	Antimony (Sb) = 74.52	Selenium (Se) = 78.96	Bromine (Br) = 79.904	
6	Rubidium (Rb) = 85.47	Strontium (Sr) = 87.62	Yttrium (Y) = 88.91	Zirconium (Zr) = 91.22	Niobium (Nb) = 92.91	Molybdenum (Mo) = 95.94	Techneium (Tc) = 99	Ruthenium (Ru) = 101.07, Rhodium (Rh) = 102.91, Palladium (Pd) = 106.4
7	Silver (Ag) = 107.87	Cadmium (Cd) = 112.40	Indium (In) = 114.82	Tin (Sn) = 118.69	Bismuth (Bi) = 121.75	Tellurium (Te) = 127.60	Iodine (I) = 126.90	
8	Cesium (Cs) = 132.90	Barium (Ba) = 137.34	Lanthanum (La) = 138.91	Cerium (Ce) = 140.12				
9								
10			Ytterbium (Yb) = 173.04	Hafnium (Hf) = 178.49	Tantalum (Ta) = 180.95	Tungsten (W) = 183.85		Osmium (Os) = 190.2, Iridium (Ir) = 192.2, Platinum (Pt) = 195.09
11	Gold (Au) = 196.97	Mercury (Hg) = 200.59	Thallium (Tl) = 204.37	Lead (Pb) = 207.19	Bismuth (Bi) = 208.98			
12				Thorium (Th) = 232.04		Uranium (U) = 238.03		

In the formulae for oxides and hydrides, the letter 'H' is used to represent any of the elements in the group.

CL01S : Laboratory Safety

### LABORATORY SAFETY

This chart illustrates various safety protocols in a laboratory, including:
 

- Wearing safety goggles and gloves.
- Proper handling of chemicals and glassware.
- Using fume hoods for hazardous substances.
- Procedures for spills and accidents.
- First aid measures for common lab incidents.

CL02S : Laboratory Techniques

### LABORATORY TECHNIQUES

This chart shows various laboratory techniques and equipment:
 

- Titration and standardization.
- Distillation and extraction.
- Gravimetric and volumetric analysis.
- Use of analytical balances and burettes.

CL03S : pH Colour Chart



CL04S : Laboratory First Aid

### LABORATORY FIRST AID

**Report all Accidents, Injuries and Spills Immediately !!!**

This chart provides instructions for handling common laboratory accidents:
 

- Chemical Burns to Eye:** Flush with water for 15 minutes.
- Chemical Burns to Body:** Wash with water; do not use ointments.
- Cuts and Bruises:** Clean with antiseptic; apply a bandage.
- Fainting or Collapse:** Lay the person flat; call for help.
- Electric Burn:** Turn off power; do not touch the person.
- Minor Thermal Burns:** Cool with water; do not pop blisters.
- Poisoning:** Do not induce vomiting; call for help.
- Glass Piece in Skin:** Do not remove; seek medical attention.
- Foreign Matter in Eyes:** Flush with water; seek medical attention.
- Clothes on Fire:** Stop, drop, and roll; use fire blanket.

**GE01S : Pedigree Analysis - 1**

## PEDIGREE ANALYSIS - 1

### STANDARD SYMBOLS AND SAMPLE PEDIGREE

After the rediscovery of Mendel's work the practice of analysing inheritance pattern of traits in human beings began. Since control crosses are not possible in case of human beings, study of the family history about inheritance of a particular trait provides an alternative. Such an analysis of traits in several generations of a family is called the Pedigree Analysis. In human genetics, pedigree study provides a strong tool, which is utilized to trace the inheritance of a specific trait, abnormality or disease.

#### Standard symbols used in Pedigree Analysis

		<b>I, II, III</b> generation number			

#### SAMPLE PEDIGREE

**Pedigree 1 : Inheritance of an autosomal dominant trait.**

**Pedigree 2 : Inheritance of an autosomal recessive trait.**

**Pedigree 3 : Inheritance of an X-linked recessive trait.**

**GE02S : Pedigree Analysis - 2**

## PEDIGREE ANALYSIS - 2

### AUTOSOMAL RECESSIVE TRAIT

#### Myotonic Dystrophy Pedigree

**Tongue Curler Pedigree**

■ or ■ = affected    D = allele for Myotonic Dystrophy  
 □ or □ = normal    d = normal allele

**GE03S : Pedigree Analysis - 3**

## PEDIGREE ANALYSIS - 3

### AUTOSOMAL RECESSIVE TRAIT

#### Inheritance of Attached Ear Lobe

■ or ■ = individual with attached ear lobe    F = allele for free ear lobe  
 □ or □ = individual with free ear lobe    f = allele for attached ear lobe

#### Inheritance of Sickle Cell Anemia

■ or ■ = affected individual    L = allele for normal blood cell  
 □ or □ = normal individual    l = allele for sickle cell

**GE04S : Pedigree Analysis - 4**

## PEDIGREE ANALYSIS - 4

### X-LINKED RECESSIVE TRAIT

#### Haemophilia Pedigree

■ or ■ = Colour blind individual    C = normal allele  
 □ or □ = Normal individual    c = colour blind allele

#### Colour Blindness Pedigree

■ or ■ = affected individual    X<sup>H</sup> = allele for haemophilia  
 □ or □ = normal individual    X<sup>h</sup> = allele for hypophospatemia

**GE05S : Pedigree Analysis - 5**

## PEDIGREE ANALYSIS - 5

### X-LINKED DOMINANT TRAIT

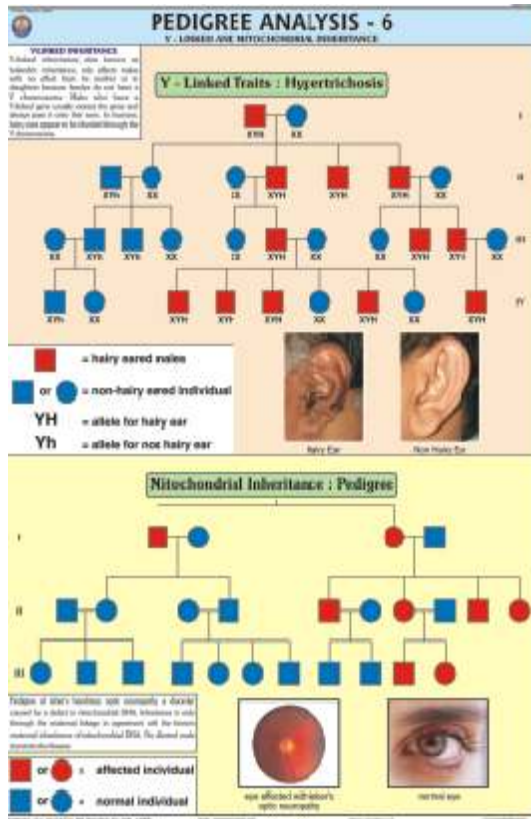
#### Pedigree of Hypophospatemia

■ or ■ = affected individual    X<sup>H</sup> = allele for haemophilia  
 □ or □ = normal individual    X<sup>h</sup> = allele for hypophospatemia

#### Pedigree of Deoxy Lactate

■ or ■ = affected individual    X<sup>H</sup> = allele for haemophilia  
 □ or □ = normal individual    X<sup>h</sup> = allele for hypophospatemia

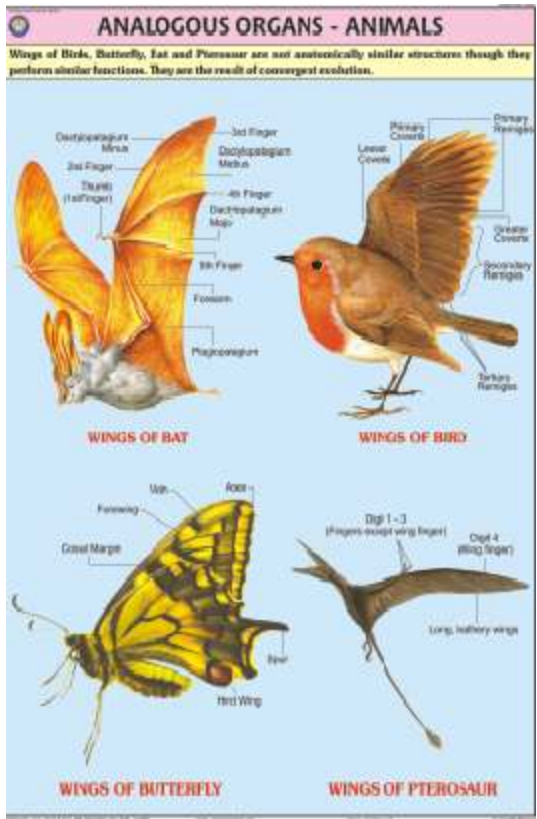
GE06S : Pedigree Analysis - 6



GE07S : Homologous Organs - Animals



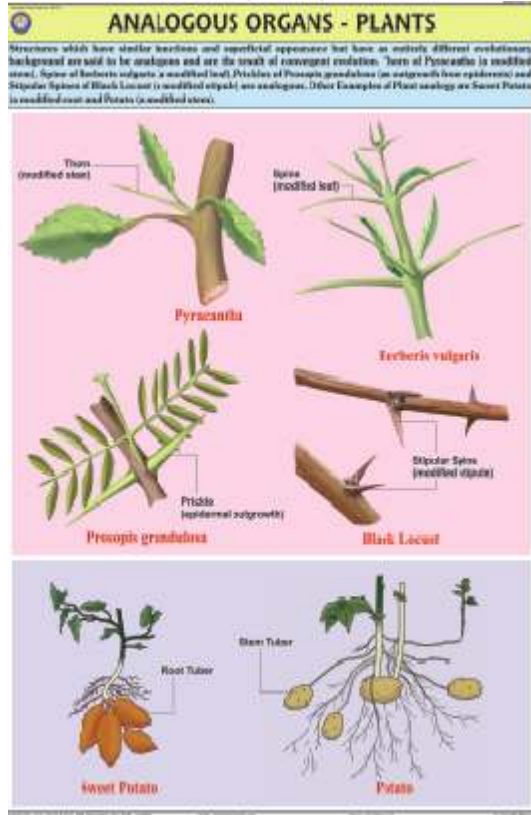
GE08S : Analogous Organs - Animals



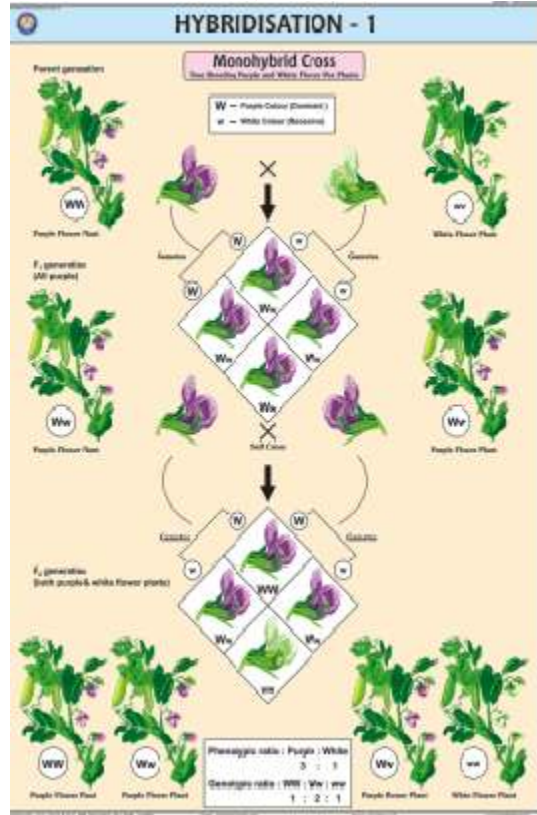
GE09S : Homologous Organs - Plant



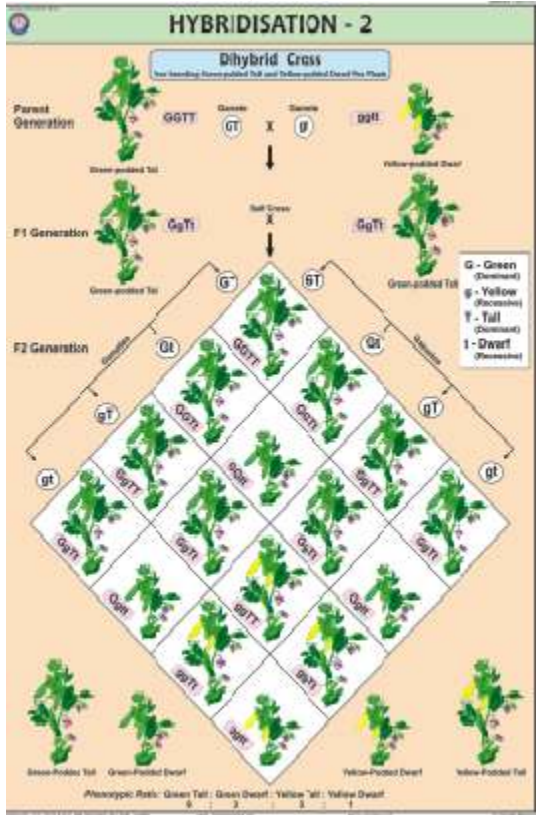
GE10S : Analogous Organs - Plants



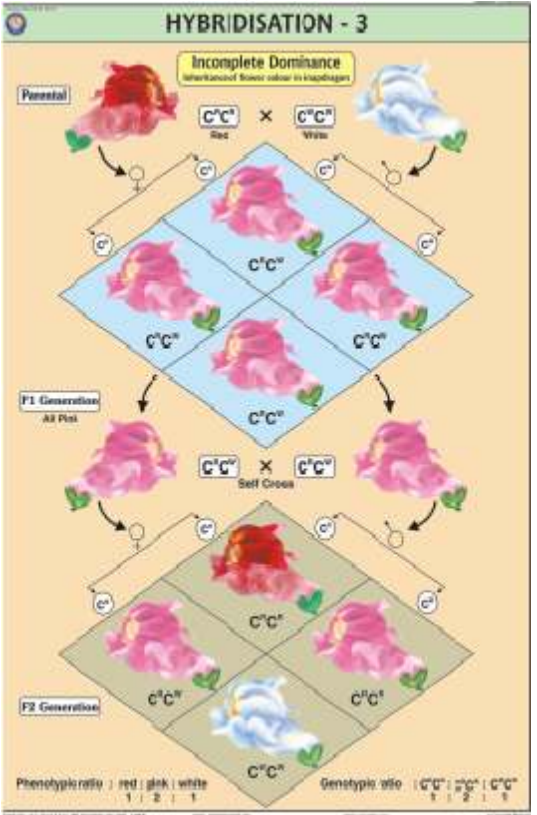
GE11S : Hybridisation - 1



GE12S : Hybridisation - 2



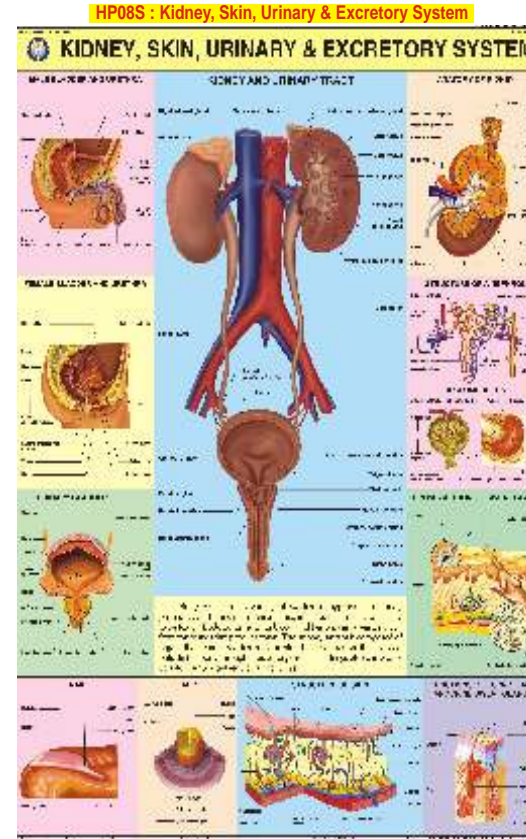
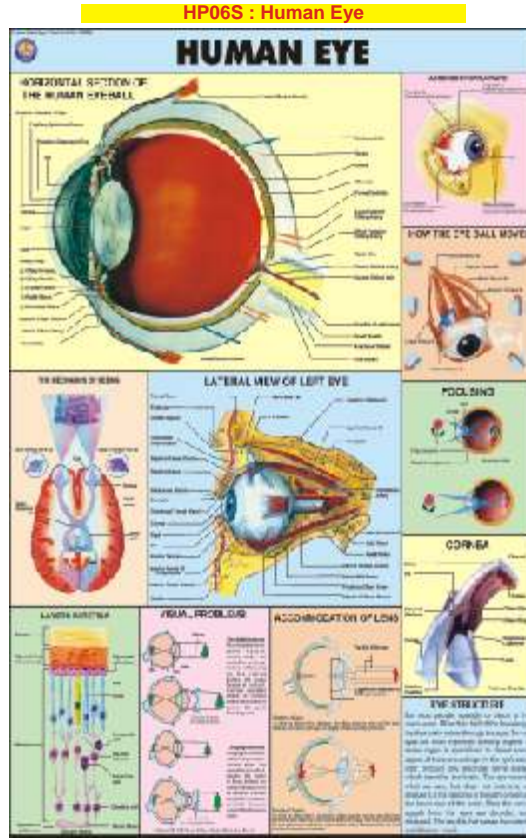
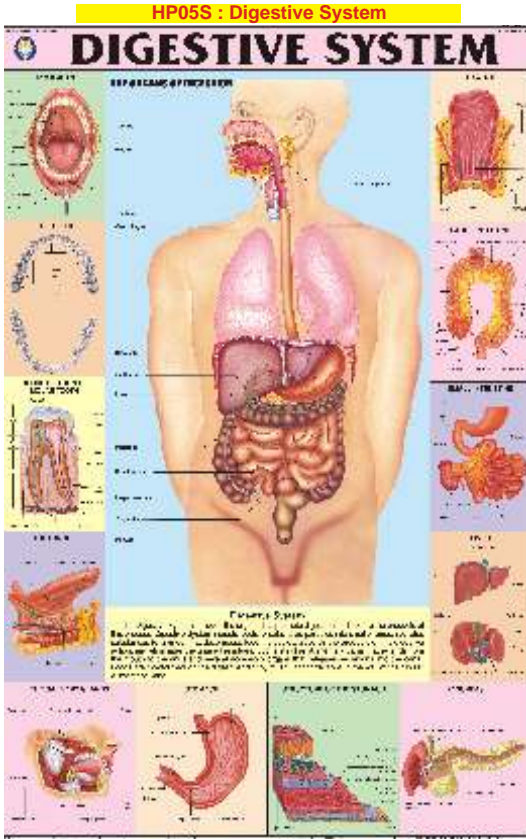
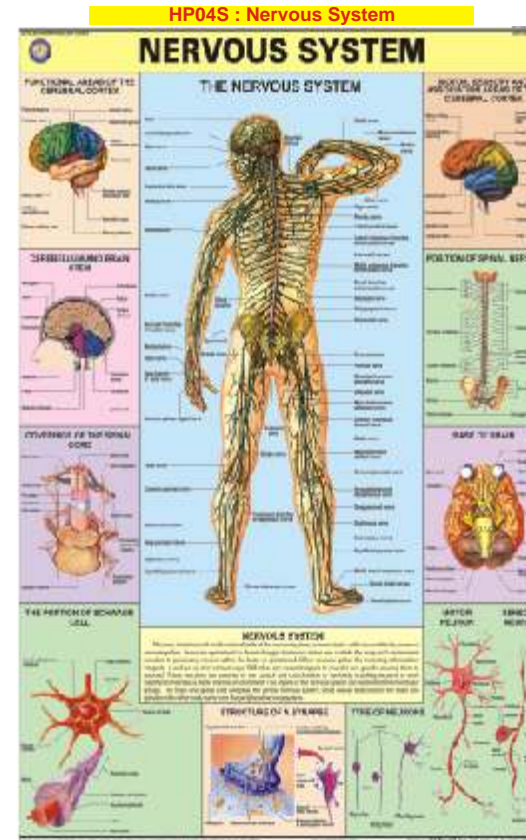
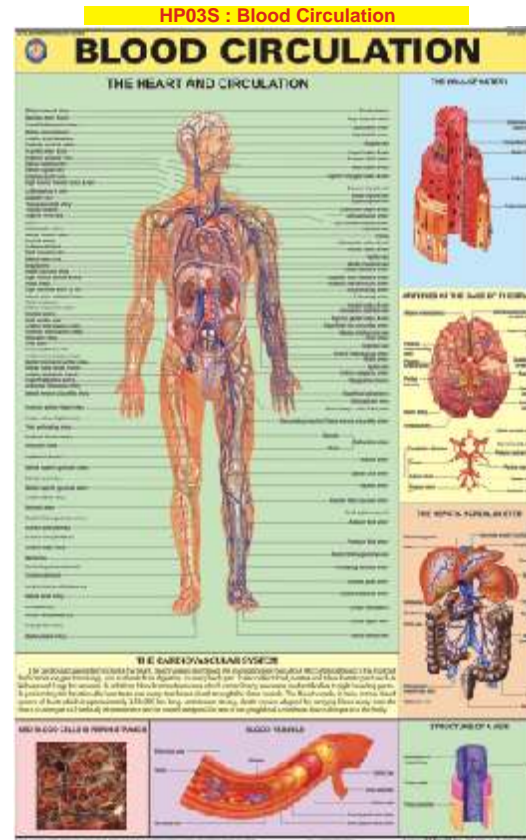
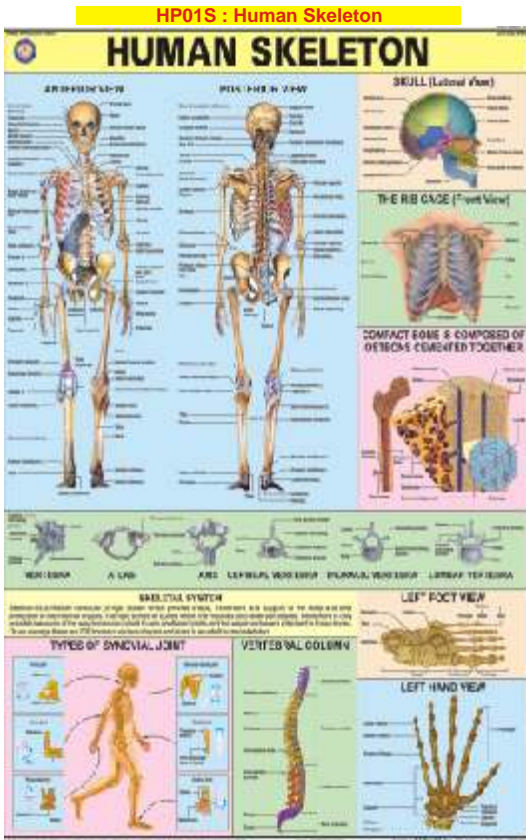
GE13S : Hybridisation - 3



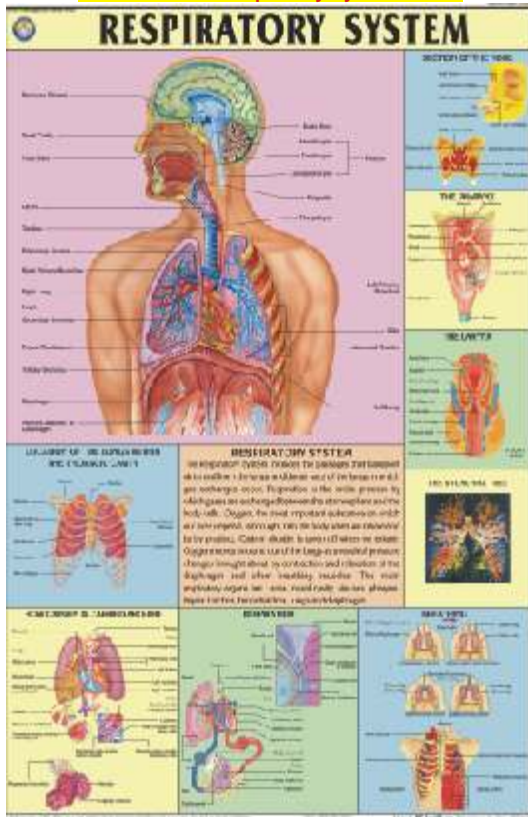
# HUMAN PHYSIOLOGY CHARTS

A set of 31 charts

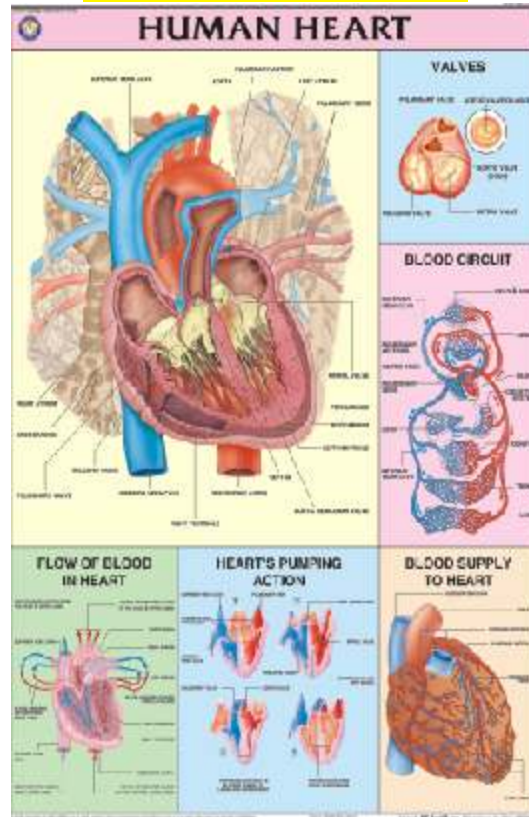
Synthetic, Size 70 x 100 cm (In English only)



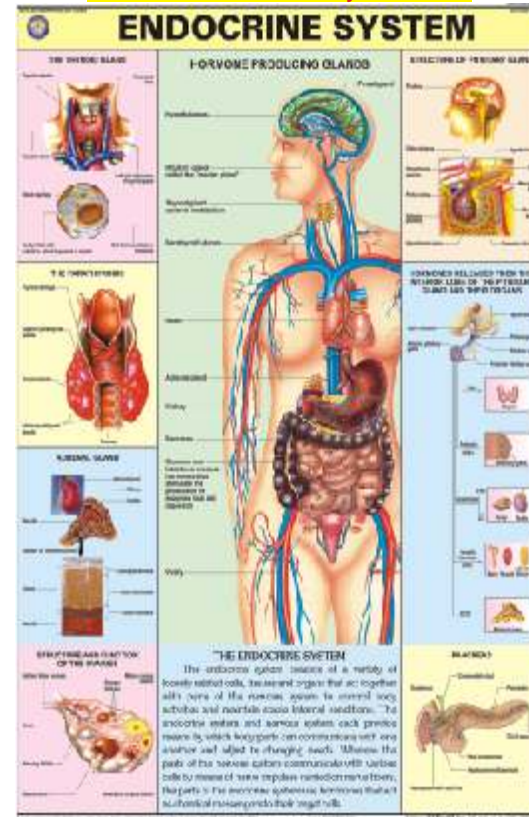
HP09S : Respiratory System



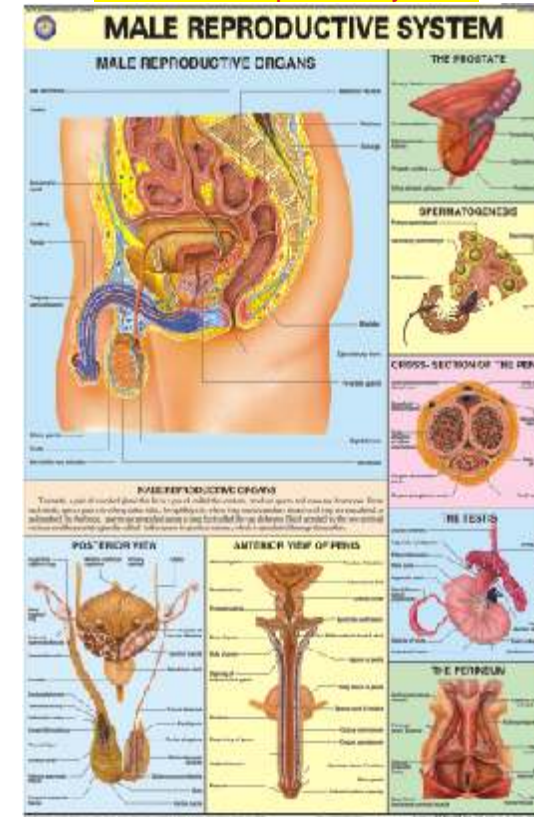
HP10S : Human Heart



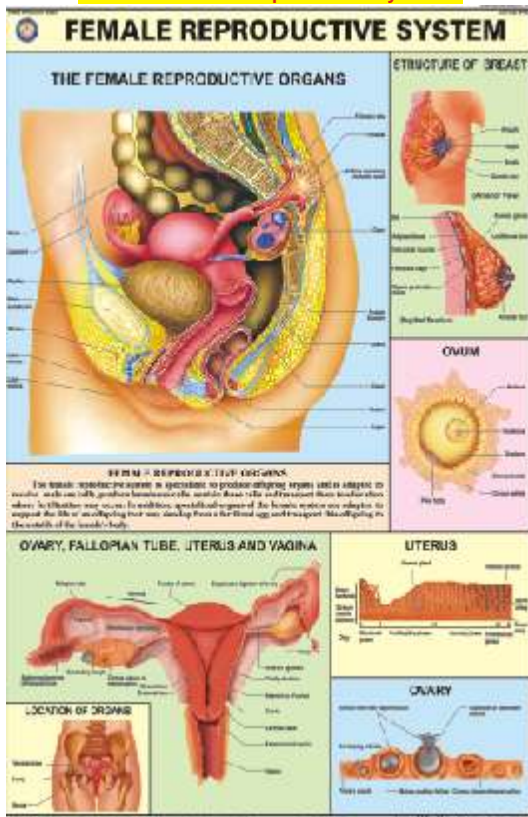
HP11S : Endocrine System



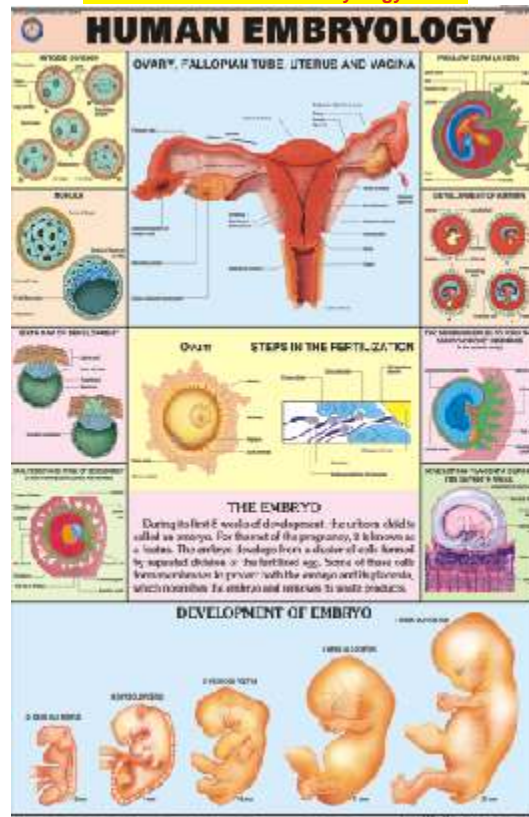
HP12S : Male Reproductive System



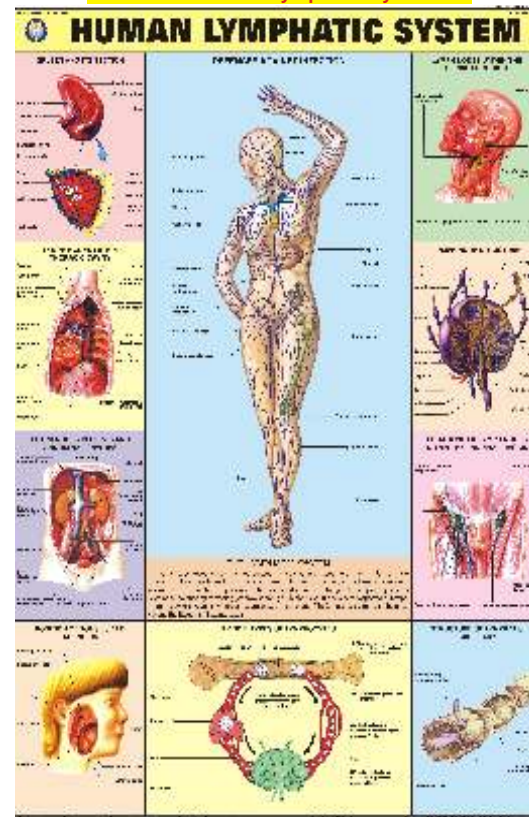
HP13S : Female Reproductive System



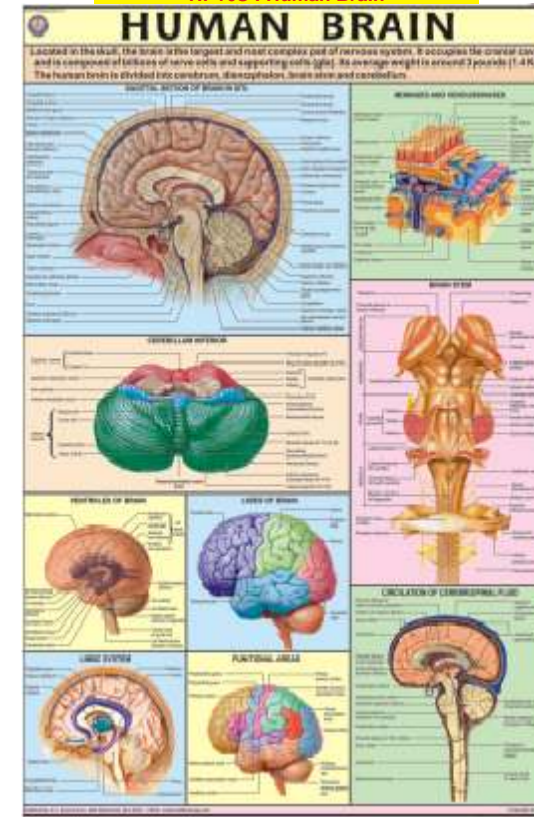
HP14S : Human Embryology



HP15S : Human Lymphatic System



HP16S : Human Brain



**HUMAN PHYSIOLOGY CHARTS**  
 A set of 31 charts  
 Synthetic, Size 70 x 100 cm (In English only)

# HUMAN PHYSIOLOGY CHARTS

A set of 31 charts

Synthetic, Size 70 x 100 cm (In English only)

### HP17S : Human Teeth

## HUMAN TEETH

Teeth are essential for chewing and tearing food into small pieces and with special adaptations for the stages of life. Humans develop two sets of teeth: a normal dentition. The first set, in a number, is known as the deciduous, primary or baby teeth. The secondary or permanent set, comprising 32 teeth, begins to erupt at the first year of life and continues to erupt until the age of 17 years. Permanent teeth include:

#### STRUCTURE OF THE MOUTH

#### TEETH-STRUCTURE

#### TEETHING

#### TYPES OF TEETH

#### MANDIBULAR DENTAL ARCADE

#### MAXILLARY AND MANDIBULAR TEETH (DIPYCNOSIS) - Lateral aspect

#### ROOT CANAL THERAPY (Endodontics)

### HP18S : Pregnancy And Birth

## PREGNANCY AND BIRTH

Pregnancy is the state of having a developing fetus in the uterus which extends from conception to labour (parturition). Pregnancy takes approximately 283 days from the first day of last menstrual period (approximately 297 days from conception).

#### Development of Ovary and Uterus

#### Development of Chorion and Amnion

#### Placenta

#### STAGES OF LABOUR (PARTURITION)

Labour is the process in which muscular contractions force the fetus through the birth canal resulting in the birth of the foetus. The position normally begins with the fetus lying in a head-down position against the umbilical attachment of the placenta.

#### After the birth of the foetus, the placenta gets separated from the uterine wall and is expelled by reflex contractions through the birth canal.

#### Adaptation of foetus

### HP19S : Human Kidney

## HUMAN KIDNEY

#### Right Kidney (External)

#### Suprarenal

#### Blood Vessels in Parenchyma of Kidney

#### Renal Capsule

#### Renal Arteries

#### Renal Veins and Vein in situ

### HP20S : Urinary Tract

## URINARY TRACT

The urinary system regulates the volume and composition of fluids in the body and removes waste products and excess fluid. Waste products are filtered from the blood by nephrons in the kidneys. The filtrate then passes through the collecting ducts to the bladder, where it is stored until it is expelled from the body through the urethra.

#### Female Urethra

#### Female Primary Urinary Tract (sagittal section)

#### Male Urethra

#### Male Primary Urinary Tract (sagittal section)

### HP21S : Human Skull

## HUMAN SKULL

The skull describes the entire of the head, with a part of the neck. It consists of cranial bones, facial bones, and hyoid bone. The skull is composed of 22 cranial bones, 14 facial bones, and 3 ear ossicles. The skull is divided into the cranium and the facial skeleton.

#### Skull (Anterior)

#### Cranial Base (Anterior view)

#### Skull (Lateral)

#### Skull (Superior)

#### Skull of Newborn

#### Skull (Posterior)

#### Skull (Inferior)

### HP22S : Ear, Nose & Throat

## EAR, NOSE & THROAT

The ear, nose, and throat (ENT) are the organs of the head and neck. The ear is responsible for hearing and maintaining balance. The nose is responsible for breathing and filtering the air. The throat is responsible for breathing and swallowing.

#### FRONTAL SECTION OF EAR

#### INTERNAL EAR

#### NOSE AND THROAT

#### PHARYNX (Posterior)

#### PHARYNX (Anterior)

#### ORGAN OF EAR

#### ORGAN OF NOSE

#### ORGAN OF THROAT

### HP23S : Liver, Gallbladder & Pancreas

## LIVER, GALLBLADDER & PANCREAS

The liver, gallbladder, and pancreas are the organs of the digestive system. The liver is responsible for producing bile and filtering the blood. The gallbladder stores bile. The pancreas produces pancreatic juice.

#### LIVER (Anterior)

#### LIVER LOBULE

#### LIVER (Dorsal)

#### GALLBLADDER AND BILIARY DUCT SYSTEM

#### PANCREAS ENDOCRINE AND EXOCRINE PARTS

#### PANCREAS

### HP24S : Human Lungs

## HUMAN LUNGS

The lungs are the organs of the respiratory system. They are responsible for breathing and exchanging gases. The lungs are located in the chest cavity and are protected by the rib cage.

#### LUNGS

#### BRANCHES OF THE BRONCHIAL TREE

#### LYMPH VESSELS AND NODES OF LUNG

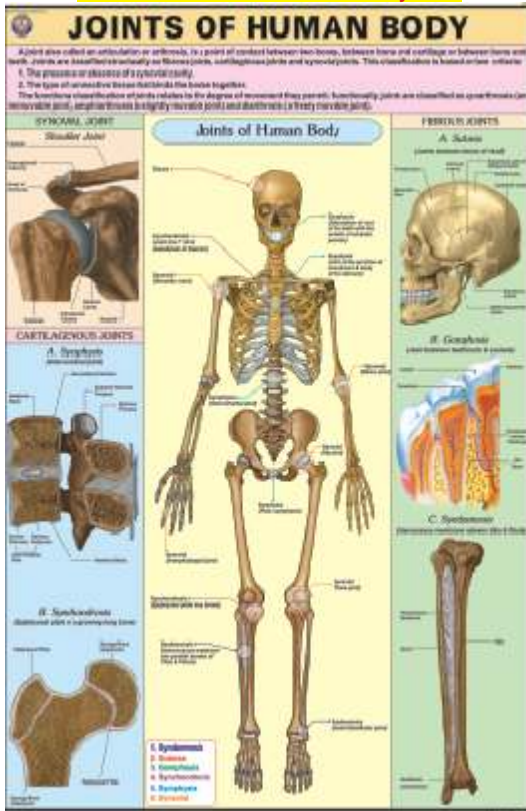
#### INTRAPLEURAL BLOOD CIRCULATION

#### CROSS SECTION OF ALVEOLUS

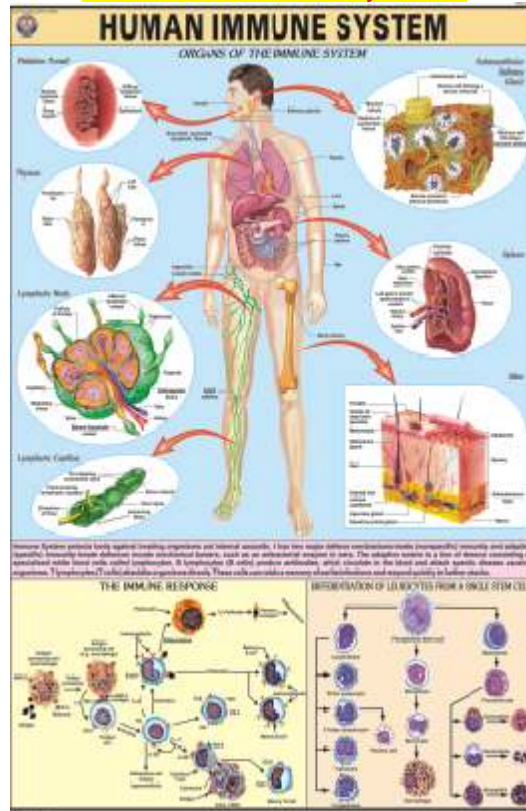
#### MEDIAL VIEW OF RIGHT LUNG

#### MEDIAL VIEW OF LEFT LUNG

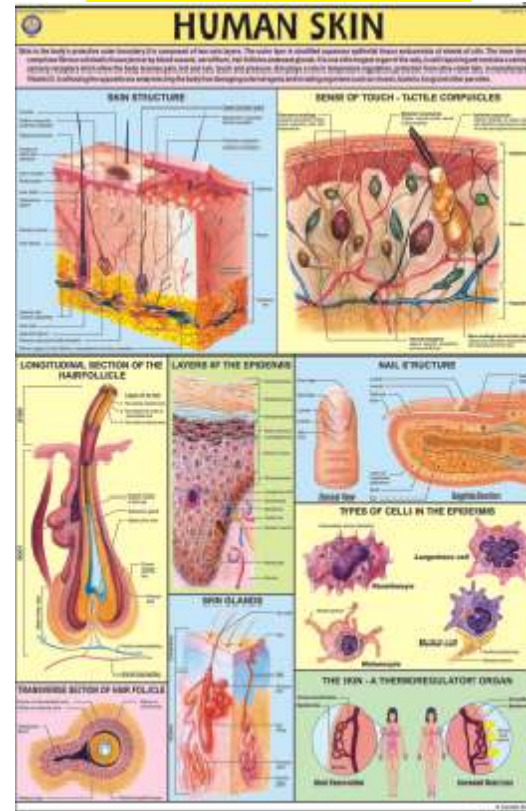
HP25S : Joints of Human Body



HP26S : Human Immune System



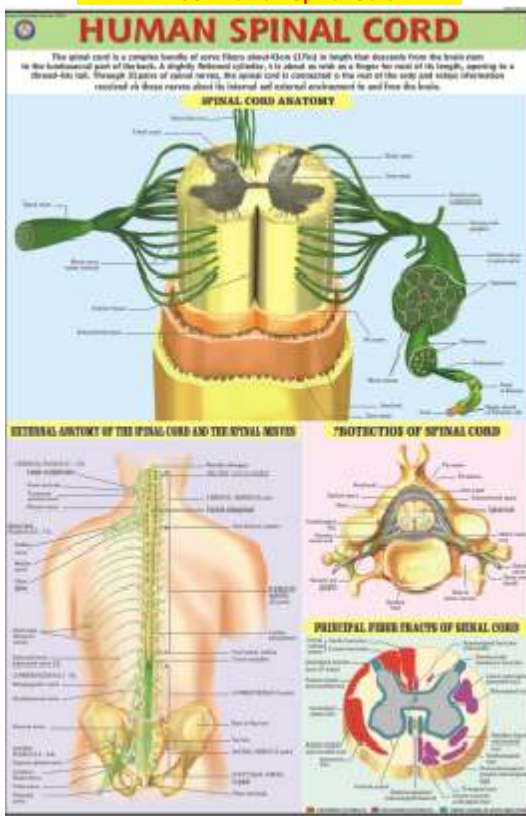
HP27S : Human Skin



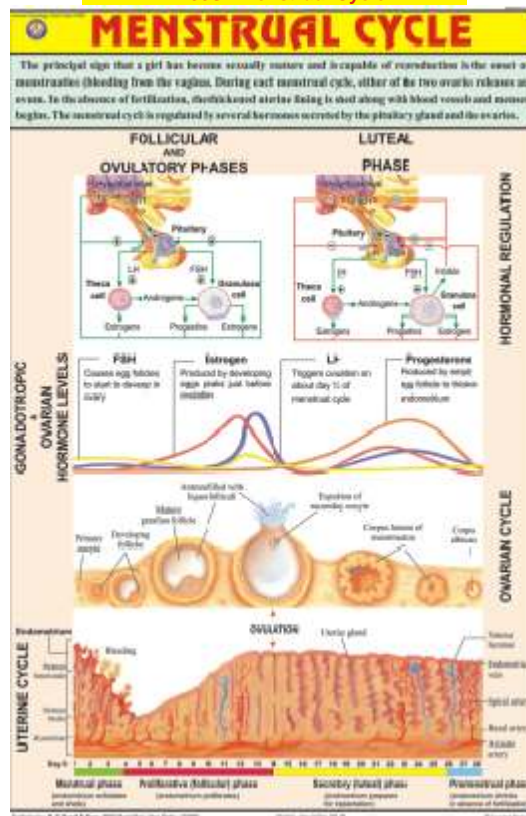
HP28S : Synovial ( Movable) Joints



HP29S : Human Spinal Cord



HP30S : Menstrual Cycle



HP31S : Contraception ( Birth Control)



**Human Physiology Charts**

The first fifteen charts of this series are also available in size 70 x 100 cm, Laminated, english - hindi combined.


**Human Physiology Charts**

**Small size**  
The first ten charts of this series are also available in size 50 x 75 cm, Laminated, english - hindi combined.

# LIFE SKETCH OF SCIENTISTS

A set of 20 charts  
Laminated, Size 45 x 57 cm (In English and Hindi Separately)

LSS01 : Albert Einstein



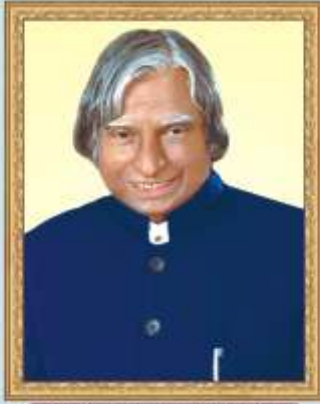
**PHYSICIST** **ALBERT EINSTEIN** 1879-1955

The greatest intellect of all times, Albert Einstein revolutionized our understanding of matter, space and time with his two great theories of relativity. Einstein redefined the foundations of classical mechanics and showed that Newton's Theory of Gravitation is a close approximation of his more exact Theory of Relativity. Scientists with his extraordinary insight into the workings of nature, have consistently advanced the frontiers of human knowledge. Einstein's investigations related to thermal properties of light with a new radiation density led to the formulation of the Photon Theory which he used to explain the photoelectric effect, the discovery which won him the 1921 Nobel Prize for Physics.

Albert Einstein was born in Ulm, Germany, Germany to a Jewish family on 14th March, 1879. He was not a very brilliant student from the start though he showed an aptitude for scientific and mathematical processes, all through his life. After getting his diploma from Swiss Federal Polytechnic School in Zurich in 1900, he started working for some time. Later in the same year he accepted the post of a technical assistant in the Swiss Patent Office in Bern. The same year he acquired his Swiss citizenship. During his stay at Patent Office, he worked on theoretical physics using his spare time and produced much of his revolutionary work. In 1905, Einstein published four papers on quantum physics, the Photoelectric Effect and Special Theory of Relativity. As a result, he was appointed as a junior professor at the University of Zurich in 1908. As his fame spread, he became Director of the Institute of Physics in Zurich in 1911. In 1914, he was appointed Director of the Kaiser Wilhelm Physics Institute in Berlin. He became a German citizen in 1918. Einstein's prediction in his General Theory of Relativity which he published in 1915 that light rays are bent by gravity. When his theory was proved experimentally in 1919, he became world famous.

He returned to Berlin until 1933 after which he resumed his activities for political reasons and went to America accepting the professorship at the Princeton Institute for Advanced Study. He eventually decided to return to the discipline. In 1940 Einstein became a citizen of USA. In 1952, the state of New York elected him as Governor, which he could not do. He was awarded the Nobel Prize for his discovery of the photoelectric effect in 1921. He was awarded the Nobel Prize for his discovery of the photoelectric effect in 1921. He was awarded the Nobel Prize for his discovery of the photoelectric effect in 1921.

LSS02 : Dr. A. P. J. Abdul Kalam



**Missile Man** **DR. A. P. J. ABDUL KALAM**

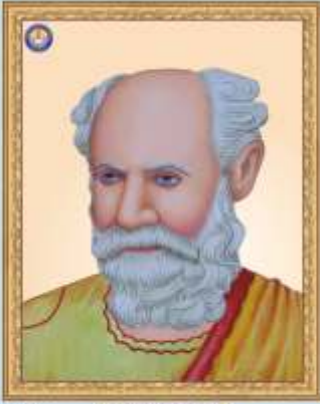
Often referred to as the Missile Man of India, Dr. Avul Pakir Jainulabdeen Abdul Kalam's credit to the country was his work on missile technology and Space Launch Vehicle. The first of his missile tests, the Prithvi missile, took place on 12th & 13th May 1998 a great success, which fulfilled his long dream of seeing India as a nuclear power.

Dr. Abdul Kalam was born on 15th October, 1931 at Rameswaram, Tamil Nadu. His father, an orthodox, a simple religious man, was a boat builder. As a child, Kalam got his early education at a village school. Then he moved to Rameswaram and passed his high school exams in 1949 from Dr. J. R. D. College. After that, he moved to Madras and got admission in St. Joseph College. He got his B.Sc. from there and continued his study in Aeronautical Engineering at Madras Institute of Technology in 1954. Prof. Sunder, Prof. K. A. S. Rao and Prof. Ramalingam Rao of MIT deeply influenced Kalam's life and gave it a direction.

In 1958, Kalam joined the Defense Research and Development Organisation as a Senior Scientific Assistant. He developed a strategic concept called Prithvi that led to the project that resulted in Prithvi and Aridhan and was included in better Air Force. Later, Kalam joined Indian Space Research Organisation in 1962. From there he was sent to ISRO to study rocket propulsion under the leadership of Vikram Sarabhai. On his return he successfully launched India's first satellite, Aryabhata, on 19th November, 1980, giving a national boost to the knowledge he gained. Soon he became Director of IIT Madras. As a result of his efforts, IIT Madras was successfully put into orbit on July 18, 1980. In 1982 Kalam became Director of Defense Research and Development Organisation and held responsible of developing indigenous Ballistic Missile which he called as Prithvi, Trishul, Akash, Nag and Agni. Successful launch of these missiles guaranteed the home independence of the nation in the field of science and technology. In 1984, Government honoured him with Padma Bhushan. Kalam was elected as the 11th President of India on July 25, 2002.

For his great service to nation, government and scientific institutions presented him with numerous honours and awards. In 1987, he was awarded Bharat Ratna. In 1998, he was given Padma Vibhushan. In 2002, he was given the highest civilian award of India, Bharat Ratna. In 2002, he was given the highest civilian award of India, Bharat Ratna. In 2002, he was given the highest civilian award of India, Bharat Ratna.

LSS03 : Archimedes



**MATHEMATICIAN & PHYSICIST** **Archimedes** 287 B.C. - 212 B.C.

Archimedes was born on the western coast of Syracuse, now known as Taormina, Sicily in 287 B.C. The Hellenistic mathematician and physicist was noted for his many contributions to the field of mathematics. His father Phidias was an astronomer. He was an inventor among these with his screw-driven water-raising device. He was the first to use the word 'mathematics' in its modern sense. His work in geometry and mechanics was of great importance and had a long lasting impact on modern science.

Archimedes was in Alexandria a great centre of learning for mathematics and studied under mathematicians of great calibre like Eratosthenes and Apollonius. He also studied under Eratosthenes. He studied under Eratosthenes and Apollonius. He studied under Eratosthenes and Apollonius. He studied under Eratosthenes and Apollonius.

He discovered his famous principle of buoyancy, a key principle in hydrostatics which explains why objects float or sink. The discovery was demonstrated by the problem of determining whether King Hiero's crown was pure gold or not. He was also the first to identify the concept of centre of gravity, being only second Greek generally to give equilibrium conditions of floating bodies or solids on a foundation of their weight. Archimedes also employed hydrostatics to solve other problems and to determine square roots by approximation. He also evolved methods for the determination of the surface area and volume of curved surfaces and solids. He was the first to figure out the method of exhaustion for the determination of the area and volume of curved surfaces and solids. He was the first to figure out the method of exhaustion for the determination of the area and volume of curved surfaces and solids.

Archimedes was killed in 212 B.C. by a Roman soldier during the sack of Syracuse in the second Punic War. He was killed while doing a geometrical construction on the sand. Despite the fact that Archimedes never knew what he was doing, he was the first to figure out the method of exhaustion for the determination of the area and volume of curved surfaces and solids.

LSS04 : Birbal Sahni



**PALAEOBOTANIST** **Birbal Sahni** 1891-1949

Birbal Sahni was the third child of Prof. Dattaram Sahni and Shantabai Jethani. Sahni was born on November 16, 1891 at Meerut, near Dehra Dun. His father was a chemistry teacher. During his school days with his father and younger brother used to go on excursions to the mountains to collect rocks, plants and fossil-bearing rocks. These excursions were very fruitful as he collected many and perhaps that opened the window of his father, who was keen that he should join the Indian Civil Service, he took them up as his career.

After graduating from Punjab University, Lahore in 1913, he secured B.Sc. from London University in 1915. Subsequently, he took up research on ferns, carbon and fossil plants under the guidance of a noted botanist, A.C. Seward. In 1916 he was elected Fellow of the Royal Society of London. He was elected Vice-President of paleobotany section of the 10th International Botanical Congress in 1928 and 1932 respectively. In 1938 he was elected as Foreign Honorary member of the American Academy of Arts and Sciences.

In 1928, Sahni started teaching in 1921 to teach charge of Botany Department of Lucknow University as its first professor. He was the first Indian to study extensively the flora of India. He was the first to study the fossil plants of India. He was the first to study the fossil plants of India. He was the first to study the fossil plants of India.

He established the Institute of Paleobotany. The foundation stone of the building was laid on 3rd April 1937 by Jawahar Lal Nehru. Unfortunately a week after on the midnight of 9th and 10th April 1949 died. The Institute is today known as the Birbal Sahni Institute of Paleobotany.

LSS05 : Chandrasekhara Venkata Raman



**PHYSICIST** **Chandrasekhara Venkata Raman** 1888-1970

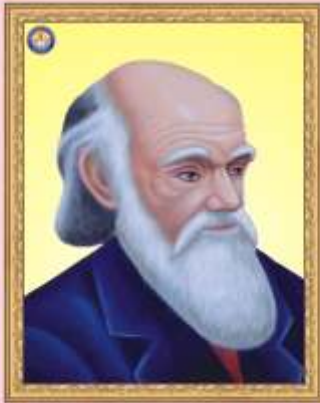
C.V. Raman was the Indian physicist who was awarded the Nobel Prize for his discovery known as the Raman Effect. He discovered that light is scattered by molecules in gases, liquids or solids as a result of inelastic scattering. The Raman Effect has provided us with a better understanding of the structure of molecules to a great extent.

Raman was born in Thiruvananthapuram (Travancore) to Venkatasubramanian Raman on 7th November, 1888. He was a brilliant student from the start. He studied at Presidency College of the University of Madras in 1905. He was awarded B.A. in 1908 and M.A. in 1909. He was awarded Ph.D. in 1917. He was awarded Ph.D. in 1917. He was awarded Ph.D. in 1917.

In 1917 he accepted the professorship of physics at the University of Calcutta. In 1921 Raman was elected Fellow of the Royal Society of London. In 1930, Raman became head of the physics department at the Indian Institute of Science. Raman became the first Director of the Indian Research Institute at Bangalore in 1930. Raman Sahni was among the colleagues of the Institute. Raman received the Nobel Prize for his discovery of the Raman Effect in 1930.

Raman was inspired to work on the scattering of light in 1912, when he was working in India by working in a workshop in the US. When he got the idea he worked on it. He returned to India and worked on it. He returned to India and worked on it. He returned to India and worked on it.

LSS06 : Charles Robert Darwin




**Naturalist** **Charles Robert Darwin** 1809-1882

Charles Robert Darwin was an eminent English naturalist who laid the foundation of modern evolutionary theory with his revolutionary concept of the development of all forms of life through natural selection over the long time evolutionary time. The work was not only revolutionary but also revolutionary in its approach, psychology and philosophy.

Darwin was born in Shrewsbury, Shropshire, England on 12th February, 1809. He was the fifth child of Robert Darwin, a famous doctor and surgeon. Darwin was educated at two local schools and then sent to the University of Edinburgh in 1825 to study medicine. In 1827 he changed to study natural history because of his attraction towards natural history and joined in Christy's College at the University of Cambridge. He studied there, intending to become a member of the Church of England but abandoned the subject. He developed his interest in geology and natural history when he came to natural with Adam Sedgwick, a geologist and John Henslow, a naturalist. After graduating from Cambridge in 1831, Darwin was recommended by Henslow to do an unpaid appointment on the H.M.S. Beagle. The five year expedition around the world started when Darwin sailed from Devonport on 27th September, 1831.

The voyage was a turning point in the young Darwin's life. Darwin's job as a naturalist gave him the opportunity to observe the natural world and to collect specimens. He collected many specimens during the voyage. Many of these were in nature. In his geological observations, Darwin was most impressed with the fact that some of the fossils he collected during the voyage were similar to those of the present day. He collected many specimens during the voyage. Many of these were in nature. In his geological observations, Darwin was most impressed with the fact that some of the fossils he collected during the voyage were similar to those of the present day.

LSS07 : Galileo Galilei



**ASTROPHYSICIST** **Galileo Galilei** 1564-1642

Galileo Galilei was credited with the invention of the scientific revolution in the 17th century in Italy. His work revolutionized the scientific methods of observing nature, to explain the results of astronomical and experiments. His great achievements include the discovery of the properties of pendulums, invention of the telescope, formulation of laws that govern the motion of falling bodies and the improvement and use of the telescope to make observations of the Moon, Sun, planets and other stars.

Galileo was born in Pisa, in the Tuscan region of Italy on 15th February, 1564. He received his primary education from private tutors at Pisa. In 1581, he foundy moved to Florence. Later he returned to Pisa to study medicine but found mathematics and physics more interesting. He was the man of great imagination and for experiments and great ingenuity in mechanical construction. He became a professor of mathematics at the University of Pisa in 1609. Soon after, in 1610, he became a professor of astronomy at Padua and taught and worked there for many years.

When Galileo was already an old man and still a student at the University of Pisa, he discovered counting the pulse in a particular string. He used to do this in the same period of time as the pulse of the string. He used to do this in the same period of time as the pulse of the string. He used to do this in the same period of time as the pulse of the string.

Galileo's work was revolutionary and led to the scientific revolution. He was the man of great imagination and for experiments and great ingenuity in mechanical construction. He became a professor of mathematics at the University of Pisa in 1609. Soon after, in 1610, he became a professor of astronomy at Padua and taught and worked there for many years.

LSS08 : Homi Jehangir Bhabha



**PHYSICIST** **Homi Jehangir Bhabha** 1909-1966

The eminent physicist, Prof. Homi Jehangir Bhabha is regarded as the father of Indian nuclear physics. He made several important contributions to the development of atomic energy, the encouragement of research and teaching of advanced physics in India and was instrumental in establishing the Indian Atomic Energy Programme for nuclear power.

Bhabha was born in Mumbai to a rich family on 29th October, 1909. His father was a lawyer and his mother was related to the Tatas. From the very childhood, he was interested in science. Thanks to a great collection of science books by his parents, he took his engineering degree from Cambridge University in 1930. He was awarded his Ph.D. in 1935. During his stay at Cambridge he came in contact with renowned scientists like Paul Dirac, Wolfgang Pauli and Enrico Fermi and became a research assistant at the Cavendish Laboratory.

In 1938 he returned to India. The same year he was given the Cosmic Ray Research Unit at the Indian Institute of Science, Bangalore under C.V. Raman. With the help of J.C.S. Tata, he established the Tata Institute of Fundamental Research at Mumbai in 1945 with himself as Director. A position he held until his death. He set up the Atomic Energy Commission of India in 1947 which gave a steady impetus to research on nuclear energy in the country. Under his expert guidance four atomic reactors, Apsara, Cirus and Dhruva were built and construction of the country's first nuclear power station began at Tarapur in 1962.

His major contributions include work on quantum electrodynamics, prediction of mesons in cosmic showers and experimental proof of Einstein's theory of relativity. He was the first person to determine the probability of electrons scattering photons - a phenomenon known as Compton Scattering.

In Bhabha's an interest of very high nature, because a figure of great importance to the international scientific community and received many national and international appointments. He acted as President of Indian Physics Congress for the general area of Atomic Energy held in Gandhinagar in 1955. He was also the President of the International Union of Pure and Applied Physics (IUPAP) in 1948. He was awarded the 'Padma Vibhushan' in 1954 and received the 'Vigyan' award. He was elected a Fellow of the Royal Society, London, when he was only 21. He got the 'Raman' Award in 1953. Bhabha Award Research Centre is named in his honor.

He got a fellowship in the nuclear program when Bhabha and a lecture ship in an event of World Bank on 28th January, 1956. He was given the 'Padma Vibhushan' award of International Nuclear Energy Agency.




# LIFE SKETCH OF SCIENTISTS

A set of 20 charts

Laminated, Size 45 x 57 cm (In English and Hindi Separately)

LSS09 : Jagdish Chandra Bose



**BIOLOGIST & PHYSICIST** **Jagdish Chandra Bose** 1858-1937

Dr. Jagdish Chandra Bose was an eminent biologist and physicist. He was the first in India to develop the device that generates microwaves, the invention that proved and settled how heating and cooking is highly sensitive microwave to cook the cubes of a meat. This is observed in the world that India is not only a land of spiritual faith but also a pocket excellent brain for modern scientific studies.


Bose was born in Medinipur, now in Bangladesh on 30th November, 1858 to Bhagwan Chandra and Manu Sankar Bose. Bose was brought up at home along with his siblings and others. He did his schooling first at a school set up by his father and then at St. Xavier's School in Kishoreganj. He received his B.A. in Science from Presidency University in 1877. Later he went to England for higher studies and returned to India in 1882 with a B.Sc. degree and a Bachelor Science Paper. He accepted the position of a lecturer in Presidency College in Kolkata and continued to draw his salary as a private teacher till the death of his father's colleagues. After three years, his work was recognized and he was given full salary with retrospective effect for three years, in 1887. He was married to Adula Bose.

He was rightly called the inventor of wireless telegraphy. His inspired genius and keen a well additional using electromagnetic waves confirming that electromagnetic signals can be sent without using wires. In 1895, Bose invented 'his-wireless' that worked with mechanical devices. He was the first to use a semi-conductor junction to detect radio waves. His other conceptual inventions taught electromagnetic waves.

Bose also invented several scientific instruments. The Crookes tube which he invented to measure the rate of growth of a plant that is 30,000 times faster than usually. His experiments showed that plants respond to various stimuli as if they have nervous system. He also showed that plants grow faster in downward than in upward and their growth rate is higher in moist or warm soil. He demonstrated the electrical nature of the conduction of various stimuli in plants which were well thought to be of chemical in nature. In 1902, he discovered the theory for the extent of light scattering in the particles of the living cells by the scattering of light waves.

Bose founded the Bose Research Institute in Kolkata in 1917, apart from the study of plants, research on several other subjects was carried out here. Research on the structure of molecules of the earth on 12th November, 1927.

LSS10 : Louis Pasteur



**MICROBIOLOGIST & CHEMIST** **Louis Pasteur** 1822-1895


Louis Pasteur was born on 27th December 1822 in Dole, in eastern France. He grew up in the town of Arbois, where he did his primary and secondary schooling. He continued his education at the Royal College in Besancon and obtained B.A. in 1840 and B.Sc. in 1842. In 1843 he entered the Ecole Normale Supérieure in Paris, the great school that prepares teachers for the training of young professors. He obtained his bachelors in 1847.

He served briefly in 1848 as a professor of physics and as an unpaid consultant in chemistry at the laboratory of the young University named Ecole Normale Supérieure. His professorship was short-lived and he returned to Besancon in 1849. He was then elected to the position of lecturer in chemistry at the University of Strasbourg. He was elected to the position of lecturer in chemistry at the University of Besancon in 1850. He was elected to the position of lecturer in chemistry at the University of Besancon in 1850. He was elected to the position of lecturer in chemistry at the University of Besancon in 1850.

In 1849, Pasteur became Dean of the new College of Science at Lille University. He began his biological investigations there. He demonstrated that fermentation is caused by the growth of micro-organisms, and that the growth of these organisms is sensitive to heat, and that the spontaneous generation of life is impossible. He also discovered that the growth of micro-organisms is sensitive to heat, and that the spontaneous generation of life is impossible. He also discovered that the growth of micro-organisms is sensitive to heat, and that the spontaneous generation of life is impossible.

Louis Pasteur generalised his studies on various diseases with rotting matter, a disease of silkworms that was causing much loss to the silk industry, the cholera and typhoid fever (causing the deaths of many children from the disease) could be prevented. In 1881, Pasteur developed a method for reducing the virulence of certain pathogenic micro-organisms. His prepared vaccines for Cholera, Cholera and Anthrax. Later he produced the first vaccine for rabies by growing the virus in rabbits and then examining it by dipping the affected tissue. This vaccine was used on a 9-year old boy, Joseph Meister, on July 6, 1885, after the boy was badly scratched by a rabid dog. The treatment proved to be a spectacular success which brought Pasteur's name greater acclaim and led to the establishment of the Pasteur Institute in 1888. He died on 28th September 1895 after fighting complications of an ailment of unknown origin.

LSS11 : Marie Curie



**CHEMIST & PHYSICIST** **Marie Curie** 1867-1934

Marie Sklodowska-Curie, generally known as Marie Curie, was born a Polish girl in Warsaw on 7th November, 1867. She was the second of four children. Her father was a poor teacher. She was educated at home until she was 16, when she went to the Lycee in Paris. She was the first woman to receive a degree in science from the Sorbonne in Paris. She was the first woman to receive a degree in science from the Sorbonne in Paris. She was the first woman to receive a degree in science from the Sorbonne in Paris.

In 1891 she went to Paris and commenced her study in Sorbonne with the greatest number of her class. She was the first woman to receive a degree in science from the Sorbonne in Paris. She was the first woman to receive a degree in science from the Sorbonne in Paris. She was the first woman to receive a degree in science from the Sorbonne in Paris.

She was elected to the position of lecturer in chemistry at the University of Besancon in 1891. She was elected to the position of lecturer in chemistry at the University of Besancon in 1891. She was elected to the position of lecturer in chemistry at the University of Besancon in 1891.

Marie Curie was awarded the Nobel Prize for physics in 1903 together with Pierre Curie and Henri Becquerel in recognition of the discovery of radioactivity. She was the first woman to receive a Nobel Prize. She was the first woman to receive a Nobel Prize. She was the first woman to receive a Nobel Prize.

After her husband's tragic death in a road accident, she took the place of her husband in the Faculty of Science. She was the first woman to receive a Nobel Prize. She was the first woman to receive a Nobel Prize. She was the first woman to receive a Nobel Prize.

Marie Curie became the first woman to receive a Nobel Prize. She was the first woman to receive a Nobel Prize. She was the first woman to receive a Nobel Prize. She was the first woman to receive a Nobel Prize. She was the first woman to receive a Nobel Prize.

LSS12 : Meghnad Saha



**ASTROPHYSICIST** **Meghnad Saha** 1893-1956


Meghnad Saha was an outstanding Indian Astrophysicist born on 16th October, 1893 in Dhanbad, a small village in the district of Bardhaman, West Bengal. He was the first Indian to receive a Ph.D. in Physics from the University of Cambridge. He was the first Indian to receive a Ph.D. in Physics from the University of Cambridge. He was the first Indian to receive a Ph.D. in Physics from the University of Cambridge.

In 1916, Meghnad started teaching in newly established Science College in Ranchi. He was the first Indian to receive a Ph.D. in Physics from the University of Cambridge. He was the first Indian to receive a Ph.D. in Physics from the University of Cambridge. He was the first Indian to receive a Ph.D. in Physics from the University of Cambridge.

In 1925, Saha became head of the department of physics at Allahabad University and continued to work there until 1937. He was the first Indian to receive a Ph.D. in Physics from the University of Cambridge. He was the first Indian to receive a Ph.D. in Physics from the University of Cambridge. He was the first Indian to receive a Ph.D. in Physics from the University of Cambridge.

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LSS13 : Dmitri Mendeleev



**CHEMIST** **Dmitri Mendeleev** 1834-1907


The Russian chemist Dmitri Mendeleev was born in Tobolsk, Siberia on 18th February, 1834. He was the only one who predicted the existence of the Periodic Table of Elements. He was the first to propose the periodic table of elements. He was the first to propose the periodic table of elements. He was the first to propose the periodic table of elements.

In 1869 the idea came to the government to further studies on the University of Kazan where he worked as the lecturer of physics and chemistry. He returned to St. Petersburg and became a professor of general chemistry at the Technical Institute in 1869. He was elected to the position of Rector of the University of Kazan in 1874.

Mendeleev had to make tables for his students who decided to produce his own. He wrote the periodic 'Principles of Chemistry' which was an important book. Through this work he attempted to classify the elements according to their chemical properties which led him to propose the periodic table. On 17th March, 1869 Mendeleev was a formal presentation to the Russian Chemical Society entitled 'The Dependence between the Properties of the Simple Substances'.

In 1889, he was elected to the position of Rector of the University of Kazan. He was the first to propose the periodic table of elements. He was the first to propose the periodic table of elements. He was the first to propose the periodic table of elements.

LSS14 : Isaac Newton



**Physicist & Mathematician** **Isaac Newton** 1643-1727

Newton is generally regarded as the most influential figure in the history of science who exercised a profound influence on 19th century scientific and intellectual thought. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation.

Isaac Newton was born on 4th January, 1643 in Woolsthorpe, Lincolnshire. His father was a prosperous farmer, who died three months before Newton was born. His mother remarried when he was barely three years old and Newton was left in the care of his grandparents. In 1661, he was sent to King's College, Cambridge for his education. He was the first to propose the laws of motion and universal gravitation.

In 1687, he became a lecturer of Trinity and the next year he became a major fellow. He received his M.A. in 1688 and became Lucasian Professor of Mathematics at the age of 25. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation.

In 1687, with the support of his friend, the famous astronomer Edmund Halley, Newton published his greatest work, the Philosophiæ Naturalis Principia Mathematica. It was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation.

LSS15 : Raja Ramanna



**PHYSICIST** **Raja Ramanna** 1925-2004

Raja Ramanna was an eminent nuclear physicist and one of the greatest Indian scientists of science and technology in India. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation.

Ramanna was born on 25th August, 1925 in Tatkur in Karnataka. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation.

In 1947, he became a lecturer of Trinity and the next year he became a major fellow. He received his M.A. in 1948 and became Lucasian Professor of Mathematics at the age of 25. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation.

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LSS16 : Srinivasa Ramanujan



**MATHEMATICIAN** **Srinivasa Ramanujan** 1887-1920

Srinivasa Ramanujan was one of the greatest Indian mathematicians of all time. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation.

Ramanujan was born on 22nd December, 1887 in Erode, Tamil Nadu. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation.

In 1913, he became a lecturer of Trinity and the next year he became a major fellow. He received his M.A. in 1914 and became Lucasian Professor of Mathematics at the age of 25. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation. He was the first to propose the laws of motion and universal gravitation.


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# LIFE SKETCH OF SCIENTISTS

A set of 20 charts

Laminated, Size 45 x 57 cm (In English and Hindi Separately)

LSS17 : Ernest Rutherford



**PHYSICIST** **Ernest Rutherford** 1871-1937

Rutherford was born at Spring Grove (now Highfields) near Nelson in New Zealand on 18th August, 1871. His father James Rutherford was a schoolmaster and a farmer. Following a scholarship from Nelson College in 1889, he went to Canterbury College in Christchurch. He received his B.A. in 1893, M.A. in 1895 and B.Sc. in 1894. For his honors degree he investigated the magnetic properties of iron by high frequency electric discharges and published his first scientific paper on the topic. He completed a very successful dissertation on magnetic based atomic research.

Rutherford went to England for higher studies at the Cavendish Laboratory University of Cambridge in 1895. There he worked under J.J. Thomson as a research student. In 1898, Rutherford accepted the Massey Research Professorship of McGill University in Montreal, Canada. While working on radioactivity he discovered alpha rays and beta rays in 1899 and in the next year he found the first type with great penetrating power: the gamma rays. In 1900, Rutherford, in collaboration with Frederick Soddy put forward the disintegration theory of radioactivity and showed that radioactivity involves actual transmutation of elements into different kinds of matter.

In 1907, to seek the professorship of physics at the University of Manchester. The most important contribution of Rutherford to physics came in relation with his discovery of alpha and beta particles and his experiments, demonstrating the relative mass of the atom and all positive charge of the atom is concentrated in the very minute centre. Rutherford demonstrated the nuclear structure of the atom in 1911.

During World War I, Rutherford was given charge of investigating the use of radium in Canada to locate German submarines. In 1917, Rutherford successfully brought his research work into practical application by developing his first process to change nitrogen into oxygen. He was appointed Director of the Cavendish Laboratory in 1919 and remained in the post until 1937.

Rutherford was awarded with many honors and awards besides 1908 Nobel Prize for chemistry. They included Royal Society's Copley Medal in 1920, the Presidency of Royal Society from 1920 to 1925, the Order of Merit in 1925, the Albert Medal of Royal Society of Arts in 1926 and the Faraday Medal of the Institution of Electrical Engineers in 1930. He also got many honorary doctorates from the Universities all over the world. He died in Cambridge on October 19, 1937 and he is buried in Westminster Abbey, London.

LSS18 : Satyendra Nath Bose



**PHYSICIST-MATHEMATICIAN** **Satyendra Nath Bose** 1894-1974

Satyendra Nath Bose was a scientist of exceptionally brilliant caliber. With his very high intelligence he solved many problems and kept winning the admiration of his teachers. He made important contributions to quantum statistics. Perhaps no other scientist in our country drew as much admiration from his contemporaries as he did.

Satyendra Nath Bose was born on 1st of January 1894, in Shriniketan, West Bengal. From his earliest days, he was recognized as a brilliant student. He joined Presidency College of Kolkata, he found himself among the company of brilliant students like Meghnad Saha, J.C. Ghosh and other scientists like C.C. Bose and P.C. Ray. This period of great genius happened from an exceptionally gifted intellect. He read for two years that led to his B.Sc. award in 1916. In the meanwhile, in 1914, he received a Gold Medal.


In 1918, he joined the University College of Science in Kolkata as a lecturer in physics with the illustrious Sir S.N. Bose. He was awarded the D.Sc. in 1920 based on research conducted jointly with Meghnad Saha and published in 'Philosophical Journal' of London in 1920. His work which earned 'Bose-Einstein Equation of Equilibrium' was published in 1924. In 1926, he with Saha, investigated Einstein's paper on relatively free Bosons in England.

In 1927, Bose moved to Oxford University as a reader in physics. He continued to work on theoretical and mathematical physics. He used his research paper 'Planck's Law and Light Quantum Hypothesis' as an introduction and subsequently to several other works. All of them related to Thermodynamics. In 1924, he used his paper to show that Bose-Einstein statistics also apply to photons. He also introduced it himself into German for the translation by 'Statistische Physik'. His explanation of the behavior of radiation was well accepted and came to be known as 'Bose-Einstein Statistics'. Elementary particles such as photons and alpha particles which obey 'Bose-Einstein' are now called 'Bosons'. In his research, Bose did much experimental work in the spectroscopy and thermodynamics. He also produced a new electrical instrument which is still used as an amplifier.

He was a very learned personality. Besides science, he was much interested in literature and music also. He had made a deep study of several works in Sanskrit, Hindi, Persian and English literature. He also translated some Sanskrit stories. He could also play 'Tabla', and a Bengali musical instrument.

Bose was awarded with several honors and awards. He received the D.Sc. in 1920, the Order of Merit in 1931, the Albert Medal in 1931 and the Copley Medal in 1931. He was also awarded the Padma Vibhushan in 1954. He died on 23rd February, 1974.

LSS19 : Dr. Vikram Sarabhai



**PHYSICIST** **Dr. Vikram Sarabhai** 1919-1971


Dr. Vikram Sarabhai, one of the greatest scientists and statesmen of India, is remembered as the father of Indian Space Research Program because of his significant contribution to the field of cosmic ray physics and development of space technology in India. He was not only an imaginative and creative scientist but also a pioneering industrialist and an astute planner. Besides his technical work, he was also an imaginative and creative scientist but also a pioneering industrialist and an astute planner. Besides his technical work, he was also an imaginative and creative scientist but also a pioneering industrialist and an astute planner.

Sarabhai was born on 12th August 1919 at Anandkheda in an affluent intellectual family. His father, Shri. Sarabhai, owned many wells in Gujarat. He got his early education in a private school established by his mother, Shri. Sarabhai. After that he went to Cambridge and studied in the Tripos for Natural Sciences from St. John's College in 1940. Due to second world war, he returned to India and joined Indian Institute of Physics in Bangalore. He started his research in cosmic rays there under the expert guidance of P.C.U. Ramani. After the war, he returned to Cambridge and obtained his Ph.D. in 1947 for his thesis titled 'Cosmic Ray Ionization in Tropical Latitudes'.

Sarabhai, with the support of his wife, Shri. Sarabhai, managed to start the Physical Research Laboratory on 13th November, 1947 which is now known as PRL. It was the first of its kind in India. He believed that the study of cosmic rays would provide complete information on fundamental theoretical questions, atmospheric nature of them and the outer space. Therefore, he established different branches of the laboratory on Cosmic, Stratospheric and Ionospheric. He was the one who took on the world stage of space science. He organized the Indian Space Research Organization and was mainly responsible for setting up of Thumba Equatorial Launching Station from where the tropical night was launched on November 11, 1963 with a Russian Raketon Padma. India's first satellite, Aryabhata was put to orbit in 1975 due to project headed by Dr. Sarabhai.

Dr. Sarabhai died suddenly on 30th December, 1971 in Mumbai. His International Conference, Kerala. He received many honors and awards for his services to science and society. In his memory the International Astronomical Union named after him a crater on the moon.

LSS20 : Thomas Alva Edison



**PHYSICIST** **Thomas Alva Edison** 1847-1931

Edison was the most prolific and practical inventor whose work has greatly influenced the world, particularly in the fields of communication and electrical power. He had patented more than a thousand inventions. The first patent of which was the telegraph, the precursor of the gramophone and the incandescent filament lamp.

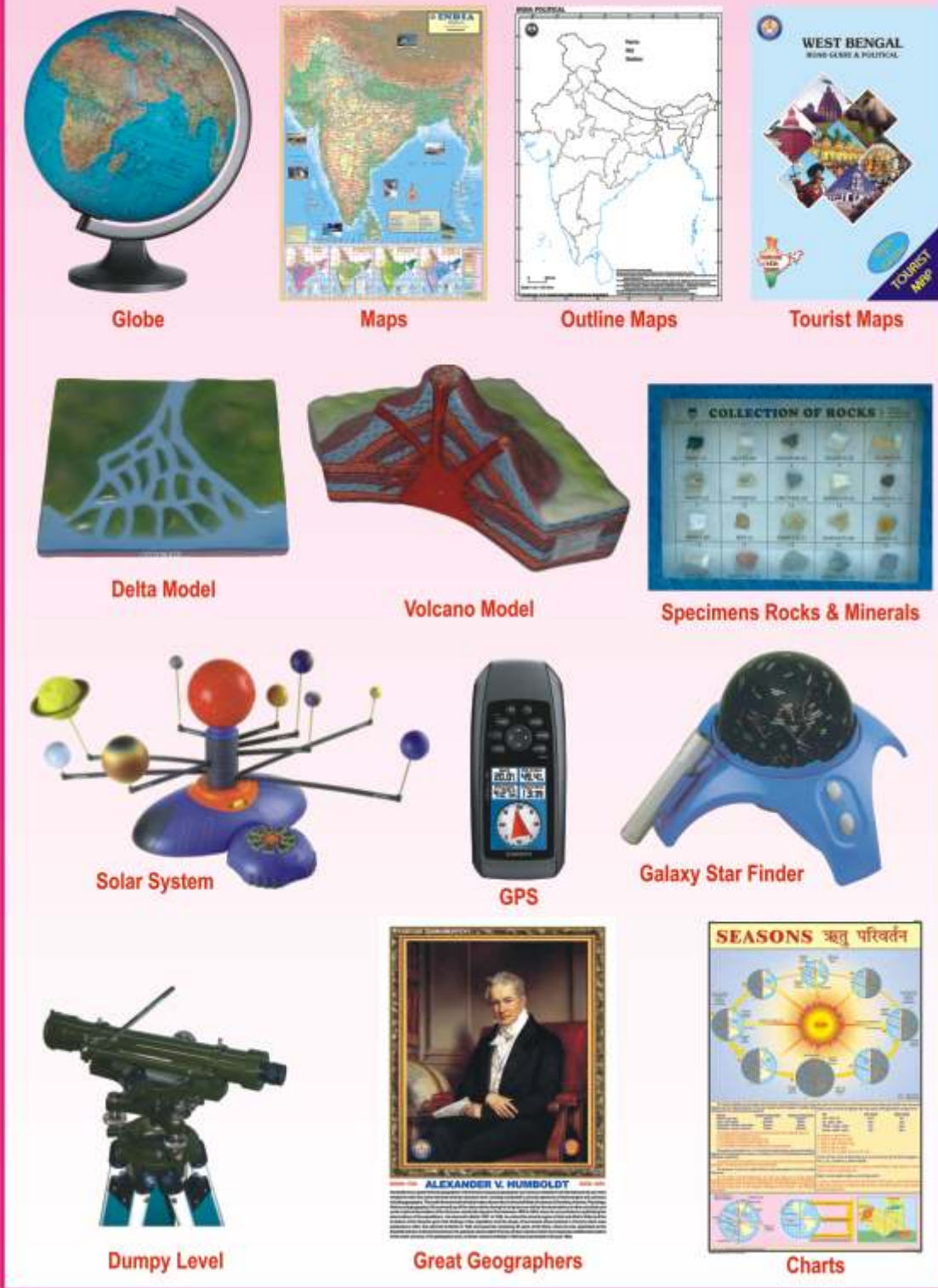
Edison was the seventh child of Samuel Edison who managed to escape against a plan to overthrow Canadian Governor and ended in Milan, Ohio with the help of a large captain, Mrs. Bradley. He was born on 11th February, 1847. His father was born and named Thomas Alva Edison in honor of the captain. He was brought up in Milan and most of his fortune was provided by the mother. He received only three months school education.

He was born to be an inventor. In 1863, he patented his first invention - an electric vote-counter. One day he found that he was working with Western Union Telegraph in Boston which he joined in 1862 as a telegraph operator. Bored with Boston, he moved to New York. He got his first success there with a tape machine called 'Tape' which communicated stock exchange prices across the country. The amount of \$ 30,000. He got his selling his invention to Gold and Stock Telegraph Company, who used to set up an industrial research laboratory in 1869 in Newark, New Jersey.

In 1871, he married Mary Stilwell. He turned his attention then to telegraphy. In 1876 he patented his first telegraph system but it proved less commercially successful than Bell's invention. He then invented carbon pencil telegraph and made a large amount of money. He moved to Menlo Park, a small village in New Jersey and set up his laboratory which remained the center for his research. In 1877, he invented the phonograph - a musical instrument. In October, 1879 he obtained a patent of light-bulb in Menlo Park. He was an inveterate traveler. In 1880 he met Joseph Wilson Swan, inventor of the Edison and Swan United Illuminating Company Ltd. to get commercial benefits of his discovery.

In 1889 Mary died of typhoid. In 1890, he got with an idea of serving pictures and developed a high-speed camera and cinematograph. In 1895, he invented Kinetograph and named it Kinetograph. In his last days, he spent most of his time in developing his own power plant in West Orange, New Jersey. He died on 18th October, 1931 in West Orange.

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### FN01 : Our Food

#### OUR FOOD हमारा भोजन

**BALANCED DIET**  
 Diet which contains all the nutrients in proper amounts to help in normal growth and development.  
 सही मात्रा में सभी पोषक तत्वों को एक साथ रखने वाला भोजन है।

**COMPONENTS OF FOOD**  
 कार्बोहाइड्रेट्स, प्रोटीन, वसा, शर्करा, खनिज, वीटामिन, जल, फाइबर

**FUNCTIONS OF FOOD**  
 1. Energy  
 2. Growth  
 3. Repair  
 4. Protection

**FOOD PYRAMID**  
 पात, दूध आदि (1-2 सर्विसेस)  
 दूध आदि (1-2 सर्विसेस)  
 सब्जियाँ (3-4 सर्विसेस)  
 फलों (3-4 सर्विसेस)  
 अनाज (4-5 सर्विसेस)  
 तेल, घी आदि (1-2 सर्विसेस)

**TABLE SHOWING DAILY REQUIREMENT OF NUTRIENTS**

Nutrient	Male (15-18)	Male (19-30)	Male (31-50)	Male (51-70)	Female (15-18)	Female (19-30)	Female (31-50)	Female (51-70)
Energy (kcal)	2800	3000	2800	2400	2200	2400	2200	1800
Protein (g)	55	60	55	45	45	50	45	35
Carbohydrate (g)	375	400	375	300	300	325	300	225
Fat (g)	65	70	65	55	55	60	55	40
Vitamin A (IU)	5000	5000	5000	4000	4000	4000	4000	3000
Vitamin B1 (mg)	1.5	1.5	1.5	1.2	1.2	1.2	1.2	0.9
Vitamin B2 (mg)	1.3	1.3	1.3	1.0	1.0	1.0	1.0	0.7
Vitamin B3 (mg)	17	17	17	14	14	14	14	10
Vitamin B6 (mg)	1.7	1.7	1.7	1.3	1.3	1.3	1.3	0.9
Vitamin C (mg)	90	90	90	75	75	75	75	60
Vitamin D (IU)	400	400	400	400	400	400	400	400
Calcium (mg)	1000	1000	1000	1000	1000	1000	1000	1000
Iron (mg)	10	10	10	8	8	8	8	6
Zinc (mg)	10	10	10	8	8	8	8	6

### FN02 : Proteins

#### PROTEINS प्रोटीन

**Plant Sources (Vegetarian)**  
 सोयाबीन, दालें, अनाज, सब्जियाँ, फलियाँ

**Animal Sources (Non-vegetarian)**  
 दूध, अंडे, मांस, मछली

**FUNCTIONS OF PROTEINS**  
 1. Growth  
 2. Repair  
 3. Enzymes  
 4. Hormones  
 5. Antibodies

**SPECIAL HIGH PROTEIN NEEDS**  
 1. Growing children  
 2. Pregnant women  
 3. Lactating women  
 4. Athletes  
 5. Elderly people

### FN03 : Fats

#### FATS वसा

**CLASSIFICATION OF FATS**  
 Saturated (Animal)  
 Unsaturated (Plant)  
 Monounsaturated  
 Polyunsaturated

**ESSENTIAL FATTY ACIDS**  
 Omega-3, Omega-6

**SOURCES**  
 दूध, अंडे, घी, तेल, नट्स, बीज

**FUNCTIONS OF FATS**  
 1. Energy  
 2. Insulation  
 3. Protection  
 4. Hormones

### FN04 : Carbohydrates

#### CARBOHYDRATES कार्बोहाइड्रेट्स

**CLASSIFICATION**  
 Simple (Monosaccharides, Disaccharides)  
 Complex (Polysaccharides)

**SOURCES**  
 अनाज, फल, सब्जियाँ, दालें

**FUNCTIONS**  
 1. Energy  
 2. Structural components  
 3. Storage

### FN05 : Vitamins

#### VITAMINS विटामिन

**FAT SOLUBLE**  
 1. Vitamin A  
 2. Vitamin D  
 3. Vitamin E  
 4. Vitamin K

**WATER SOLUBLE**  
 1. Thiamine (B1)  
 2. Riboflavin (B2)  
 3. Niacin (B3)  
 4. Pantoic (B5)  
 5. Pyridoxine (B6)  
 6. Folic Acid (B9)  
 7. Ascorbic Acid (C)

### FN06 : Minerals

#### MINERALS खनिज

**MACRO MINERALS**  
 Calcium, Phosphorus, Magnesium, Sodium, Potassium, Chloride

**TRACE MINERALS**  
 Iron, Zinc, Copper, Iodine, Selenium, Manganese, Fluoride

### FN07 : Water and Roughage

#### WATER AND ROUGHAGE जल और रूखांश

**SOURCES OF WATER**  
 पेयजल, दूध, फल, सब्जियाँ

**SOURCES OF ROUGHAGE**  
 अनाज, सब्जियाँ, फलियाँ

**FUNCTIONS**  
 1. Hydration  
 2. Regulation of body temperature  
 3. Protection of organs

### FN08 : Deficiency Diseases

#### DEFICIENCY DISEASES हीनताजनित रोग

**Malnutrition**  
 1. Kwashiorkor  
 2. Marasmus

**Rickets**  
 1. Vitamin D deficiency

**Scurvy**  
 1. Vitamin C deficiency

**Pellagra**  
 1. Niacin deficiency

**Dental Caries**  
 1. Fluoride deficiency



HC01 : Health Rules

### Health Rules स्वास्थ्य के नियम

1. Take regular bathing  
2. Brush your teeth regularly  
3. Exercise regularly  
4. Eat healthy food  
5. Sleep well  
6. Wash your hands regularly  
7. Avoid junk food  
8. Drink plenty of water  
9. Avoid smoking and drinking  
10. Get regular check-ups  
11. Maintain good hygiene  
12. Avoid stress  
13. Eat fruits and vegetables  
14. Avoid sugary drinks  
15. Get enough sleep  
16. Avoid excessive screen time

HC02 : Causes of Diseases

### Causes of Diseases रोग के कारण

1. Insects (flies, mosquitoes, rats)  
2. Poor diet  
3. Lack of exercise  
4. Bad habits (smoking, drinking)  
5. Poor hygiene  
6. Stress  
7. Genetic factors  
8. Environmental factors  
9. Weakened immune system  
10. Poor sleep  
11. Excessive screen time  
12. Poor air quality  
13. Water pollution  
14. Food contamination  
15. Lack of medical care  
16. Poor mental health

HC03 : Prevention of Diseases

### Prevention of Diseases रोग से बचाव

1. Wear a face mask  
2. Try to stay away from crowded places  
3. Avoid eating street food  
4. Wash hands regularly  
5. Avoid touching your face  
6. Avoid going to crowded places  
7. Avoid sharing personal items  
8. Avoid smoking and drinking  
9. Get vaccinated  
10. Maintain good hygiene  
11. Avoid stress  
12. Get regular check-ups  
13. Avoid excessive screen time  
14. Avoid poor air quality  
15. Avoid water pollution  
16. Avoid food contamination

HC04 : Effects of Alcohol

### Effects of Alcohol मद्य (शराब) के परिणाम

1. Liver damage  
2. Addiction  
3. Social issues  
4. Health problems  
5. Family issues  
6. Financial problems  
7. Legal issues  
8. Physical health problems  
9. Mental health problems  
10. Reduced productivity  
11. Increased risk of accidents  
12. Poor decision making  
13. Loss of control  
14. Increased aggression  
15. Poor judgment  
16. Health and safety issues

HC05 : Tobacco & Other Habit Forming Drugs

### Tobacco & Other Habit Forming Drugs तम्बाकू तथा अन्य मादक पदार्थ

1. Smoking  
2. Drinking  
3. Gambling  
4. Drug use  
5. Addiction  
6. Withdrawal symptoms  
7. Cravings  
8. Relapse  
9. Health problems  
10. Social issues  
11. Financial problems  
12. Legal issues  
13. Physical health problems  
14. Mental health problems  
15. Reduced productivity  
16. Increased risk of accidents

HC06 : Clean Body

### Clean Body स्वच्छ शरीर

1. Bathing  
2. Brushing teeth  
3. Wearing clean clothes  
4. Washing hands  
5. Using hand sanitizer  
6. Avoiding public places  
7. Avoiding crowded places  
8. Avoiding touching surfaces  
9. Avoiding sharing personal items  
10. Avoiding smoking and drinking  
11. Avoiding stress  
12. Get regular check-ups  
13. Avoid excessive screen time  
14. Avoid poor air quality  
15. Avoid water pollution  
16. Avoid food contamination

HC07 : Clean Water

### Clean Water स्वच्छ पानी

1. Boiling water  
2. Using water filters  
3. Avoiding contaminated sources  
4. Using hand sanitizer  
5. Avoiding public places  
6. Avoiding crowded places  
7. Avoiding touching surfaces  
8. Avoiding sharing personal items  
9. Avoiding smoking and drinking  
10. Avoiding stress  
11. Get regular check-ups  
12. Avoid excessive screen time  
13. Avoid poor air quality  
14. Avoid water pollution  
15. Avoid food contamination  
16. Avoid health and safety issues

HC08 : Constituents of Food

### Constituents of Food अन्न के पौष्टिक अंगु

<b>FRESH MEATS</b> Fresh meat, fish, chicken, eggs, etc.	<b>GRAIN IS</b> Wheat, rice, corn, etc.
<b>CARBOHYDRATES</b> Rice, wheat, corn, etc.	<b>FA-TS</b> Butter, oil, ghee, etc.
<b>VITAMINS</b> Vitamin A, B, C, D, E, etc.	<b>जीवन तत्व</b> Vitamin A, B, C, D, E, etc.

1. Vitamin A: Carrots, sweet potatoes, spinach, etc.  
2. Vitamin B: Whole grains, legumes, etc.  
3. Vitamin C: Citrus fruits, bell peppers, etc.  
4. Vitamin D: Fatty fish, fortified milk, etc.  
5. Vitamin E: Nuts, seeds, etc.

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HEALTH CARE SERIES

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# HEALTH CARE SERIES

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**HC09 : Malnutrition**

## Malnutrition कुपोषण

**Kwashiorkor and Marasmus कुपोषण के प्रकार**



**SYMPTOMS लक्षण**

**TREATMENT उपचार**

**SUPPORTIVE CARE सह-उपचार**

**HC10 : Immunization of The Child**

## Immunization of The Child बच्चे का प्रतिरक्षीकरण

**ALL VACCINES ARE AVAILABLE AT THE FREE OF COST FROM THE PRIMARY HEALTH CENTRES, FAMILY WELFARE CENTRES, MUNICIPAL DISPENSARIES, AND GOVERNMENT HEALTH SHOPS.**

**सभी वैक्सीन मुफ्त में उपलब्ध हैं। प्रारंभिक स्वास्थ्य केंद्र, परिवार कल्याण केंद्र, नगर स्वास्थ्य केंद्र, और सरकारी स्वास्थ्य दुकानों पर मुफ्त में उपलब्ध हैं।**

<b>0-6 Weeks 0-6 वर्ष के बच्चे</b>	<b>6 Weeks 6-12 वर्ष के बच्चे</b>	<b>10 Weeks 10 वर्ष के बच्चे</b>
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<b>15-18 Months 15-18 वर्ष के बच्चे</b>	<b>18 Years 18 वर्ष के बच्चे</b>	<b>Adults 18 वर्ष के बच्चे</b>

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**Development of Foetus**

**PLACENTA PRAEVIA**

**PD01 : Cholera हैजा**

**Microscopic view of bowel** अंतर्गुहा का सूक्ष्मदर्शी दृश्य

**CAUSES** कारण

**SYMPTOMS** लक्षण

**TREATMENT** उपचार

**SUPPORTIVE CARE** सह-उपचार

**PD02 : Malaria मलेरिया**

**CAUSES** कारण

**SYMPTOMS** लक्षण

**TREATMENT** उपचार

**SUPPORTIVE CARE** सह-उपचार

**PD03 : AIDS एड्स**

**CAUSES** कारण

**SYMPTOMS** लक्षण

**PRECAUTIONS** सावधानियाँ

**PD04 : Plague प्लेग**

**CAUSES** कारण

**SYMPTOMS** लक्षण

**PREVENTION** बचाव

**TREATMENT** उपचार

**SUPPORTIVE CARE** सह-उपचार

**PD05 : Tuberculosis (T.B.) क्षय रोग (टी.बी.)**

**X-Ray of Human Lung** मानव फेफड़े का एक्स-रे

**CAUSES** कारण

**SYMPTOMS** लक्षण

**TREATMENT** उपचार

**SUPPORTIVE CARE** सह-उपचार

**PD06 : Leprosy कुष्ठ रोग (कोह)**

**CAUSES** कारण

**SYMPTOMS** लक्षण

**TREATMENT** उपचार

**SUPPORTIVE CARE** सह-उपचार

**PD07 : Influenza श्लेष्माज्वर (फ्लू)**

**CAUSES** कारण

**SYMPTOMS** लक्षण

**TREATMENT** उपचार

**SUPPORTIVE CARE** सह-उपचार

**PD08 : Jaundice पीलिया**

**CAUSES** कारण

**SYMPTOMS** लक्षण

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**PD09 : Cancer**

# CANCER कैंसर

**Causes / कारण**

**Symptoms / लक्षण**

**Treatment / उपचार**

**Supportive Care / सह-उपचार**

**PD10 : Typhoid**

# Typhoid मियादी बुखार (टाइफाइड)

**Causes / कारण**

**Symptoms / लक्षण**

**Prevention / बचाव**

**Treatment / उपचार**

**Supportive Care / सह-उपचार**

**PD11 : Viral Diseases**

# Viral Diseases विषाणु संक्रमण

**Causes / कारण**

**Symptoms / लक्षण**

**Treatment / उपचार**

**Supportive Care / सह-उपचार**

**PD12 : Chicken Pox**

# Chicken Pox चेचक

**Causes / कारण**

**Symptoms / लक्षण**

**Treatment / उपचार**

**Supportive Care / सह-उपचार**

**PD13 : Dysentery**

# Dysentery अतिसार

**Causes / कारण**

**Symptoms / लक्षण**

**Treatment / उपचार**

**Supportive Care / सह-उपचार**

**PD14 : Hepatitis**

# Hepatitis हैपेटाइटिस

**Causes / कारण**

**Symptoms / लक्षण**

**Prevention / बचाव**

**Treatment / उपचार**

**Supportive Care / सह-उपचार**

**PD15 : Heart Attack**

# Heart Attack हृदय घात

**Causes / कारण**

**Symptoms / लक्षण**

**Treatment / उपचार**

**Supportive Care / सह-उपचार**

**PD16 : Diabetes**

# Diabetes मधुमेह (शर्करा)

**Causes / कारण**

**Symptoms / लक्षण**

**Treatment / उपचार**

**Supportive Care / सह-उपचार**



**PD17 : Asthma दमा**

**Microscopic view of Lungs** **कंफुओं का सूक्ष्मदर्शी दृश्य**

**CAUSES** **कारण**

**SYMPTOMS** **लक्षण**

**TREATMENT** **उपचार**

**SUPPORTIVE CARE** **सह-उपचार**

**PD18 : Arthritis जोड़ों का दर्द**

**CAUSES** **कारण**

**SYMPTOMS** **लक्षण**

**TREATMENT** **उपचार**

**SUPPORTIVE CARE** **सह-उपचार**

**PD19 : Thyroid थाईरॉयड**

**Thyroidal Disorders and Thyroid Gland**

**SYMPTOMS** **लक्षण**

**TREATMENT** **उपचार**

**SUPPORTIVE CARE** **सह-उपचार**

**PD20 : Blood - Pressure उच्च रक्तचाप**

**Hypertension रक्तचाप**

**A view of Artery Blockage** **रक्तचाप का एक दृश्य**

**CAUSES** **कारण**

**SYMPTOMS** **लक्षण**

**TREATMENT** **उपचार**

**SUPPORTIVE CARE** **सह-उपचार**

**PD21 : Dengue डेंगू**

**CAUSES** **कारण**

**TRANSMISSION** **प्रेषण**

**SYMPTOMS** **लक्षण**

**TREATMENT & SUPPORTIVE CARE** **उपचार व सह-उपचार**

**PREVENTION** **बचाव**

**PD22 : Measles खसरा**

**CAUSES** **कारण**

**SYMPTOMS** **लक्षण**

**COMPLICATIONS** **जटिलताएं**

**TREATMENT & PREVENTION** **उपचार व बचाव**

**PD23 : Food Poisoning खाद्य विषाक्तता**

**CAUSES** **कारण**

**SYMPTOMS** **लक्षण**

**TREATMENT & SUPPORTIVE CARE** **उपचार व सह-उपचार**

**PREVENTION** **बचाव**

**PD24 : Poliomyelitis (Polio) पोलियो मेरुजन्तुशोथ**

**POLIOMYELITIS (PCUJ)** **पोलियो मेरुजन्तुशोथ**

**CAUSES** **कारण**

**SYMPTOMS** **लक्षण**

**TREATMENT & SUPPORTIVE CARE** **उपचार व सह-उपचार**

### AS01S : HIV

## HIV

**Structure of HIV**

**Mechanism of infection by human immunodeficiency virus**

### AS02S : Transmission of HIV

## Transmission of HIV

HIV is transmitted to only a few specific ways. The virus is not highly contagious. Transmission occurs only when blood or certain other body fluids from infected person enter another person's body. Various means of transmission are:

- Unprotected vaginal sex
- Unprotected anal sex
- Unprotected oral sex
- Sharing needles during drug abuse.
- Transfusion of HIV infected blood.
- Breast feeding by HIV infected mother.
- Infants born to HIV infected mothers.
- Using improper sterilized hospital tools.
- Transplantation of infected organs.

### AS03S : Prevention

## PREVENTION

HIV, although lethal, does not spread as readily as the flu viruses or cold viruses. Individual can protect themselves from AIDS by adopting various preventive measures.

- Practice safer sex. Use condoms.
- Never share needles. Always use sterile needles.
- Avoid multiple sexual partners.
- HIV infected mothers should feed their baby formula milk instead of breast feeding.
- Drug treatment for HIV infected mothers during pregnancy.
- Delivering infant by cesarean section if mother is HIV infected.

### AS04S : How AIDS is not Transmitted

## HOW AIDS IS NOT TRANSMITTED

AIDS patients often face various types of discriminations because of several misconceptions widespread in the society. Also, these misconceptions unnecessarily create confusions in the minds of people. Therefore, everyone should have an accurate information about AIDS.

- AIDS is not caused by mosquito/blood bite.
- AIDS is not caused by touching or hugging.
- AIDS is not caused by hand shaking.
- AIDS is not caused by studying with HIV positive.
- AIDS is not caused by sharing public toilets.
- AIDS is not caused by working with HIV positive.
- AIDS is not caused by sneezing or coughing.
- AIDS is not caused by sharing food.

### AS05S : Progress of Infection

## PROGRESS OF INFECTION

AIDS PROGRESSES THROUGH THREE DISTINCT PHASES:- ACUTE PHASE, CHRONIC PHASE AND FULL BLOWN AIDS.

- 1. ACUTE PHASE**
  - HIV enters the body and begins reproducing itself.
  - T4-cell count is high.
  - The number of viruses rises rapidly.
  - Antibodies to HIV begin to increase.
  - Most patients show no symptoms during the first few months after infection. A few may exhibit symptoms similar to those of infectious mononucleosis - fever, chills, aches and swollen lymph nodes. However these symptoms vanish shortly thereafter.
- 2. CHRONIC PHASE**
  - T4 cell count begins to fall.
  - Antibody levels rise initially and then fall.
  - Patients begin to show outward signs - fatigue, unexplained persistent fever, persistent cough, loss of memory, depression, diarrhea, difficulty in thinking and unexplained weight loss.
- 3. FULL-BLOWN PHASE**
  - AIDS has been defined as occurring in a person who:
    - has a laboratory documented HIV infection.
    - has a CD4 count less than 200 cells per ml of blood.
    - has had one or more infections that wouldn't normally occur in a person with a healthy immune system.
  - Persistent infections, some loss of weight and weakness.
  - Infections that normally are not capable of producing serious infections, take hold and become life-threatening.

### AS06S : Opportunistic Diseases

## OPPORTUNISTIC DISEASES

Multiple infections and cancer may develop because of the disturbed immune response. Many of these infections are highly unusual in people with healthy immune systems. They are called opportunistic infections because they take advantage of a weakened immune system due to AIDS.

- KAPOSI'S SARCOMA
- CANDIDIASIS
- PNEUMOCYSTIS CARINII
- LYMPHOMAS
- CMV-INFECTION
- HERPES SIMPLEX INFECTION

### AS07S : Sexually Transmitted Diseases

## Sexually Transmitted Diseases

Individuals who are infected with STDs are more prone to acquire HIV than uninfected individuals when they are exposed to the virus through sexual contact. Also, an HIV-infected individual if also infected with another STD, is more likely to transmit HIV through sexual contact than other HIV-infected persons. Thus, presence of other STDs increases the likelihood of both transmitting and acquiring HIV.

- Syphilis
- Gonorrhoea
- Trichomoniasis
- Chlamydia
- Chancroid
- Genital Herpes

### HP26S : Human Immune System

## HUMAN IMMUNE SYSTEM

**ORGANS OF THE IMMUNE SYSTEM**

**THE IMMUNE RESPONSE**

**DIFFERENTIATION OF LEUCOCYTES FROM A SINGLE STEM CELL**



FA09 : Electric Shock And Treatment

## ELECTRIC SHOCK AND TREATMENT

**INSIDE THE HOUSE**

**OUTSIDE THE HOUSE**

**Effects of Shock**

1. Paralysis of voluntary muscles
2. Loss of consciousness
3. Loss of reflexes
4. Breathing stops
5. Stopping of blood circulation
6. Injury to internal organs

**First Aid**

1. Do not touch the victim
2. Call for help
3. Lay the victim on a non-conducting surface
4. Do not touch the victim's body
5. Give artificial respiration
6. Do not touch the victim's body

**ARTIFICIAL RESPIRATION**

**CONTACT IN EMERGENCY :**

FA10 : Emergency Resuscitation

## EMERGENCY RESUSCITATION

**Mouth-to-Mouth Rescue Breathing**

**Step 1**

**Step 2**

**Step 3**

**Step 4**

**Cardiac Compressions**

FA11 : Removal of Foreign Bodies

## REMOVAL OF FOREIGN BODIES

Foreign bodies of all kinds can become lodged in body parts or orifices and may cause injury, bleeding, infection, discomfort and other problems. Foreign bodies must be removed safely and clearly.

**FOREIGN BODY IN THE EYE**

**FOREIGN BODY IN THE EAR**

**FOREIGN BODY IN THE NOSE**

**GLASS PICE IN THE SKIN**

**FOREIGN BODY BLOCKING AIRWAY (CHOKING)**

FA12 : Burns & Scalds

## Burns & Scalds

A major priority in all burn cases is to cool the skin and cover the burn to prevent infection. Remove anything that is stuck to the burn. Do not burst any blisters. In case of chemical burn do not try to neutralize the chemical.

FA13 : Snakes & Their Bites

## Snakes & Their Bites

**Morphology of poisonous Snake**

**Coral Snake**, **Black-necked Viper**, **Eastern Green Mamba**, **Cobra**

**First Aid:**

FA14 : Poisons & Their Antidotes

## POISONS & THEIR ANTIDOTES

A poison is a substance capable of injuring & killing a person. An antidote is an agent which counter acts a poison. An antidote for an acid is an alkali & for an alkali is an acid.

**POISON MAY ENTER BODY THROUGH MOUTH, NOSE OR SKIN. FOR PROPER TREATMENT TRY TO FIND OUT THE POISON TAKEN**

Poisons	Symptoms	Treatment
<b>ACIDS</b> Hydrochloric, Sulphuric or Sulfuric acid	Reddening, stinging, burning sensation in the throat, head and upper abdominal pain, vomiting yellow or grey saliva, skin, if vomiting stops, there will be after-effects on vomiting in contact with acid.	No vomiting should be induced. Give plenty of water to dilute the acid. If possible, add two spoonfuls of weak alkali such as soda or milk of magnesia or plaster of Paris wash to a pint of water.
<b>ALKALIS</b> Lye, Caustic Soda, Ammonia, Carbolic Soda, Potash	Stings on skin. If it reaches the face there will not be any after-effects on vomiting in contact with alkali.	Vomiting should not be induced. Give plenty of water to dilute the alkali. If possible, add two spoonfuls of weak acid, lemon or lime juice to a pint of water.
<b>DISINFECTANTS</b> Carbolic acid, Phenol, Lysol, Dettol, Bleach, Cresololol	Stings on skin. If it reaches the face there will not be any after-effects on vomiting in contact with alkali.	Do not make the casualty vomit. Give two spoonfuls of weak acid to a pint of water or to a large mug full of medicinal paraffin.
<b>ALCOHOL</b> Ethyl, Methylated spirit, other strong liquors	Same as above.	Give tea or coffee on any vomiting stop. Give heat to the feet and wash to the head. Induce vomiting by giving few spoonfuls of vomit until the water is clear or by taking the back of the hand.
<b>CARBON MONOXIDE</b> Carbon monoxide, carbon dioxide, carbon tetrachloride, phosphorus, arsenic, cyanide, lead, strychnine, etc.	Headache, dizziness, weakness, loss of consciousness, vomiting, etc.	Immediately remove the casualty from the place. Remove free passage of air. Apply artificial respiration and oxygen.
<b>ARSENIC</b> Potassium arsenite, arsenic trioxide	Liver and face are black, contraction of pupils and stupor afterwards.	Give some arsenic to induce vomiting and give water, coffee, lemon juice, milk, etc. Give one spoon of potassium permanganate solution to induce vomiting.
<b>CHLORAL</b> Chloral hydrate, chloroform, opium, etc.	Coma and heart weakness.	Give some arsenic to induce vomiting. Keep the casualty awake. Give one spoon of arsenic or potassium permanganate solution to induce vomiting.
<b>HYDROFLUORIC ACID</b> Concentrated hydrofluoric acid	Swelling of throat, difficulty in breathing, etc.	Give some arsenic to induce vomiting. Give white of egg in water followed by milk, hot water or alcohol. Give few spoonfuls of potassium permanganate solution to induce vomiting.
<b>PHOSPHORIC ACID</b> Concentrated phosphoric acid	Swelling of throat, difficulty in breathing, etc.	It is an emergency. Induce vomiting. Give artificial respiration. Repeat the above steps.
<b>STRYCHNINE &amp; Strychnine salts</b>	No effect.	Induce vomiting, unless spasms have begun. Keep very quiet. Do not keep the casualty lying down. Give artificial respiration.
<b>URTICARIA</b> Canned goods, etc.	Swelling of throat, difficulty in breathing, etc.	Induce vomiting. Keep the casualty awake. Give an emetic. Repeat the above steps. Give water or milk. Rub the skin with oil.

FA15 : First Aid & Appliances

## FIRST AID & APPLIANCES

**FIRST AID LEARNING IS A CIVIC RESPONSIBILITY OF EVERY CITIZEN.**

**FIRST AID** is to preserve life and assist the casualty in recovery until doctor is available.











**FIRST AIDER** is a person qualified to give first aid.

**PRIORITY OF TREATMENT**

1. Immediate response to call for assistance.
2. Proper examination & diagnosis.
3. Control of bleeding, if necessary give cardio-respiratory resuscitation.
4. Treat shock with care of unconsciousness.
5. Fracture immobilization.
6. Eye, Ear, Nose injuries, burns, etc.
7. Arrange transport for the injured to hospital or to his home.
8. Assure the casualty of good treatment.

**ESSENTIAL ITEMS FOR FIRST AID**

## SHUDDHI KRIYAS (SHAT KARMAS)

 <p><b>Kunjal (Vaman Dhauti)</b> Sit in Utkatasana and drink 4-6 glasses of lukewarm salty water. Bend forward. Touch the uvula by two fingers and do Uddiyan Bandha. Throw out all the water through the mouth.</p>	 <p><b>Kapal Bhati</b> Exhale forcefully through the nose, turning the neck left and right, up and down. Repeat it 10 times. Do it after Jalneti also. Brain is cleaned, intelligence develops.</p>
 <p><b>Jal Neti</b> Take salty lukewarm water in a spout lota (vessel). Tilt it to let water enter into one nostril and come out through the other.</p>	 <p><b>Sutra Neti</b> After wetting the sutra (string), insert its thin end in one nostril. When it touches the inner throat, draw it out from mouth with two fingers. Repeat this exercise through other nostril also.</p>
 <p><b>Ghrit Neti</b> Drop 3-4 drops of ghee (Clarified butter) in both nostrils before going to sleep.</p>	
 <p><b>Vastra Dhauti</b> Keep wet dhauti's end on the last portion of the tongue and take it inside slowly. Keep a bit outside. Take out the vastra (muslin cloth) after Nauli/Uddiyan Bandha. Drink water if needed.</p>	 <p><b>Dand Dhauti</b> Fill the stomach with normal water. Insert Dand Dhauti (rubber tube about one foot) in the mouth. Vomiting may happen. Take it out after doing Nauli or Uddiyan Bandha.</p>
 <p><b>Nauli Karma</b> First practice Uddiyan Bandha. Do middle Nauli, after that left &amp; right and rotate right-left and left-right also many times.</p>	 <p><b>Basti (enema)</b> Fill the enema pot with water. Put nozzle in anus to get the water in. Retain water for some time and go for latrine.</p>
 <p><b>Tratak</b> Gaze at a bright point for 1 to 5 minutes. When water comes in eyes close them and do palming. Wash eyes with water.</p>	
<p><b>Benefits</b></p> <ol style="list-style-type: none"> <li>1. Kunjal, Dand Dhauti &amp; Vastra Dhauti: These remove the ailments of ulcer, blood, vatt (air), pitt (fire), kaff (water), skin diseases, constipation, asthma, dyspepsia, gas, blindness, anaemia. Remove heartburn and develop the appetite.</li> <li>2. Neties: Ghrit Neti lubricates the nose, helps in sleep and to remove the mental dryness. Other netis are helpful in ear, nose, throat weaknesses, headache, sinus problems.</li> <li>3. Nauli, Basti: Diseases related to stomach, kidney, urinary bladder and anus are removed.</li> <li>4. Tratak — Develops concentration, will power and eyesight.</li> </ol>	





## SHANKH PRAKSHALAN

 <p><b>Kanyasha</b> Do in Kanyasha. Drink one glass lukewarm water.</p>	 <p><b>Uddiyan</b> Stand erect. Inhale. Hold the breath on chest. Breathe and stretch the neck up. Hold. Hold the neck up. Repeat 10 times.</p>	 <p><b>Tiryak Tadasana</b> Stand erect. Inhale. Stretch the arms &amp; neck to the right. Hold. Hold the neck to the right. Repeat 10 times.</p>	 <p><b>Tiryak Bhujangasana</b> Cater to your body or parts. Breathe. Look up. Hold. Hold the neck up. Repeat 10 times.</p>
 <p><b>Urdhva Dhanurasana</b> Do in Urdhva. Hold the hands on the heels. Arch the back. Hold. Hold the neck up. Repeat 10 times.</p>	 <p><b>Matsya</b> Lie on your back. Arch the back. Look up. Hold. Hold the neck up. Repeat 10 times.</p>	 <p><b>Nauli Karma</b> Do in Nauli. Hold the hands on the knees. Arch the back. Hold. Hold the neck up. Repeat 10 times.</p>	 <p><b>Shankh Prakshalan</b> Do in Shankh. Hold the hands on the knees. Arch the back. Hold. Hold the neck up. Repeat 10 times.</p>




## YOG MUDRAS, PADMASAN & MATSYASAN

<p><b>FIVE FINGERS DENOTE FIVE ELEMENTS</b></p>  <p>1. Thumb - Earth 2. Index - Water 3. Middle - Fire 4. Ring - Air 5. Little - Ether</p>	<p><b>YOGA MUDRA</b></p>  <p>1. Sit in Padmasana. Hold your right wrist with left hand. 2. Bend forward. Slowly exhale. Touch the forehead to the ground. 3. Hold the hands joined. Breathe normal, some time. Release hands and sit normally.</p>
<p><b>PADMASAN</b></p>  <p>1. Sit. Legs stretched out in front. Palm on knees. Breathe normal. 2. Bend right knee. Each leg toe with left hand &amp; side with right hand. Draw inward. Breathe normal.</p>	<p><b>MATSYASAN</b></p>  <p>1. Sit in Padmasana. Hold the right leg with left hand. Bend it on ground. Breathe normal. 2. With help of hands turn legs backward and place it on earth. Keep the chest up. Breathe normal. 3. Hold the right leg with left hand and left leg with right hand. Bend it on ground. Breathe normal. Release hands. Repeat 10 times.</p>

## SURYA NAMASKAR

 <p><b>Surya Namaskar 1</b> Stand erect. Inhale. Stretch the arms &amp; neck to the right. Hold. Hold the neck to the right. Repeat 10 times.</p>	 <p><b>Surya Namaskar 2</b> Stand erect. Inhale. Stretch the arms &amp; neck to the left. Hold. Hold the neck to the left. Repeat 10 times.</p>
 <p><b>Surya Namaskar 3</b> Stand erect. Inhale. Stretch the arms &amp; neck to the right. Hold. Hold the neck to the right. Repeat 10 times.</p>	 <p><b>Surya Namaskar 4</b> Stand erect. Inhale. Stretch the arms &amp; neck to the left. Hold. Hold the neck to the left. Repeat 10 times.</p>
<p><b>Benefits of Surya Namaskar</b></p> <p>1. It is a very effective exercise. It makes the body healthy and active. It is a very good exercise for the heart and lungs. It is a very good exercise for the stomach and intestines. It is a very good exercise for the brain and nerves. It is a very good exercise for the eyes and ears. It is a very good exercise for the skin and hair. It is a very good exercise for the bones and joints. It is a very good exercise for the muscles and tendons. It is a very good exercise for the blood and circulation. It is a very good exercise for the energy and vitality. It is a very good exercise for the overall health and well-being.</p>	

## PASCHIMOTTANASAN - ARDHMATSYENDRASAN

<p><b>PASCHIMOTTANASAN</b></p>  <p>1. Sit with legs stretched. Toe stretched. Keep hands on knees. 2. Bend forward. Slowly exhale. Touch the forehead to the ground. 3. Hold the hands joined. Breathe normal, some time. Release hands and sit normally.</p>	<p><b>ARDHMATSYENDRASAN</b></p>  <p>1. Sit with stretched legs. 2. Bend left leg and right. Place the left leg on outer side of the right leg. Place the right leg on inner side of the left leg. Hold the left knee with right hand and left knee with right hand. 3. Press the left thigh with the left hand. Circle. Press right elbow on left knee. 4. Inhale. Bring the hands over head in stretched position. Also stretch the body upwards.</p>
<p><b>Matsyasan</b></p>  <p>1. Sit in Padmasana. Hold the right leg with left hand. Bend it on ground. Breathe normal. 2. With help of hands turn legs backward and place it on earth. Keep the chest up. Breathe normal. 3. Hold the right leg with left hand and left leg with right hand. Bend it on ground. Breathe normal. Release hands. Repeat 10 times.</p>	<p><b>Benefits</b></p> <p>1. It is a very effective exercise. It makes the body healthy and active. It is a very good exercise for the heart and lungs. It is a very good exercise for the stomach and intestines. It is a very good exercise for the brain and nerves. It is a very good exercise for the eyes and ears. It is a very good exercise for the skin and hair. It is a very good exercise for the bones and joints. It is a very good exercise for the muscles and tendons. It is a very good exercise for the blood and circulation. It is a very good exercise for the energy and vitality. It is a very good exercise for the overall health and well-being.</p>

**CHARTS ON YOGA**  
 A set of 12 charts, Size 50 x 75 cm  
 Laminated, (Available in English Only and also in English-Hindi Combined)

### YO06 : Vajrasan, Ushtrasan & Suptavajrasan

#### VAJRASAN, USHTRASAN & SUPTAVAJRASAN

<p><b>Vajrasan</b></p> <p>Step-1 Sit on your heels. Sit on the ground. Catch the ankles behind the knees. Feet are touching.</p> <p>Step-2 Bend both the legs behind. Feet close together. Head down. Neck straight. Forehead touching the knees. Hands on the thighs. Sit on the heels. Keep the spine &amp; neck erect.</p> <p>Step-3 Sit in Vajrasan. Bend on knees. Open up the feet &amp; sit down. Nipples on the knees.</p> <p>Step-4 Catch the ankles. Put the elbows on the ground. Bend backward. Keep the knees together.</p> <p>Step-5 Put the head on the ground and palms on the thighs. Hold steady. Stay for some time. Breathe normally.</p> <p>Step-6 Place the hands on the floor and lower the head as much as possible. This is the final posture. Rise, inhale and come back.</p> <p>Step-7 Put hands and keep the arms under the head. Raise the body. Take normal breathing. Come back by taking 3 s-lings.</p> <p><b>Benefits</b>-It removes cervical and hip disc defects, assists diseases of abdomen and back, rheumatoid disorders, rheumatoid arthritis, obesity, it strengthens the heart, throat, spleen, lungs, back and male reproductive system. It is a good pose for relaxation. It is -Anabolic pregnancy.</p>	<p><b>Suptavajrasan</b></p> <p>Step-1 Lie flat on your abdomen. Feet stretched out. Forehead on the ground, hands placed by the sides of the chest with elbows bent.</p> <p>Step-2 Lie on your stomach. Chin on the ground. Catch the ankles behind the knees. Feet are touching.</p> <p>Step-3 Inhale and exhale 10 times. Relax and hold still.</p> <p>Step-4 Curl up and raise the knees. Inhale and take the chest up. Stretch legs and hands up as much as possible. Only head should be on the ground. Stay a bit then come back slowly while exhaling.</p> <p>Step-5 Slowly raise the body up to the level of abdomen. Concentrate on the spine. Reverse the movement slowly and gently.</p> <p>Step-6 Place one leg towards left while exhaling. Come back slowly while exhaling. Repeat the process with the other leg. It is Anahar Mudrasana.</p> <p>Step-7 Inhale. Pressing on the palms, raise both legs as much as you can without bending. Come back slowly while exhaling. It is Bhujangasana. Do 10 repetitions.</p> <p>Step-8 Inhale. Making balance on hands, raise both legs together. Body should be straight and horizontal. Stay for 2-3 seconds and come back with exhalation.</p> <p>Step-9 Inhale. Making balance on hands, raise both legs together. Body should be straight and horizontal. Stay for 2-3 seconds and come back with exhalation.</p> <p>Step-10 Inhale. Making balance on hands, raise both legs together. Body should be straight and horizontal. Stay for 2-3 seconds and come back with exhalation.</p> <p><b>Benefits</b>-The spine flexes. Backache, discoloration and disc is prevented. Improves the functions of lungs, liver, pancreas, stomach, spleen and intestines. Legs become strong and well-proportioned.</p>
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### YO07 : Bhujangasan, Shalbhaskan, Dhanurasan & Mayurasan

#### BHUJANGASAN, SHALBHASKAN, DHANURASAN & MAYURASAN

<p><b>Bhujangasan</b></p> <p>Step-1 Lie flat on your abdomen. Chin on the ground. Catch the ankles behind the knees. Feet are touching.</p> <p>Step-2 Inhale and exhale 10 times. Relax and hold still.</p> <p>Step-3 Curl up and raise the knees. Inhale and take the chest up. Stretch legs and hands up as much as possible. Only head should be on the ground. Stay a bit then come back slowly while exhaling.</p> <p>Step-4 Slowly raise the body up to the level of abdomen. Concentrate on the spine. Reverse the movement slowly and gently.</p> <p>Step-5 Place one leg towards left while exhaling. Come back slowly while exhaling. Repeat the process with the other leg. It is Anahar Mudrasana.</p> <p>Step-6 Inhale. Pressing on the palms, raise both legs as much as you can without bending. Come back slowly while exhaling. It is Bhujangasana. Do 10 repetitions.</p> <p>Step-7 Inhale. Making balance on hands, raise both legs together. Body should be straight and horizontal. Stay for 2-3 seconds and come back with exhalation.</p> <p>Step-8 Inhale. Making balance on hands, raise both legs together. Body should be straight and horizontal. Stay for 2-3 seconds and come back with exhalation.</p> <p>Step-9 Inhale. Making balance on hands, raise both legs together. Body should be straight and horizontal. Stay for 2-3 seconds and come back with exhalation.</p> <p><b>Benefits</b>-The spine flexes. Backache, discoloration and disc is prevented. Improves the functions of lungs, liver, pancreas, stomach, spleen and intestines. Legs become strong and well-proportioned.</p>	<p><b>Dhanurasan</b></p> <p>Step-1 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-2 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-3 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-4 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-5 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-6 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-7 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-8 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-9 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-10 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p><b>Benefits</b>-The abdominal organs, digestion, the spleen, colon, nervous system &amp; muscles become strong. Removes gastro-intestinal disorders. It aids cancer &amp; other cancers. It is irregularities of menstrual cycle and urinary ailments. Note: Hypertension, blood pressure, hernia, heart disease etc. Note: Hypertension, blood pressure, hernia, heart disease etc.</p>
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### YO08 : Pawan Muktasan & Chakrasan

#### PAWAN MUKTASAN & CHAKRASAN

<p><b>Pawan Muktasan</b></p> <p>Step-1 Lie on your back. Bend the left knee and place on the chest. Inhale &amp; try to press the leg firmly on the chest with both hands.</p> <p>Step-2 Inhale and touch the chest with knees. Inhale and come back.</p> <p>Step-3 Lie on your back. Bend the right knee and place on the chest. Exhale and touch the knee with chest &amp; continue.</p> <p>Step-4 Lie on your back. Bend the right knee and place on the chest. Exhale and touch the knee with chest &amp; continue.</p> <p>Step-5 Lie on your back. Bend the right knee and place on the chest. Exhale and touch the knee with chest &amp; continue.</p> <p>Step-6 Lie on your back. Bend the right knee and place on the chest. Exhale and touch the knee with chest &amp; continue.</p> <p>Step-7 Lie on your back. Bend the right knee and place on the chest. Exhale and touch the knee with chest &amp; continue.</p> <p>Step-8 Lie on your back. Bend the right knee and place on the chest. Exhale and touch the knee with chest &amp; continue.</p> <p>Step-9 Lie on your back. Bend the right knee and place on the chest. Exhale and touch the knee with chest &amp; continue.</p> <p>Step-10 Lie on your back. Bend the right knee and place on the chest. Exhale and touch the knee with chest &amp; continue.</p> <p><b>Benefits</b>-It helps the spine along and flexible, improves strength, bearing stress, back &amp; rheumatoid arthritis. It is a good pose for relaxation. It is -Anabolic pregnancy.</p>	<p><b>Chakrasan</b></p> <p>Step-1 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-2 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-3 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-4 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-5 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-6 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-7 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-8 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-9 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p>Step-10 Lie on your back. Bend the knees. Arms along the body. Palms on the ground. Breathe normal.</p> <p><b>Benefits</b>-It helps the spine along and flexible, improves strength, bearing stress, back &amp; rheumatoid arthritis. It is a good pose for relaxation. It is -Anabolic pregnancy.</p>
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### YO09 : Sarvangasan & Halasan

#### SARVANGASAN & HALASAN

<p><b>Sarvangasan</b></p> <p>Step-1 Lie on your back. Keep the arms on the sides of body. Palms on the ground &amp; legs together stretching out. Breathe normal.</p> <p>Step-2 Lie on your back. Keep the arms on the sides of body. Palms on the ground &amp; legs together stretching out. Breathe normal.</p> <p>Step-3 Lie on your back. Keep the arms on the sides of body. Palms on the ground &amp; legs together stretching out. Breathe normal.</p> <p>Step-4 Lie on your back. Keep the arms on the sides of body. Palms on the ground &amp; legs together stretching out. Breathe normal.</p> <p>Step-5 Lie on your back. Keep the arms on the sides of body. Palms on the ground &amp; legs together stretching out. Breathe normal.</p> <p>Step-6 Lie on your back. Keep the arms on the sides of body. Palms on the ground &amp; legs together stretching out. Breathe normal.</p> <p>Step-7 Lie on your back. Keep the arms on the sides of body. Palms on the ground &amp; legs together stretching out. Breathe normal.</p> <p>Step-8 Lie on your back. Keep the arms on the sides of body. Palms on the ground &amp; legs together stretching out. Breathe normal.</p> <p>Step-9 Lie on your back. Keep the arms on the sides of body. Palms on the ground &amp; legs together stretching out. Breathe normal.</p> <p>Step-10 Lie on your back. Keep the arms on the sides of body. Palms on the ground &amp; legs together stretching out. Breathe normal.</p> <p><b>Benefits</b>-Sarvangasana Good in insomnia, rheumatoid, hernia, backache, thyroid, improves memory, blood circulation, digestion, Marjara pranayama. Do not do it right blood pressure, neural and hip disc.</p>	<p><b>Halasan</b></p> <p>Step-1 Lie flat on the back. Arms by the sides. Feet towards ground. Feet stretched. Breathe normally.</p> <p>Step-2 Lie flat on the back. Arms by the sides. Feet towards ground. Feet stretched. Breathe normally.</p> <p>Step-3 Lie flat on the back. Arms by the sides. Feet towards ground. Feet stretched. Breathe normally.</p> <p>Step-4 Lie flat on the back. Arms by the sides. Feet towards ground. Feet stretched. Breathe normally.</p> <p>Step-5 Lie flat on the back. Arms by the sides. Feet towards ground. Feet stretched. Breathe normally.</p> <p>Step-6 Lie flat on the back. Arms by the sides. Feet towards ground. Feet stretched. Breathe normally.</p> <p>Step-7 Lie flat on the back. Arms by the sides. Feet towards ground. Feet stretched. Breathe normally.</p> <p>Step-8 Lie flat on the back. Arms by the sides. Feet towards ground. Feet stretched. Breathe normally.</p> <p>Step-9 Lie flat on the back. Arms by the sides. Feet towards ground. Feet stretched. Breathe normally.</p> <p>Step-10 Lie flat on the back. Arms by the sides. Feet towards ground. Feet stretched. Breathe normally.</p> <p><b>Benefits</b>-Halasan Reduces fat, Masses arms &amp; legs, strong, spine flexible, Good for spleen, diabetes, hernia and liver, regulates blood circulation, improves intelligence and memory. Program: weakness, head aches, avoid the sun. Control down heart problems, right/left hand pressure and hip disc.</p>
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### YO10 : Bandh and Pranayam

#### BANDH AND PRANAYAM

<p><b>Bandh</b></p> <p>Uddiyani Bandh, Ushthi Bandh, Ushthi Bandh, Ushthi Bandh</p> <p>Uddiyani Bandh: Sit in any pose. Contract the abdomen for 2 or 3 minutes. It improves digestive system, improves metabolism.</p> <p>Ushthi Bandh: Contract the muscles of throat by pulling chin on the chest. It strengthens the capability of vocal cords &amp; improves the voice. Good for throat.</p> <p>Ushthi Bandh: Contract the muscles of throat by pulling chin on the chest. It strengthens the capability of vocal cords &amp; improves the voice. Good for throat.</p> <p>Ushthi Bandh: Contract the muscles of throat by pulling chin on the chest. It strengthens the capability of vocal cords &amp; improves the voice. Good for throat.</p>	<p><b>Pranayam</b></p> <p>Pranayama, Nadi Shodhan, Kapalabhati, Ushthi Bandh, Ushthi Bandh</p> <p>Pranayama: Inhale through right nostril, exhale through left nostril. Repeat 10 times. It improves respiratory system, improves metabolism.</p> <p>Nadi Shodhan: Inhale through right nostril, exhale through left nostril. Repeat 10 times. It improves respiratory system, improves metabolism.</p> <p>Kapalabhati: Inhale through right nostril, exhale through left nostril. Repeat 10 times. It improves respiratory system, improves metabolism.</p> <p>Ushthi Bandh: Contract the muscles of throat by pulling chin on the chest. It strengthens the capability of vocal cords &amp; improves the voice. Good for throat.</p>
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### YO11 : Spine and Related Organs

#### SPINE AND RELATED ORGANS

<p><b>Changes in the Spine</b></p> <p>Spinal Curvature, Spinal Curvature, Spinal Curvature</p> <p>Spinal Curvature: It is a condition where the spine is not straight. It can be caused by poor posture, injury, or disease. It can lead to back pain and other problems.</p> <p>Spinal Curvature: It is a condition where the spine is not straight. It can be caused by poor posture, injury, or disease. It can lead to back pain and other problems.</p> <p>Spinal Curvature: It is a condition where the spine is not straight. It can be caused by poor posture, injury, or disease. It can lead to back pain and other problems.</p>	<p><b>Benefits of Neck</b></p> <p>Neck Exercises, Neck Exercises, Neck Exercises</p> <p>Neck Exercises: These exercises help to strengthen the neck muscles and improve posture. They can also help to relieve neck pain and stiffness.</p> <p>Neck Exercises: These exercises help to strengthen the neck muscles and improve posture. They can also help to relieve neck pain and stiffness.</p> <p>Neck Exercises: These exercises help to strengthen the neck muscles and improve posture. They can also help to relieve neck pain and stiffness.</p>
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### YO12 : Healthy Eyes

#### HEALTHY EYES

<p><b>Yogic Exercises for Eyesight</b></p> <p>Palming, Trataka, Bhramari, Bhramari</p> <p>Palming: This exercise involves rubbing the palms together to create heat, then placing them over the eyes. It helps to relax the eyes and improve circulation.</p> <p>Trataka: This exercise involves focusing on a single point for a long period of time. It helps to improve concentration and eyesight.</p> <p>Bhramari: This exercise involves humming or making a low sound. It helps to relax the eyes and improve circulation.</p> <p>Bhramari: This exercise involves humming or making a low sound. It helps to relax the eyes and improve circulation.</p>	<p><b>Healthy Eyes</b></p> <p>Healthy Eyes, Healthy Eyes, Healthy Eyes</p> <p>Healthy Eyes: These exercises help to improve eyesight and reduce eye strain. They can also help to prevent eye diseases.</p> <p>Healthy Eyes: These exercises help to improve eyesight and reduce eye strain. They can also help to prevent eye diseases.</p> <p>Healthy Eyes: These exercises help to improve eyesight and reduce eye strain. They can also help to prevent eye diseases.</p>
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**INC01 : Breast Changes in Pregnancy**

# BREAST CHANGES IN PREGNANCY

**Breast Anatomy (Sagittal View)**

- Pectoral muscle
- Rib
- Lung
- Fatty (adipose) and connective tissue
- Blood vessels
- Lobule
- Lactiferous ampulla (sinus)
- Nipple
- Areola
- Lactiferous ducts

During pregnancy, lobules (milk-producing glands) increase in size and number in preparation for breast-feeding the baby. By the end of the first trimester, they can produce colostrum, the yellow fluid that provides antibodies to protect against allergy and respiratory and gastrointestinal infections in the newborn.

**Milk glands in Non-lactating Breast**      **Milk glands in Engorged Breast**

**BREAST CHANGES DURING PREGNANCY**

1. Hormonal changes in pregnancy can cause improved blood flow and some changes in breast tissues. This causes swelling in breasts, soaring, tingling and abnormally sensitive to touch.
2. Breasts start increasing its size at about eight weeks of pregnancy.
3. Skin start stretching, feel itchiness and develop stretch marks.
4. Nipple and areola become darker and bigger.
5. During third months of pregnancy, the colostrum start producing. In last months of pregnancy, breasts will leak a little amount of thick yellowish liquid.
6. The small glands on the surface of the areola called as Montgomery's tubercles become raised bumps.

**Histological changes during Pregnancy**  
During pregnancy, terminal tubules are converted to acinar structures. The lumina are enlarged and connective tissue is compressed. The secretory epithelial cells are now mature.

**12th week of Pregnancy**  
Breast will feel heavier and tender.

**20th week of Pregnancy**  
Nipple and areola became darker and more prominent. Note raised bumps of Montgomery Gland.

**Lactating breast**  
Note bigger areola and somewhat flat nipple due to engorgement.

**INC02 : Uterine Changes During Pregnancy**

# UTERINE CHANGES DURING PREGNANCY

**CHANGES IN THE BODY OF UTERUS:**

1. For 10 weeks the uterus follows its normal upright shape.
2. By 12 weeks the uterus follows the size of an apple.
3. By 12 weeks the uterus undergoes increased vascularity and has become the pear-shaped organ. The fundus is now located at the level of the umbilicus.
4. By 16 weeks the uterus has increased in size to the size of a grapefruit.
5. At 20 weeks the uterus is located at the level of the umbilicus. The fundus is now located at the level of the umbilicus.
6. At 24 weeks of pregnancy, the uterus may be located at the level of the umbilicus.
7. At 28 weeks the fundus is located at the level of the umbilicus.
8. At 32 weeks the fundus is located at the level of the umbilicus.
9. At 36 weeks the fundus is located at the level of the umbilicus.
10. At 40 weeks the fundus is located at the level of the umbilicus.

**Height of fundus by weeks of normal gestation with a single fetus**

**Enlarging Uterus During Gestation Period**  
Note Displacement of internal abdominal structures and diaphragm

**Changes in Uterine Size & Shape in Puerperium Period**

**INC04 : Second Stage of Labour**

# SECOND STAGE OF LABOUR

**A. Expulsion of the head of the fetus from uterus.**

**B. Expulsion of the fetus from uterus.**

The second stage of labour begins when the cervix is completely opened and ends with the delivery of the baby. The second stage is often referred to as the "pushing" stage. During the second stage, the woman becomes actively involved by pushing the baby through the birth canal to the outside world. When the baby's head is visible at the opening of the vagina, it is called "crowning". The second stage is shorter than the first stage, and generally takes between 30 to 40 minutes in a woman's first pregnancy.

**INC03 : First Stage of Labour**

# FIRST STAGE OF LABOUR

**CERVICAL EFFACEMENT AND DILATION**

**Latent Labour**      **Early Effacement**      **Complete Effacement**      **Complete Dilation (10 cm)**  
Note how cervix thins up around presenting part (internal os)

**A. Foetal Position before labor begins**      **B. Foetus moves into the birth canal and cervix begins to dilate.**

**FIRST STAGE OF LABOUR IS DIVIDED INTO TWO PHASES:**

**A. Latent Phase**

1. Definition
  - a. Cervical dilation <3 cm and
  - b. Regular contractions
2. Normal Progress
  - a. Prolonged period
  - 1. Mean duration: 8.6 hours
  - 2. Maximum normal duration: 20 hours
  - b. Multiparous women
  - 1. Maximum normal duration: 14 hours

**B. Active Phase**

1. Definition
  - a. Cervical dilation >3 cm and
  - b. Regular contractions
2. Normal Progress
  - a. Prolonged period
  - 1. Cervical Dilation: >1.2 cm/hour
  - 2. Fetal Descent: >1 cm/hour
  - b. Multiparous women
  - 1. Cervical Dilation: >1.5 cm/hour
  - 2. Fetal Descent: >2 cm/hour

**INC05 : Third Stage of Labour**

# THIRD STAGE OF LABOUR

After the baby is delivered, the new mother enters the third and final stage of labour — delivery of the placenta. This stage usually lasts just a few minutes and involves the passage of the placenta out of the uterus and through the vagina.

**A. EXPULSION OF THE PLACENTA**

**B. CONTRACTION OF UTERUS**

**C. EXPELLED PLACENTA**

**IMPORTANT NURSING CHARTS**  
A set of 20 charts  
Laminated Art, Size 51 x 66 cm (Available in English only)

**INC06 : Complete Breech Presentation**

**COMPLETE BREECH PRESENTATION**



**Complete Breech (Flexed)**  
Legs are normally flexed as in the vertex position.



**Vaginal Examination of Complete Breech**  
Sacrum, anus, genitalia and feet can be identified. The sacrum can be mistaken for the occiput unless all foramina are palpated.

**INC07 : Incomplete Breech Presentation**

**INCOMPLETE BREECH PRESENTATION**

The incomplete breech presents with the legs flexed and legs extended as the abdomen. Severely percent of breech presentations are of this type and it is particularly common in primigravidae whose good uterine muscle tone inhibits flexion of the legs and feet turning into heels.



**Frank Breech (Breech with extended legs)**  
LA: Longitudinal or vertical  
Presenting Part: Sacrum  
Attitude: Flexion except for legs at knees



**Vaginal Examination of frank breech in LLA position.**  
In feet first - the legs are extended.

**INC08 : Foot Presentation**

**FOOT PRESENTATION**

**Footling Breech**  
This is rare. One or both feet present because neither legs nor knees are fully flexed. The feet are lower than the buttocks, which distinguishes it from the complete breech.



**Single Footling Presentation**



**Knee Presentation**

Knee presentation is very rare. One or both hips are extended with the knees flexed.

**INC09 : Shoulder Presentation**

**SHOULDER PRESENTATION**

- Shoulder Presentation**
  - Occurs when fetus is transverse with back down
  - Shoulder sits over pelvic inlet
- Epidemiology**
  - Incidence: 0.3% of singleton births
- Cause**
  - Prematurity
  - Placenta Praevia
  - Abnormal uterus
  - Contracted pelvis or relaxed abdominal wall
  - Polyhydramnios
- Diagnosis**
  - Leopold's Maneuvers
    - Transverse lie should be easy to identify
  - Digital cervical exam
    - No presenting part
- Management**
  - Cesarean section requires in most cases
  - Indications to consider External Cephalic Version
    - Intact membranes and no labour
    - Back-up transverse lie with cervix fully dilated
- Complications**
  - Uterine Rupture



**Dorsoposterior Shoulder Presentation**



**Dorsoposterior Shoulder Presentation**

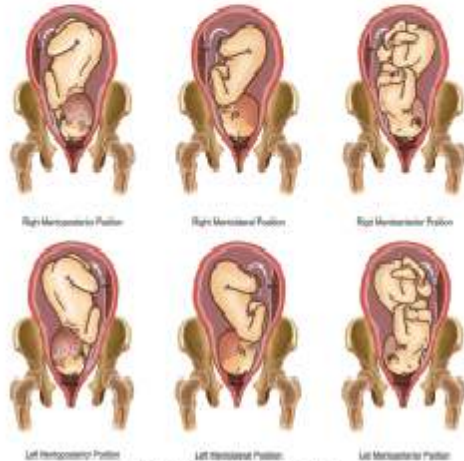
**INC10 : Face Presentation**

**FACE PRESENTATION**

When the attitude of the head is one of complete extension, the occiput of the foetus will be in contact with its spine and the face will present. The incidence is about 1:500 or less. In face presentation position, the denominator is the mentum.



**Vaginal examination in LMA position.**  
Submentopubic diameter measures 9.5 cm.



**Six positions of face presentation**

**INC11 : Brow Presentation**

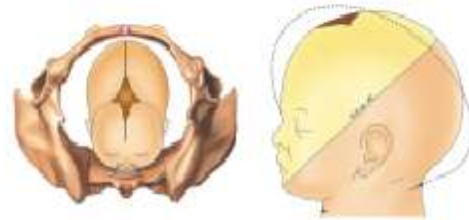
**BROW PRESENTATION**



Breech Presentation according to ICD (cervicouterine engagement)	
Incidence	1/100 or 1% of all
Nulliparae	50 (48.2%)
Pariparae	50 (50.0%)
Placenta praevia	2 (1.1%)
Pelvic malformation	-
Hydrocephalus	-
Hydrocephalus + head full	8 (8.0%)
Macrosomia + head full	8 (8.0%)
Malting	-
Spontaneous	10 (10.0%)
Forceps	50 (50.0%)
Caesarean section	40 (40.0%)

\* Includes one set of twins where both babies presented by the crown.

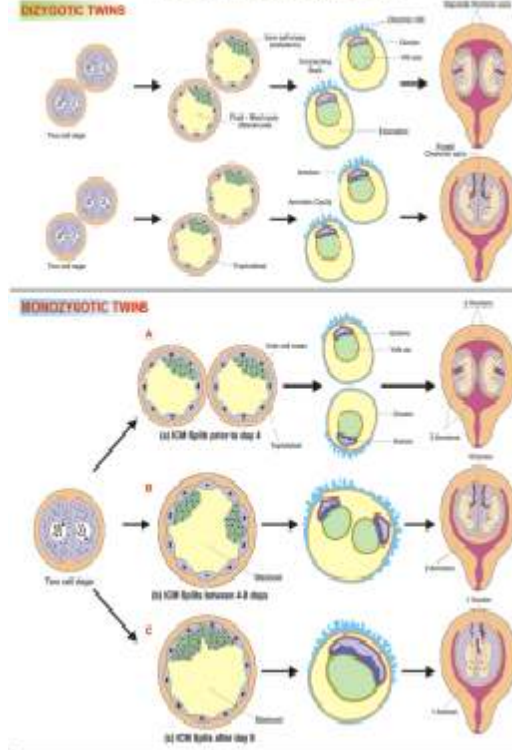
In Brow Presentation, the head is above the brim and not engaged. The mento-vertical diameter of the head is trying to engage in the transverse diameter of the brim.



**Vaginal examination with brow presentation. Moulding in a brow presentation (dotted line)**

**INC12 : Twin Pregnancy**

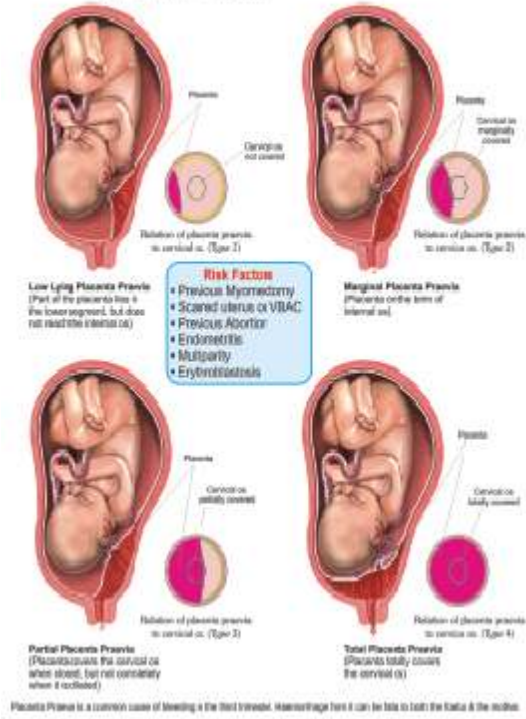
**TWIN PREGNANCY**



**INC13 : Placenta Praevia**

**PLACENTA PRAEVIA**

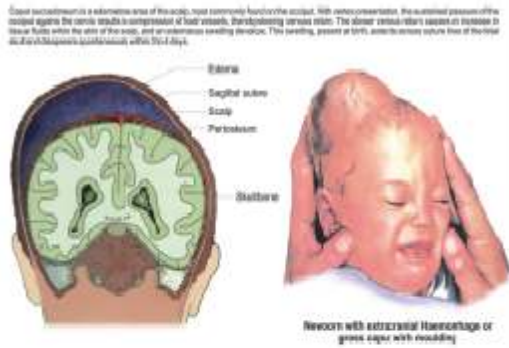
Placenta Praevia: Abnormal implantation of Placenta in lower Uterine Segment. About 85% cases occur in multiparas. Probability increases after the age of 35.



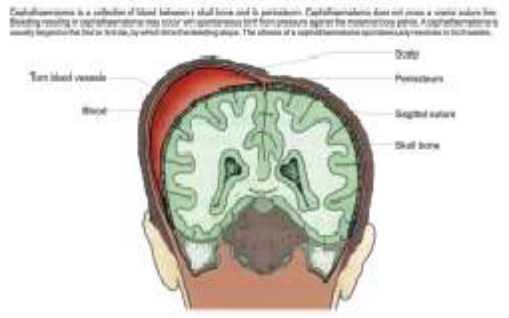


**INC14 : Caput Succedaneum**

**CAPUT SUCCEDANEUM**



**CEPHALHAEMATOMA**



**INC18 : Hydrocephalus**

**HYDROCEPHALUS**

Hydrocephalus is a condition of excess production, loss, or absorption of cerebrospinal fluid (CSF). It is characterized by an abnormal increase in CSF volume within the ventricles and/or by enlargement of the ventricles in the brain. Death is approximately 1 year after diagnosis.

**Pathophysiology and Aetiology**

1. Noncommunicating hydrocephalus
  - a. May be perinatal, idiopathic, or congenital.
  - b. Closure of the foramina of Luschka.
  - c. Closure by congenital defects.
  - d. May be caused by acquired conditions, such as infections, trauma, neoplasms, intracranial bleeding, and meningitis.
2. Communicating hydrocephalus
  - a. Failure into absorption system.
  - b. Excessive production of CSF.
  - c. The ventricular system becomes greatly distended.

**Clinical Manifestations in Infants**

1. Excessive head growth.
2. Delayed closure of the anterior fontanelle.
3. Fontanelle area and suture lines along the surface of the skull.
4. Signs of increased intracranial pressure.
5. Low-set ears.
6. Fontanelle bulging (protruding).
7. Bulging anterior fontanelle with prominent scalp veins.
8. Irritability and vomiting may be observed, especially the vomiting along the side.
9. Infant cannot gaze upward, causing "sunset eye".
10. Strabismus, hydrostrabismus, asymmetric strabismus may occur.
11. Difficulty walking (late).
12. Physical or mental developmental lag.

**Diagnostic Evaluation**

1. Ultrasonography of the skull (ultrasound).
2. CT scan in the diagnostic test of choice.
3. Skull X-rays show widening of the fontanelle and suture and enlargement of the skull.
4. Infant's head circumference, including abnormal fontanelle closure.

**Management**

1. Hydrocephalus can be treated through a variety of surgical procedures.
2. Intracranial pressure for watched cases of communicating hydrocephalus.
3. Excessive skull bone removal.

**Prognosis**

1. Many infants experience normal motor and intellectual development.
2. The severity of neurologic deficits is directly proportional to the volume of CSF.
3. Approximately two-thirds of infants die at any early age if they do not receive surgical treatment.

**Labels:** Lateral ventricle, 3rd ventricle, 4th ventricle.

**INC15 : Congenital Malformations of New Born**

**CONGENITAL MALFORMATIONS OF NEW BORN**

**Total Atrial Septal Defect (TASD)**

**Encephaloceles**

Encephalocele is a neural tube defect in which the brain and meninges protrude through a defect in the vertebral column. The brain and meninges protrude through a defect in the vertebral column. The brain and meninges protrude through a defect in the vertebral column.

**Labels:** Frontal Encephalocele, Occipital Encephalocele, Cervical Lymphatic Malformation.

**INC16 : Cleft Lip-Palate**

**CLEFT LIP-PALATE**

Cleft lip and palate are congenital anomalies resulting in structural facial malformation. The lip and palate, fail to close in approximately 1 in every 1,000 neonates. Cleft lip (with or without cleft palate) occurs more frequently in males, and isolated cleft palate is more frequent in females. Combination of cleft lip and palate occurs in approximately 30% of cases; cleft lip alone occurs in about 25% of cases; and cleft palate alone occurs in about 25% of cases.

**Labels:** Unilateral cleft lip (partial), Unilateral cleft of primary palate (complete, involving lip and alveolar ridge), Bilateral cleft lip, Partial cleft of palate, Complete cleft of secondary palate and unilateral cleft of primary palate.

**INC17 : Spina Bifida**

**SPINA BIFIDA**

Spina bifida is a type of birth defect called neural tube defect. In spina bifida, a baby's spine does not close completely during early pregnancy. Spina bifida can begin to develop in the fetus even before the mother knows she is pregnant.

**Labels:** Spina bifida with neural tube defect, Occult, Myelomeningocele, Meningocele.

**INC19 : Anencephalus**

**ANENCEPHALUS**

Anencephalus is a neural tube defect occurring prior to 28 days which prevents the closure of the anterior neuropore resulting in a large defect of the calvarium, meninges and skull.

**Labels:** Clinical Appearance in Anencephaly, Development of Neural Tube.

**INC20 : Breast Self Examination**

**BREAST SELF EXAMINATION**

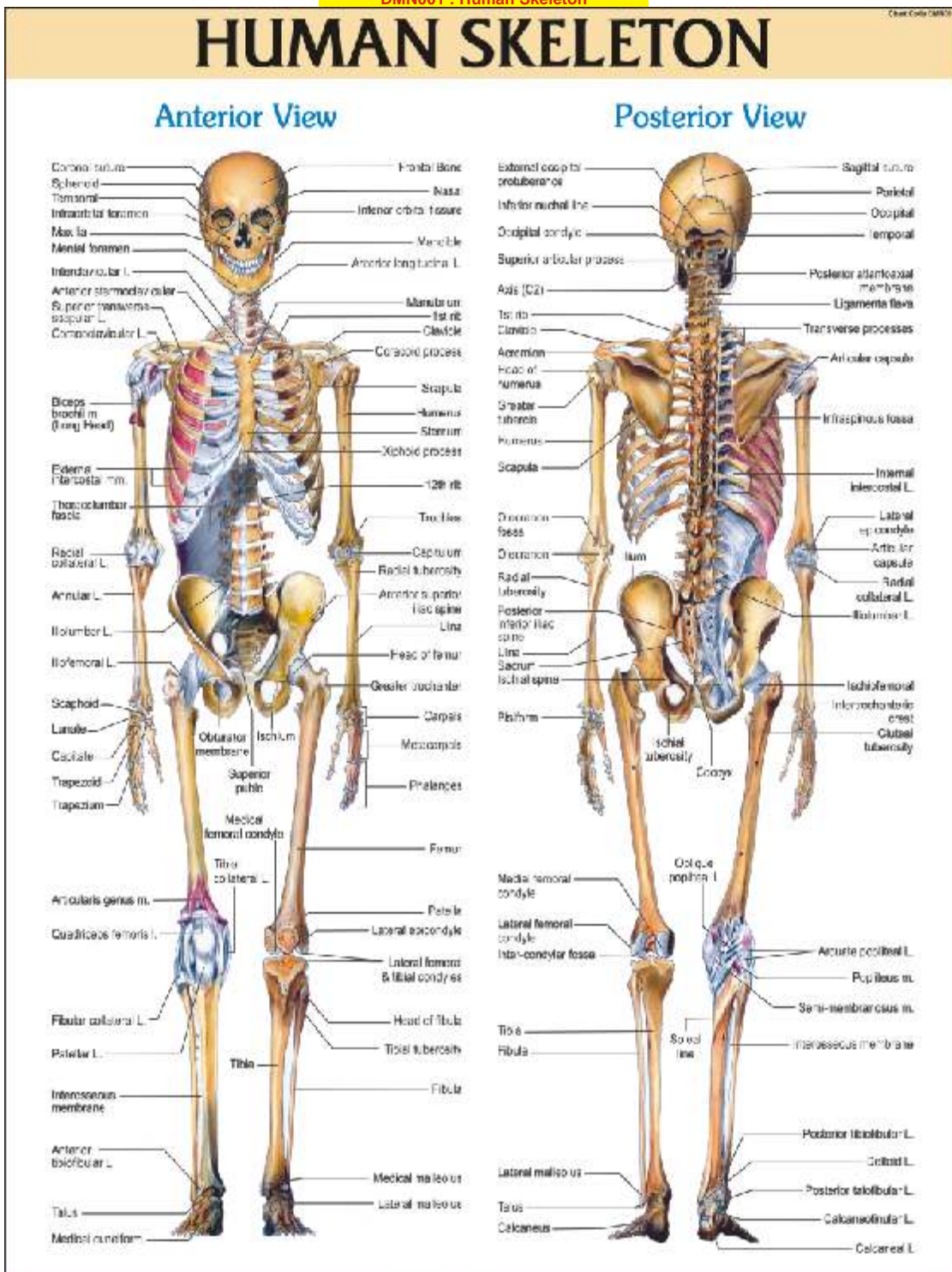
Look in the mirror for visual signs and consult your doctor as soon as possible if you notice any of these changes. The woman should check her breasts with the pads of her fingers to feel for lumps (palpate) and feel for changes in texture or tenderness.

**Labels:** Visual signs, Palpation, Breast Self Examination techniques.

**IMPORTANT NURSING CHARTS**  
A set of 20 charts  
Laminated Art, Size 51 x 66 cm (Available in English only)



DMN001 : Human Skeleton



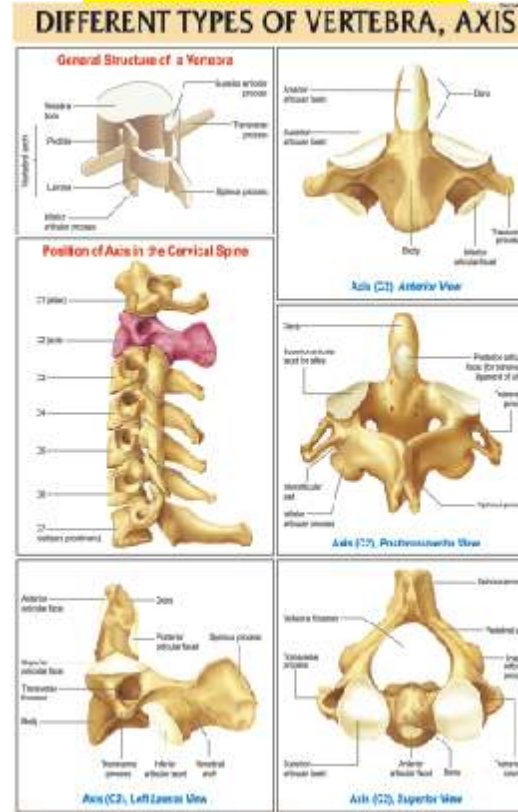
**Skeletal System**

Skeleton is a flexible structure of rigid bones which provide shape, movement and support to the body and offer protection to the internal organs. The rigid bones lie buried within the muscles and other soft tissues. Movement is only possible because of the way bones are joined to one another in joints and the way muscles are attached to those bones. On an average there are 206 bones of various shapes and sizes in an adult human skeleton.

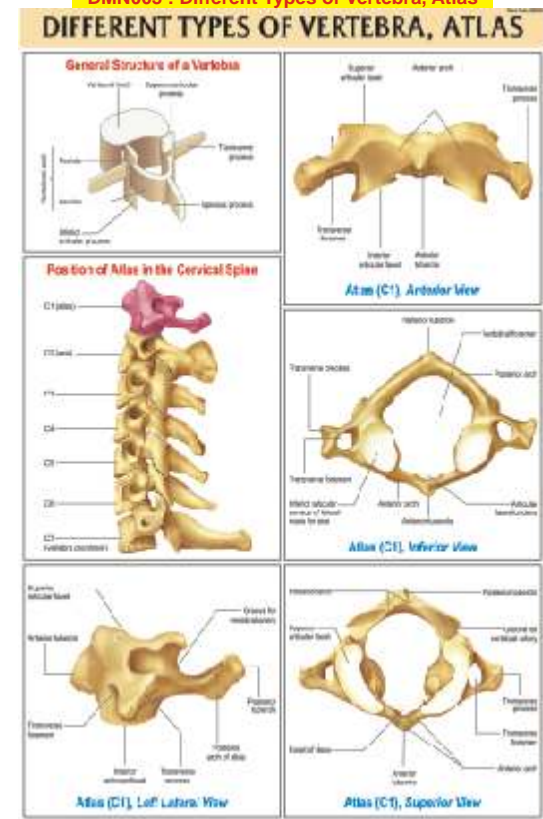
DMN002 : Different Types of Joints



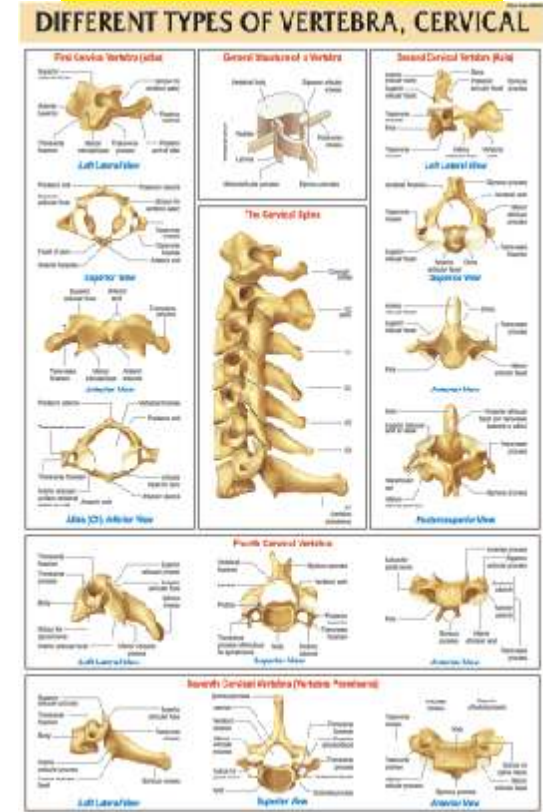
DMN004 : Different Types of Vertebra, Axis



DMN003 : Different Types of Vertebra, Atlas

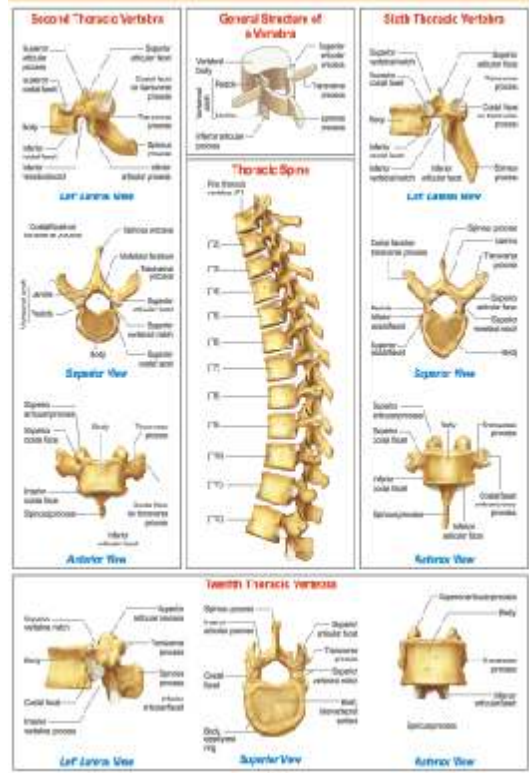


DMN005 : Different Types of Vertebra, Cervical



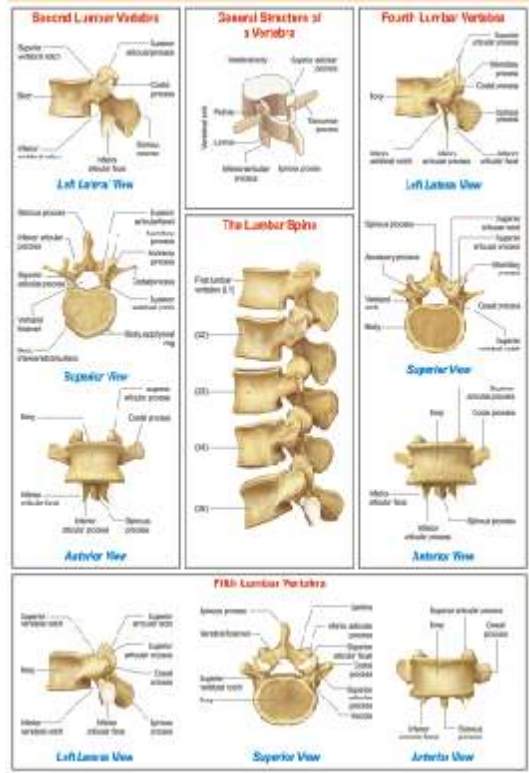
DMN006 : Different Types of Vertebra, Thoracic

DIFFERENT TYPES OF VERTEBRA, THORACIC



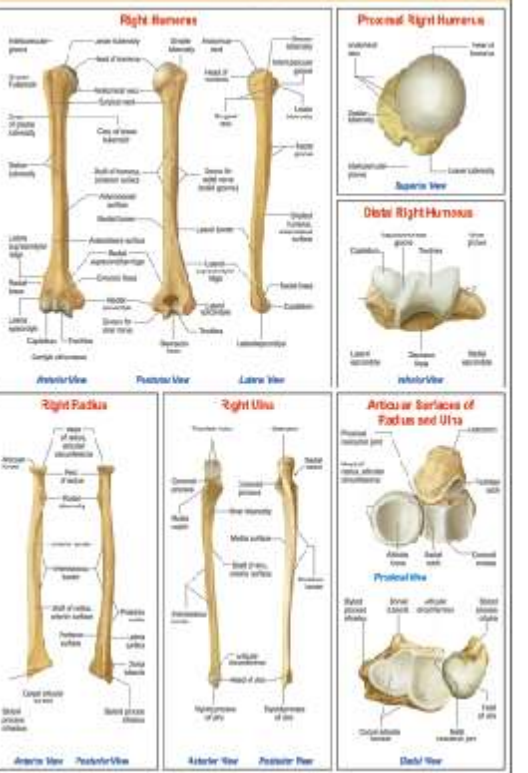
DMN007 : Different Types of Vertebra, lumbar

DIFFERENT TYPES OF VERTEBRA, LUMBAR



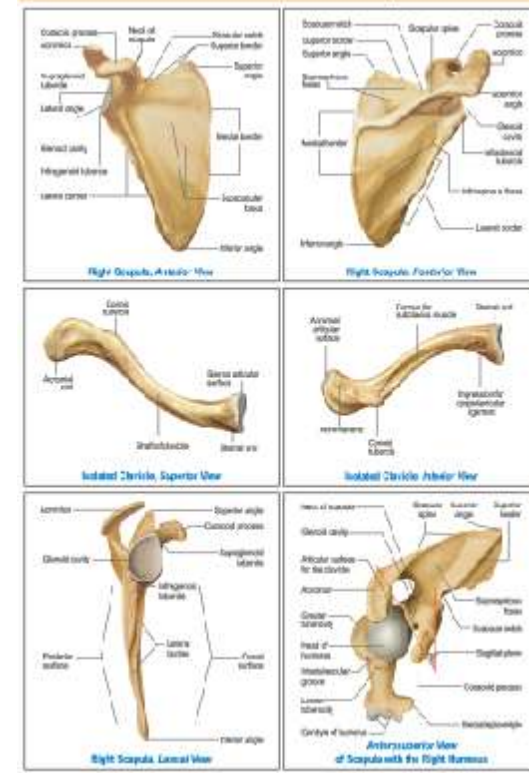
DMN008 : Different Types of Arm Bones

DIFFERENT TYPES OF ARM BONES



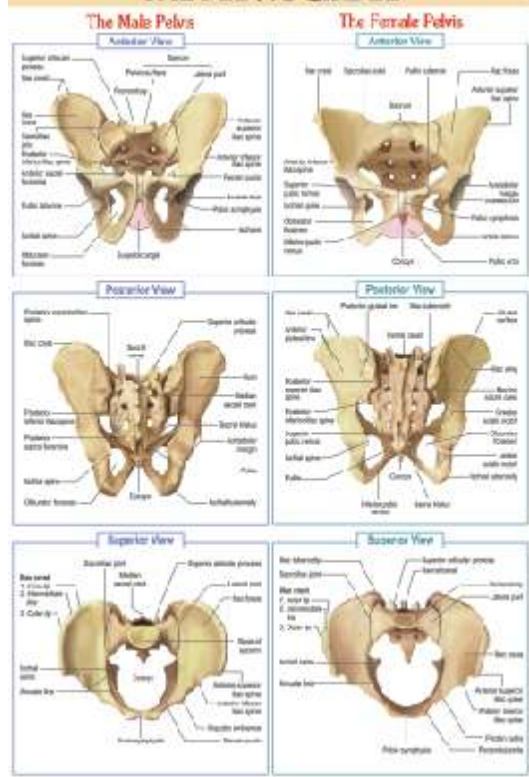
DMN009 : Different Types of Bones, Scapula

DIFFERENT TYPES OF BONES, SCAPULA



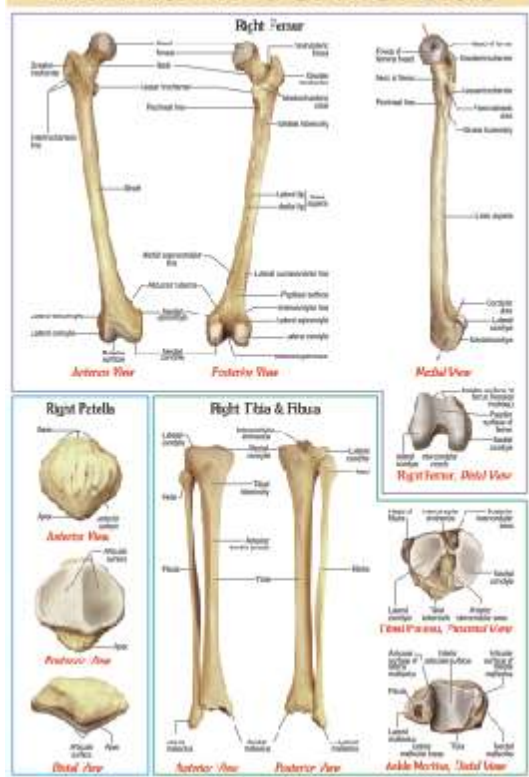
DMN010 : The Pelvic Girdle

THE PELVIC GIRDLE



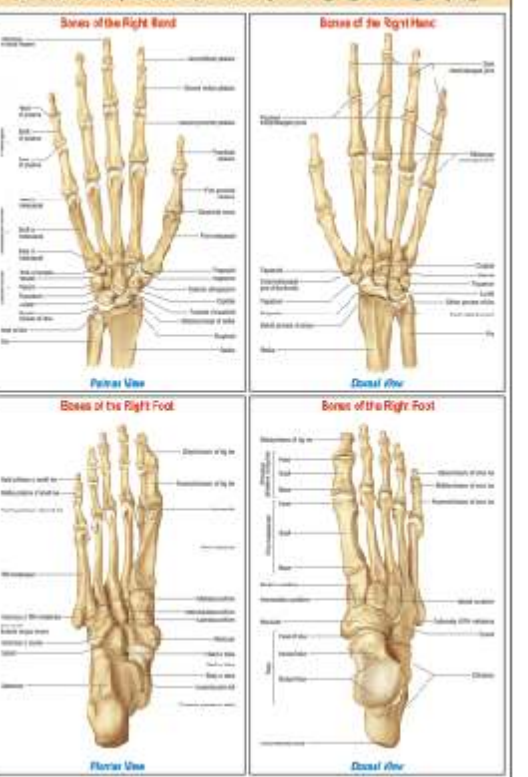
DMN011 : Different Types of Leg Bones

DIFFERENT TYPES OF LEG BONES



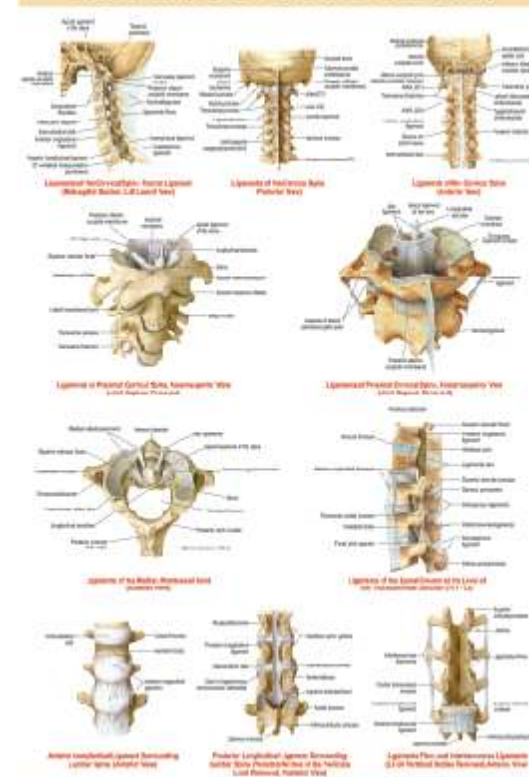
DMN012 : Human Hand And Foot Bones

HUMAN HAND AND FOOT BONES



DMN013 : Ligaments of Spinal Column

LIGAMENTS OF SPINAL COLUMN



NEW

NEW MEDICAL NURSING CHARTS  
Laminated Rigid or Laminated Flexible, Art  
Size 51 x 66 cm (Available in English only)

58

**DMN014 : Ligaments of Upper Limb**  
**LIGAMENTS OF UPPER LIMB**

This chart illustrates the ligaments of the upper limb through several anatomical diagrams. It shows the shoulder joint with ligaments like the coracoclavicular and coracohumeral ligaments. The elbow joint is shown with the ulnar collateral and radial collateral ligaments. The wrist and hand are depicted with various ligaments such as the scapho-trapezoidal, scapho-trapezoid, and scapho-trapezoidal ligaments. Each diagram is labeled with the specific ligament names and their locations.

**DMN015 : Ligaments of Lower Limb**  
**LIGAMENTS OF LOWER LIMB**

This chart illustrates the ligaments of the lower limb. It features diagrams of the hip joint, showing ligaments like the iliofemoral, ilio-tibial, and ilio-chondylar ligaments. The knee joint is shown with the anterior, posterior, and lateral collateral ligaments. The ankle and foot are depicted with ligaments such as the talocalcaneal, talonavicular, and calcaneonavicular ligaments. Each diagram is labeled with the specific ligament names and their locations.

**DMN016 : Pelvic Ligaments**  
**PELVIC LIGAMENTS**

This chart illustrates the pelvic ligaments, showing both the male and female pelvis. It includes diagrams of the ligaments of the male pelvis, such as the sacrotuberous, sacrospinous, and perineal membranes. It also shows the ligaments of the female pelvis, including the sacrotuberous, sacrospinous, and sacrotuberous ligaments. Each diagram is labeled with the specific ligament names and their locations.

**DMN100 : Dentition-Teeth Types**  
**DENTITION - TEETH TYPES**

This chart illustrates the dentition and teeth types. It includes diagrams of tooth structures, showing the crown, root, and pulp chamber. It also shows the types of teeth, including incisors, canines, premolars, and molars. The arrangement of teeth in the mouth is depicted, showing the upper and lower arches. Each diagram is labeled with the specific tooth names and their locations.

**DMN101 : Mammalian Skin - V.S.**  
**MAMMALIAN SKIN - V.S.**

This chart illustrates the structure of mammalian skin. It includes diagrams of the skin structure, showing the epidermis, dermis, and hypodermis. It also shows the longitudinal section of the hair follicle, including the hair shaft, root, and bulb. Each diagram is labeled with the specific skin structures and their locations.

**DMN102 : Trachea**  
**TRACHEA**

This chart illustrates the trachea, showing the ventral and dorsal aspects. It includes diagrams of the trachea structure, showing the cartilaginous rings and the smooth muscle. It also shows the cross-section of the trachea, including the cartilage and the smooth muscle. Each diagram is labeled with the specific trachea structures and their locations.

**DMN103 : Larynx**  
**LARYNX**

This chart illustrates the larynx, showing the anterior, posterior, and lateral views. It includes diagrams of the larynx structure, showing the cartilages and the muscles. It also shows the larynx in relation to the trachea and the pharynx. Each diagram is labeled with the specific larynx structures and their locations.

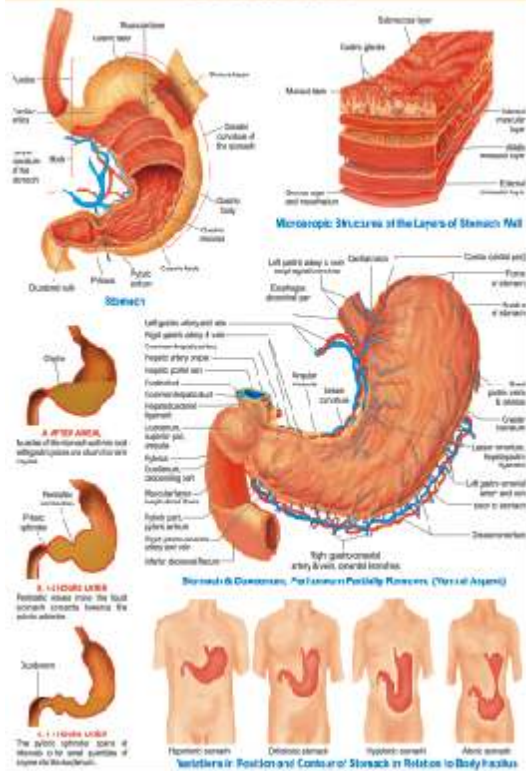
**DMN104 : Oral Cavity**  
**ORAL CAVITY**

This chart illustrates the oral cavity, showing the tongue drawn forward and the paramedian section. It includes diagrams of the oral cavity structure, showing the tongue, lips, and palate. It also shows the oral cavity in relation to the nasal cavity and the pharynx. Each diagram is labeled with the specific oral cavity structures and their locations.



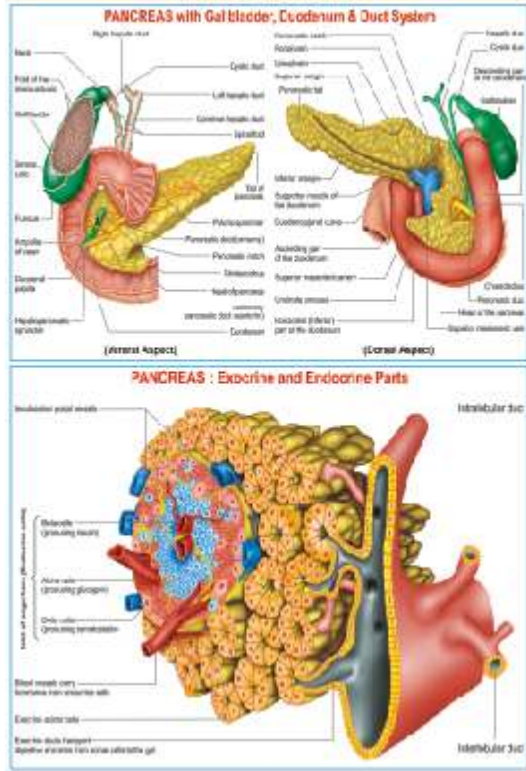
DMN105 : Stomach

STOMACH



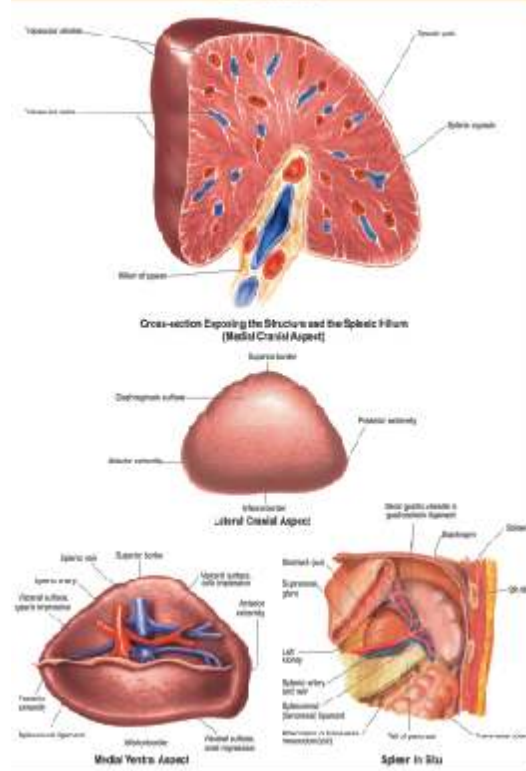
DMN106 : Pancreas

PANCREAS



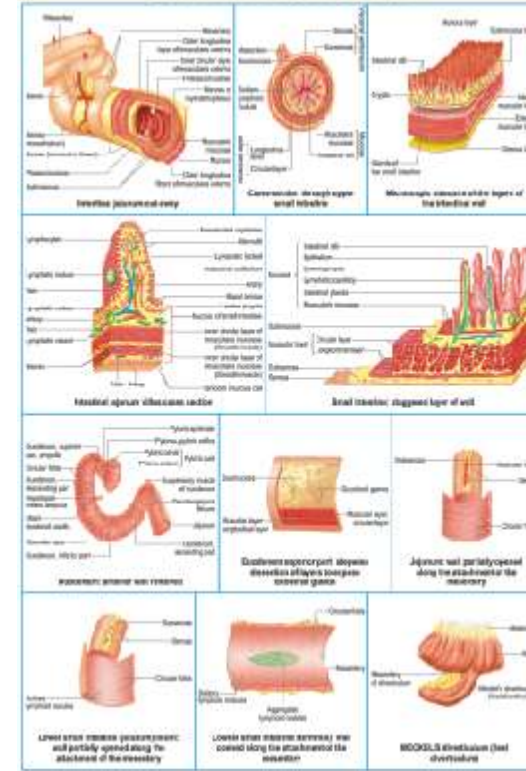
DMN107 : Spleen

SPLEEN



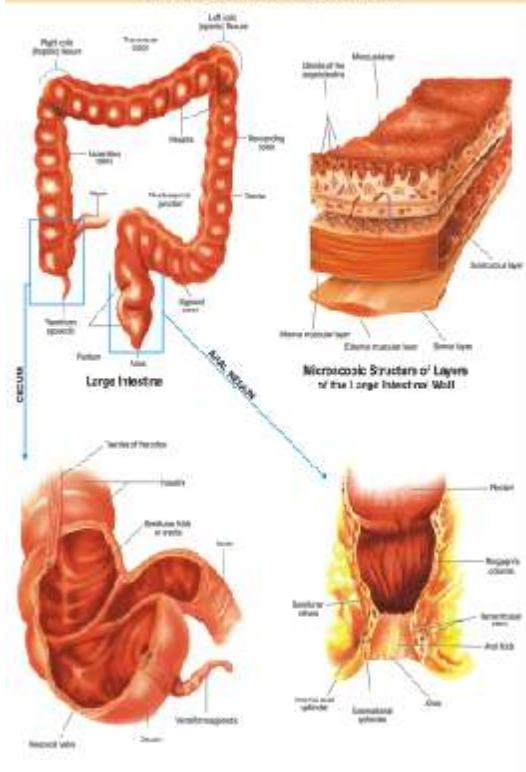
DMN108 : Small Intestine

SMALL INTESTINE



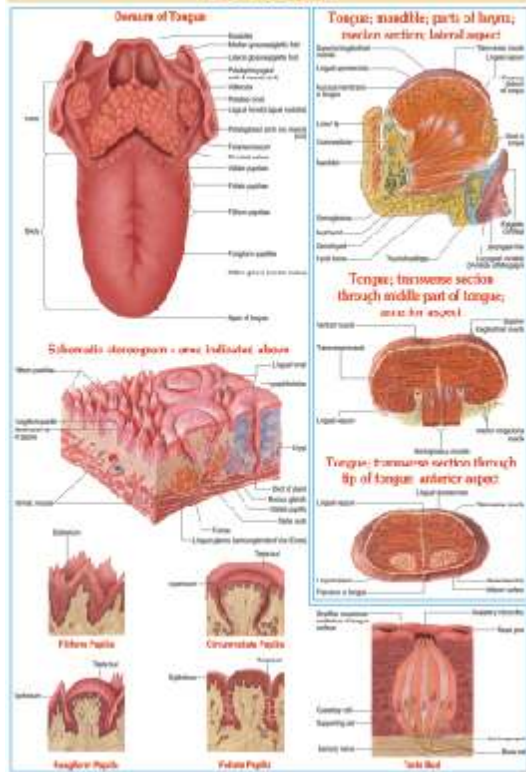
DMN109 : Large Intestine

LARGE INTESTINE



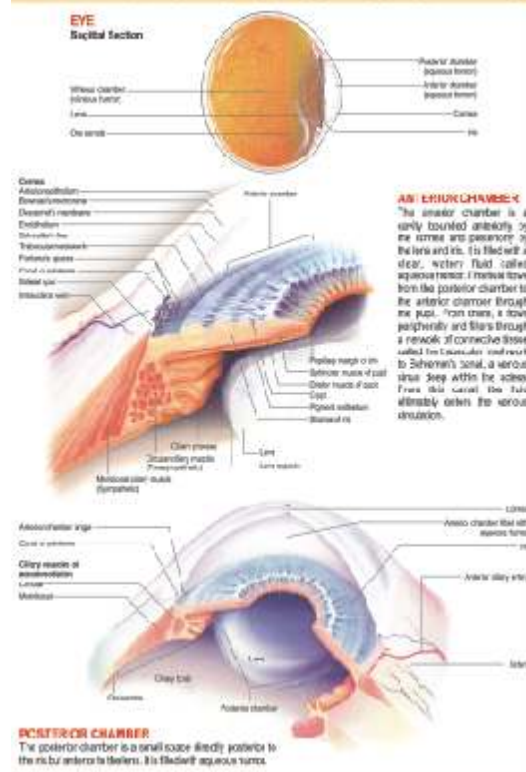
DMN110 : Tongue

TONGUE



DMN111 : The Eye : Anterior & Posterior Chambers

THE EYE : ANTERIOR & POSTERIOR CHAMBERS



DMN200 : Blood Circulatory System

BLOOD CIRCULATORY SYSTEM



NEW

NEW MEDICAL NURSING CHARTS  
Laminated Rigid or Laminated Flexible, Art  
Size 51 x 66 cm (Available in English only)

### DMN201 : Reproductive System

## REPRODUCTIVE SYSTEM

#### The Male Reproductive Organs

Labels: Ureter, Seminal vesicle, Vas deferens, Epididymis, Testis, Prostate gland, Uterus, Penis, Scrotum, Epididymis, Seminal vesicle, Uterus, Penis, Scrotum.

#### The Female Reproductive Organs

Labels: Ovary, Fallopian tube, Uterus, Vagina, Cervix, Vaginal opening, Labia majora, Labia minora, Clitoris, Uterus, Fallopian tube, Ovary, Cervix, Vaginal opening, Labia majora, Labia minora, Clitoris.

### DMN302 : Placenta Membranes

## PLACENTA MEMBRANES

#### STRUCTURE

Placenta averages 12cm in length and 2-2.5cm in thickness, with the outer length of fetus, and the weight being the following: It weighs, which approximately 470 grams. It is a vascular structure.

#### THREE DISTINCT LAYERS OF MEMBRANES

**Amnion**

1. It is the outermost layer.
2. It is the innermost layer of epithelial and connective tissue.
3. It is formed from the fetal ectoderm by outgrowth within the amniotic cavity.
4. It is continuous over the embryonic and fetal membranes.

**Chorion**

1. It is the middle layer.
2. Amnion is loosely attached to it by the internal pressure of amniotic fluid.
3. The chorion layer is composed of connective tissue within which traverses the fetal (extraembryonic) blood vessels.
4. The villi of chorion frondosum originate from the chorion.

**Decidua Capsularis**

1. It is the innermost layer.
2. It is the innermost layer of the chorion and it is the outermost component of the membranes.
3. It is formed of trophoblastic cells in contact with the fetus.
4. It also normally contains a few maternal blood vessels, some phagocytes and other cells.
5. At the placental margin, the decidua capsularis is contiguous with decidua basalis, which is the maternal decidua.

#### DEVELOPMENT

### DMN202 : Portal system

## PORTAL SYSTEM

Labels: Superior vena cava, Inferior vena cava, Liver, Spleen, Stomach, Duodenum, Pancreas, Gallbladder, Bile duct, Inferior mesenteric vein, Superior mesenteric vein, Portal vein, Inferior mesenteric vein, Superior mesenteric vein, Portal vein, Inferior mesenteric vein, Superior mesenteric vein, Portal vein.

### DMN300 : Baby Development

## BABY DEVELOPMENT

Labels: 1st Trimester, 2nd Trimester, 3rd Trimester, 9 Months.

### DMN301 : Feeding Schedule of Preterm Infants

## FEEDING SCHEDULE OF PRETERM INFANTS

Providing adequate nutrition to preterm infants is challenging because of various problems. These problems include immaturity of bowel function, inability to suck and swallow, high risk of necrotizing enterocolitis (NEC), illnesses that may interfere with adequate enteral feeding (e.g., RDS, patent ductus arteriosus) and medical interventions that preclude feeding (e.g., umbilical vessel catheters, exchange transfusions, leucocyte transfusion therapy).

#### FEEDING PROTOCOL

1. **ASPECT OF FEEDING** - Shows how often health care providers should check sucking and swallowing, this must be noted by parents.
2. **QUANTITY OF FEEDING** - Shows how much to feed.
3. **TYPE OF FEEDING** - Shows how to feed.

Corrected Age (weeks)	Volume of First Feeds (oz/ml)	Frequency	Rate of Feeding
24-28	2 or 2.5 oz/ml	every 4-6 hours	More than 5-7 days/week 10-20cc/kg/day
28-32	2	every 4-6 hours	More than 5-7 days/week 10-20cc/kg/day
32-36	2	every 4-6 hours	As tolerated but parents must still feed every 7-8 days

#### THUMB RULES FOR GROWTH OF PREMIE

1. At 28 weeks of age, a preemie will have two ages - a developmental age (calculated from the day it was born) and a corrected age (developmental age minus number of weeks premature it was born). Take this corrected age into consideration when making down when their developmental milestones should be accomplished.
2. At 32 weeks of age, a preemie will be able to hold their head up, will be able to hold their neck, will be able to hold their neck, will be able to hold their neck.
3. At 36 weeks of age, a preemie will be able to hold their head up, will be able to hold their neck, will be able to hold their neck.
4. At 40 weeks of age, a preemie will be able to hold their head up, will be able to hold their neck, will be able to hold their neck.

### DMN400 : CPR Infant

## CPR INFANT (UNDER 1 YEAR)

MAKE SURE THE ENVIRONMENT IS SAFE FOR RESCUERS & VICTIM

1. **Attempt to Wake the Infant and Call for Help.**
2. **Begin Chest Compressions.**
3. **Open the Airway.**
4. **Begin Rescue Breaths.**
5. **Repeat Chest Compressions.**
6. **Repeat Rescue Breaths.**

### DMN401 : CPR Child

## CPR CHILD (1-8 YEARS)

MAKE SURE THE ENVIRONMENT IS SAFE FOR RESCUERS & VICTIM

1. **Attempt to Wake the Child and Call for Help.**
2. **Begin Chest Compressions.**
3. **Open the Airway.**
4. **Begin Rescue Breaths.**
5. **Repeat Chest Compressions.**
6. **Repeat Rescue Breaths.**

### DMN402 : CPR Adult

## CPR ADULT (9 YEARS AND OVER)

MAKE SURE THE ENVIRONMENT IS SAFE FOR RESCUERS & VICTIM

1. **Recognition of Cardiac Arrest and Call for Help.**
2. **Begin Chest Compressions.**
3. **Open the Airway.**
4. **Begin Rescue Breaths.**
5. **Repeat Chest Compressions.**
6. **Repeat Rescue Breaths.**

### DMN500 : Ocular Infections

## OCULAR INFECTIONS

#### CONJUNCTIVITIS

Redness, swelling, discharge, and pain.

#### BLEPHARITIS AND STY

Inflammation of the eyelids.

Conjunctivitis	Bacterial	Viral	Allergic
Onset/Incubation	24h	2-7d	Instant
Discharge	Mucopurulent	Aqueous	None
Itchiness	Yes	No	Yes
Pain/Red	Rare	Fair	Yes

#### CORNEAL ULCER

Open sore on the cornea.

#### OCULAR HERPES

Herpes simplex virus infection.

### DMN501 : Anxiety Disorders

## ANXIETY DISORDERS

#### BRAIN IN ANXIETY

Brain regions like the amygdala and prefrontal cortex are involved.

#### GENERALIZED ANXIETY DISORDER (GAD)

#### PNIC ATTACK

#### COGNITIVE MODEL OF SOCIAL ANXIETY

Thoughts lead to feelings, which lead to behaviors, which then lead to more thoughts.

### DMN502 : Obsessions and Compulsions

## OBSSESSIONS AND COMPULSIONS

#### Obsessions and Compulsions

Obsessions lead to compulsions, which temporarily reduce anxiety but reinforce the cycle.

#### Signs and Symptoms of OCD

Examples include checking, washing, counting, and hoarding.

### DMN503 : Schizophrenia

## SCHIZOPHRENIA

#### Brain Regions and Systems

Regions like the prefrontal cortex, hippocampus, and amygdala are affected.

#### Signs and Symptoms

#### Risk Factors

Genetic and environmental factors contribute to the risk of schizophrenia.

### DMN504 : Bicornuate Uterus

## BICORNUATE UTERUS

#### BICORNUATE UTERUS WITH NO PREGNANCY

Two horns and a fundus.

#### BICORNUATE UTERUS WITH 34 WEEK OLD FETUS

Pregnancy in one horn.

### DMN505 : Fibroid Uterus

## FIBROID UTERUS

#### Types of Fibroids

Submucosal, Intramural, Subserosal.

#### Severe Case of Fibroid Uterus

Large fibroids causing significant enlargement.

### DMN506 : Fibroadenoma Breast

## FIBROADENOMA BREAST

#### What is a Fibroadenoma?

Benign tumor of the breast.

#### Classification

Fibroadenoma Type	Age Group
Typical (1-2 cm)	15-35 years
Atypical (1-5 cm)	35-50 years
Giant (> 5 cm)	> 50 years

### DMN507 : IUGR Baby

## IUGR BABY

#### Classification

Symmetrical vs Asymmetrical.

#### Risk Factors

Maternal Risk Factors	Fetal Risk Factors	Placental Factors
Maternal weight, hypertension, etc.	Genetic, chromosomal, etc.	Placental insufficiency, etc.



### DMN508 : Hydatidiform Mole

## HYDATIDIFORM MOLE

Hydatidiform mole is a rare cause of growth that forms inside the womb instead of the beginning of a pregnancy. It is a type of gestational trophoblastic disease (GTD).

**Causes:** Hydatidiform mole results from too much production of the tissue that is supposed to develop into the placenta. With a molar pregnancy, the tissues develop into an abnormal growth, called a mole.

There are 2 Types of These Moles:

**Complete Hydatidiform Mole**  
1. Complete molar pregnancy: There is an abnormal placenta and no fetus.

**Partial Hydatidiform Mole**  
2. Partial molar pregnancy: There is an abnormal placenta and some fetal development.

**Symptoms:**

1. Abnormal growth of the uterus
2. Missed menses
3. Vaginal bleeding during the first 3 months of pregnancy
4. Symptoms of hyperthyroidism
5. Symptoms similar to preeclampsia that occur in the first trimester or early second trimester

**Treatment:**

1. Dilation and curettage (D and C) will most likely be recommended.
2. Sometimes a continuous pregnancy can continue. However, these are very high-risk pregnancies.
3. A hysterectomy (surgery to remove the uterus) may be an option for older women who do not wish to become pregnant in the future.
4. After treatment, your HCG level will be followed. This is important to avoid another pregnancy and to make sure the contraceptive for 5 to 12 months after treatment for a molar pregnancy.

### DMN509 : Hydrosalpinx

## HYDROSALPINX

Hydrosalpinx is a condition where the fallopian tube gets filled with fluids because of chronic inflammation by bacteria like Chlamydia or Neisseria and others or due to Tuberculosis. It may cause the tube to block. In acute infection tubes may be filled with pus and is called pyosalpinx.

**Wall of hydrosalpinx simplex**      **Pseudo-follicular hydrosalpinx**

The presence of hydrosalpinx is known to reduce the pregnancy rate by half even in IVF pregnancies and disconnecting the tube with hydrosalpinx from uterus is found to double the pregnancy rate. The presence of bilaterally damaged or blocked tubes may require IVF to get conceived.

**Small and moderate sized hydrosalpinx**      **Large cystic hydrosalpinx**

### DMN700 : Stages of Human Development

## STAGES OF HUMAN DEVELOPMENT

Human life starts with the formation of eggs, a result of fertilization of ovum with the sperm. The ovules develop into a cluster of cells formed by repeated divisions of the fertilized egg. Some of these cells form membranes to protect both the ovum and the placenta, which encloses the embryo and removes its waste products.

Only during its first 8 weeks of development, the unborn child is called an embryo. For the rest of the pregnancy, it is known as a fetus.

**DEVELOPMENT OF EMBRYO**

### DMN701 : Cross Sectional Anatomy, Thoracic Vicera

## CROSS-SECTIONAL ANATOMY, THORACIC VICERA

**Transverse Section: Upper Level of T4 Intervertebral Disc**

**Transverse Section: T4 Intervertebral Disc, Anterior**

**Transverse Section: T6 Intervertebral Disc, Anterior Angle**

**Transverse Section: Level of T7, Anterior Intercostal Space**

**Coronal Section: Anterior Intercostal Space**

**Coronal Section: Mediastinal Space**

### DMN702 : Cross Sectional Anatomy, Abdominal Vicera

## CROSS-SECTIONAL ANATOMY, ABDOMINAL VICERA

**Transverse Section: Level of T8, Diaphragmatic Junction**

**Transverse Section: Level of T12, Inferior Xiphoid**

**Transverse Section: Level of T12L1 Intervertebral Disc**

**Transverse Section: Level of T12 Intervertebral Disc**

**Transverse Section: Level of L1, Superior Iliac Crest**

**Transverse Section: Level of S1, Anterior Superior Iliac Spine**

### DMN703 : Cross Sectional Anatomy, Pelvic Vicera

## CROSS-SECTIONAL ANATOMY, PELVIC VICERA

**Male Pelvic: Section Between Right Lateral Anus**

**Female Pelvic: Section Between Right Lateral Anus**

**Female Pelvic: Section Through Uterus (Anterior View) - Anterior Aspect**

**Female Pelvic: Section Through Uterus (Anterior View) - Posterior Aspect**

**Female Pelvic: Section Through Uterus (Anterior View) - Superior Aspect**

**Female Pelvic: Section Through Uterus (Anterior View) - Inferior Aspect**

**Female Pelvic: Section Through Uterus (Anterior View) - Lateral Aspect**

**Female Pelvic: Section Through Uterus (Anterior View) - Medial Aspect**

**Female Pelvic: Section Through Uterus (Anterior View) - Lateral Aspect**

**Female Pelvic: Section Through Uterus (Anterior View) - Medial Aspect**

### DMN900 : Differentiation of Head & Pubic hairs

## DIFFERENTIATION OF HEAD & PUBIC HAIRS

**LONGITUDINAL SECTION OF THE HAIR FOLLICLE**

1. The matrix of keratinization  
2. The sebaceous gland of the sebaceous pore  
3. The subcutaneous core

**TRANSVERSE SECTION OF HAIR FOLLICLE**

**HEAD HAIRS**

Head hair grown on the scalp, is the most noticeable of all human hair, which can grow longer than on most mammals. The average human head has about 140,000 hair follicles. Each follicle can grow about 28 individual hairs a person's lifetime.

Head hair density is related to both race and hair color. Caucasians have the highest hair density, while average growth rate, while Asians have the lowest density but fastest growing hair, and Africans have the thickest density and slowest growing hair.

- Lighter, long, straight or wavy
- Moderate thickness with some diameter variation
- Molecule keratin is continuous and relatively uniform
- Bottom mesenchymal
- Placode
- In cross section, the cut surface is protruding over the dermal core, depending on whether the hair is straight, wavy or curly.
- Long growth period
- Hair on the head serves as primary source of hair insulation and cooling as well as protection from ultraviolet radiation exposure.

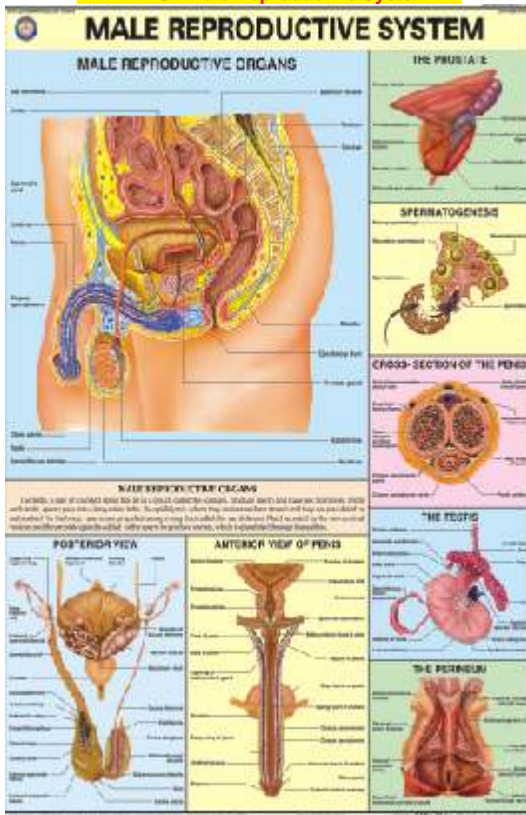
**PUBIC HAIRS**

Pubic hair is the hair in the frontal genital area of adolescent and adult humans. Pubic hair develops during puberty as an effect of rising levels of androgens. Pubic hair is therefore part of the androgenic hair (or body hair) and is a secondary sex characteristic. The hair grows in same of the first stages of puberty, it starts as downy, straight hair, and then progresses to coarse, curly hair that starts to form a ring around and around the genitals.

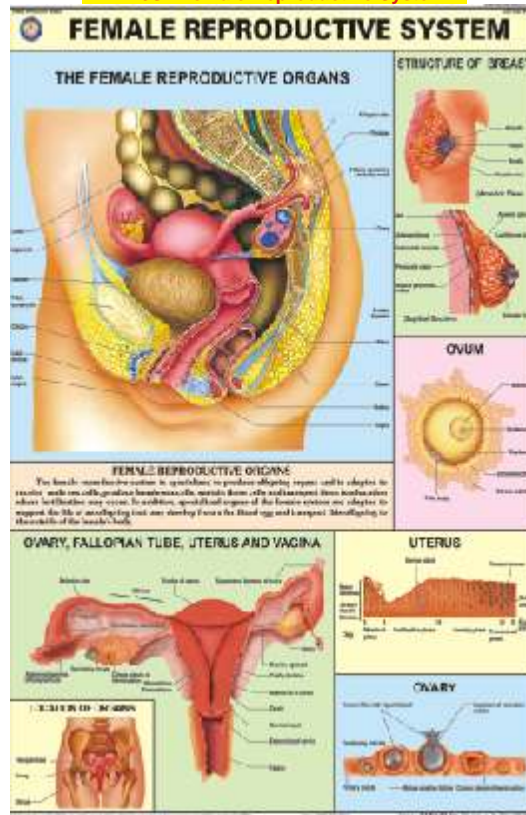
- Heavier coarser, shorter curly
- Short diameter coarse with wide variation and buckling
- Molecule relatively broad and usually continuous when present
- SHF keratin, wavy
- Top usually separated, rounded, or flattened
- Root frequently with tag
- Cut section hexagonal or triangular surface
- Short growth period. Within six months, the follicle also see it when falls out.
- Pubic hair which acts as a buffer to reduce chafing, provides a large surface area to dissipate pheromones (the chemicals of attraction).
- Pubic hair hair regulate the temperature around sex organs.



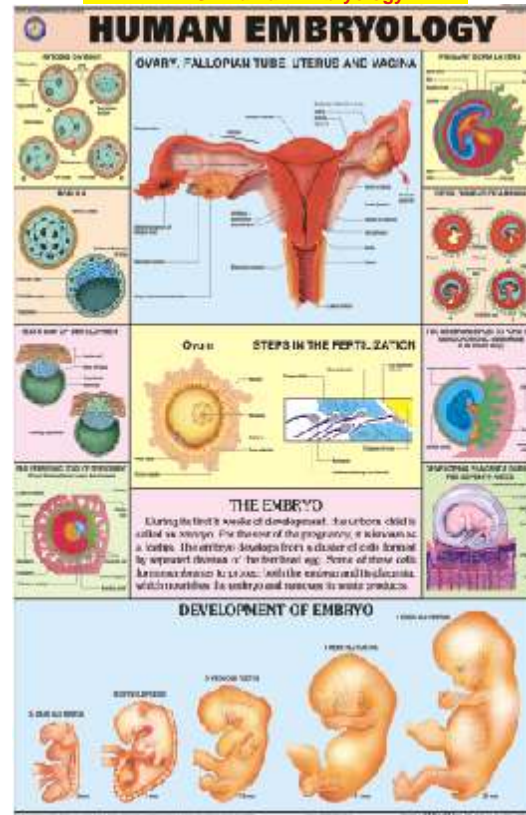
HP12S : Male Reproductive System



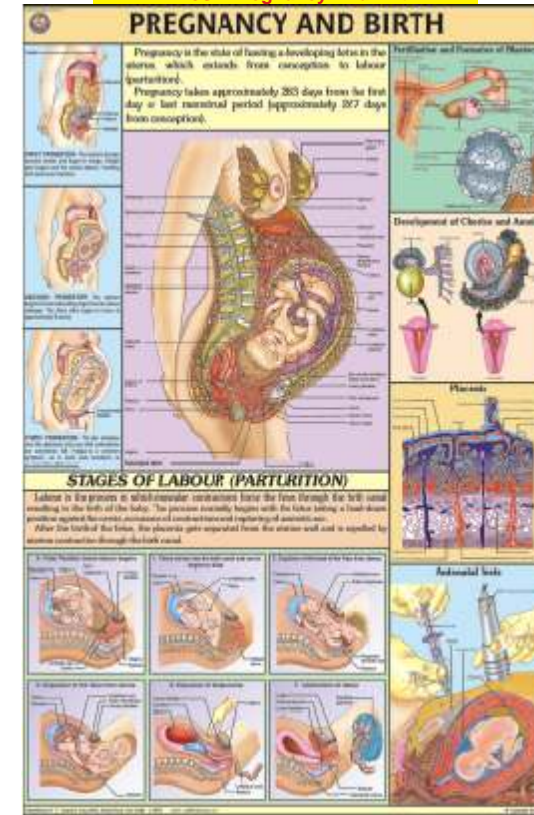
HP13S : Female Reproductive System



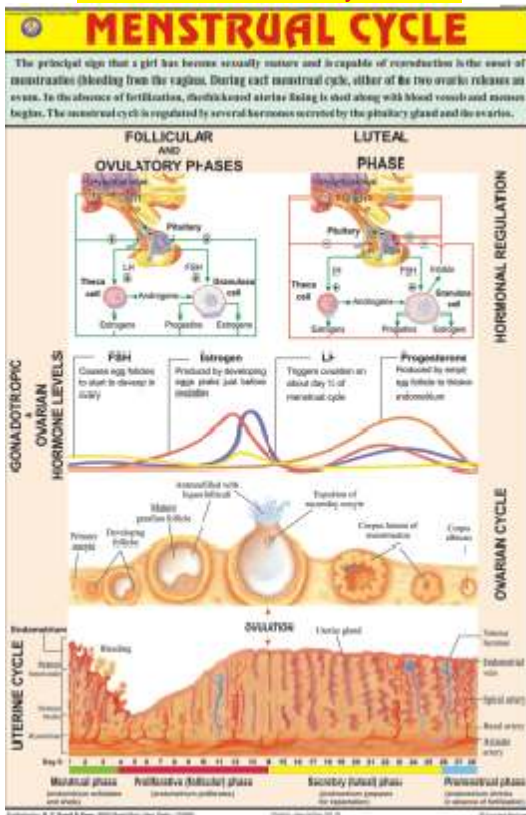
HP14S : Human Embryology



HP18S : Pregnancy And Birth



HP30S : Menstrual Cycle



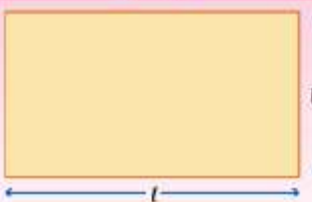
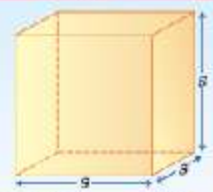
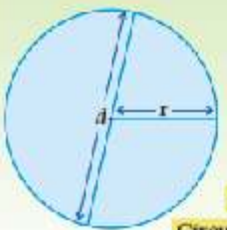
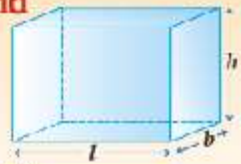


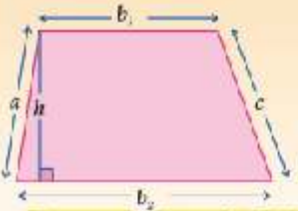
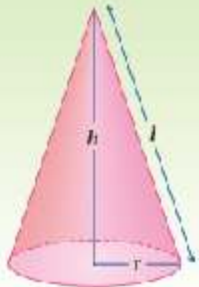

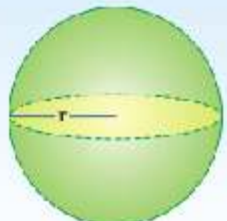
HP31S : Contraception (Birth Control)






# MENSURATION

A graphical list of the formulas for measurement concepts

 <p style="text-align: center;"><b>Rectangle</b></p> <p>Perimeter = <math>2(\text{Length} + \text{Breadth}) = 2(l + b)</math>              Area = <math>\text{Length} \times \text{Breadth} = lb</math></p>	 <p style="text-align: center;"><b>Cube</b></p> <p>Lateral Surface Area = <math>4 \times \text{Side} \times \text{Side} = 4s^2</math>              Total Surface Area = <math>6 \times \text{Side} \times \text{Side} = 6s^2</math>              Volume = <math>\text{Side} \times \text{Side} \times \text{Side} = s^3</math></p>
 <p style="text-align: center;"><b>Circle</b></p> <p>(<math>\pi = 3.14</math>)              Area = <math>\pi \text{ radius}^2 = \pi r^2</math>              Diameter = <math>2 \text{ radius} = 2r</math>              Circumference = <math>\pi \text{ diameter} = \pi d</math>              Circumference = <math>2\pi \text{ radius} = 2\pi r</math></p>	 <p style="text-align: center;"><b>Rectangular Solid (Cuboid)</b></p> <p>Lateral Surface Area = <math>2h(l + b)</math>              Total Surface Area = <math>2(lb + bh + lh)</math>              Volume = <math>\text{Length} \times \text{Breadth} \times \text{Height} = lbh</math></p>
 <p style="text-align: center;"><b>Triangle</b></p> <p>Area = <math>1/2 \times \text{Base} \times \text{Height} = 1/2 bh</math>              Perimeter = <math>\text{Sum of Three Sides} = a + b + c</math></p>	 <p style="text-align: center;"><b>Cylinder</b></p> <p>(<math>\pi = 3.14</math>, <math>r = \text{radius}</math>, <math>h = \text{height}</math>)              L. Surface Area = <math>2\pi rh</math>              T. Surface Area = <math>2\pi r(h + r)</math>              Volume = <math>\pi r^2 h</math></p>
 <p style="text-align: center;"><b>Trapezium</b></p> <p>Perimeter = <math>\text{Sum of All Sides} = a + b_1 + b_2 + c</math>              Area = <math>1/2 (\text{Sum of Parallel Sides}) \times \text{Height}</math>              Area = <math>1/2 (b_1 + b_2) h</math></p>	 <p style="text-align: center;"><b>Cone</b></p> <p>(<math>\pi = 3.14</math>, <math>r = \text{radius}</math>, <math>l = \text{slant height}</math>, <math>h = \text{height}</math>)              L. Surface Area = <math>\pi rl</math>              T. Surface Area = <math>\pi r(l + r)</math>              Volume = <math>1/3 \pi r^2 h</math></p>
 <p style="text-align: center;"><b>Parallelogram</b></p> <p>Area = <math>\text{Base} \times \text{Height} = bh</math></p>	 <p style="text-align: center;"><b>Sphere</b></p> <p>Surface Area = <math>4\pi r^2</math>              Volume = <math>4/3 \pi r^3</math></p>



















## GRAPH CHART










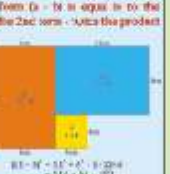

## MATHEMATICAL SYMBOL

<ul style="list-style-type: none"> <li><math>+</math> Plus; Positive</li> <li><math>-</math> Minus; Negative</li> <li><math>\pm</math> Plus or minus; error margin</li> <li><math>\mp</math> Minus or plus</li> <li><math>\times</math> Multiplied by</li> <li><math>\div</math> Divided by</li> <li><math>=</math> Equal to</li> <li><math>\neq</math> Not equal to</li> <li><math>\approx</math> Approximately equal to</li> <li><math>\therefore</math> Ratio or such that</li> <li><math>&gt;</math> Greater than</li> <li><math>&lt;</math> Less than</li> <li><math>\propto</math> Directly proportional to</li> <li><math>\infty</math> Infinity</li> <li><math>\sqrt{\quad}</math> Square root</li> <li><math>!</math> Factorial</li> <li><math>\%</math> Percent</li> <li><math>\nabla</math> Del (differential operator)</li> <li><math>^\circ</math> Degrees</li> </ul>	<ul style="list-style-type: none"> <li><math>\int</math> Integral</li> <li><math>\angle</math> Angle</li> <li><math>\perp</math> Perpendicular</li> <li><math>\parallel</math> Parallel</li> <li><math>\cong</math> Congruent to</li> <li><math>\therefore</math> Therefore</li> <li><math>\because</math> Because</li> <li><math>\forall</math> For all</li> <li><math>\setminus</math> Set</li> <li><math>\cup</math> Union</li> <li><math>\cap</math> Intersection</li> <li><math>\subset</math> Is a subset of</li> <li><math>\not\subset</math> Is not a subset of</li> <li><math>\Rightarrow</math> Implies that</li> <li><math>\Leftarrow</math> Is implied by</li> <li><math>\Leftrightarrow</math> If and only if</li> <li>etc.</li> <li><math>\circ</math> Composite function</li> <li><math>\Delta</math> Increment</li> <li><math>\Sigma</math> Sum</li> </ul>
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## SHAPES AND FIGURES

 <p><b>Triangle</b></p> <p>A three-sided closed polygon. The sum of the angles is 180 degrees.</p>	 <p><b>Scalene Triangle</b></p> <p>A triangle having no equal sides or angles.</p>	 <p><b>Isosceles Triangle</b></p> <p>A triangle having two equal sides or angles.</p>
 <p><b>Equilateral Triangle</b></p> <p>A triangle having three equal sides or angles. The angles are each 60 degrees.</p>	 <p><b>Right Triangle</b></p> <p>A triangle having a right angle (90 degrees). The other two angles are acute and sum to 90 degrees.</p>	 <p><b>Obtuse Triangle</b></p> <p>A triangle having one obtuse angle (more than 90 degrees).</p>
 <p><b>Quadrilateral</b></p> <p>A four-sided closed polygon. The sum of the angles is 360 degrees.</p>	 <p><b>Trapezium</b></p> <p>A four-sided polygon having one pair of parallel sides.</p>	 <p><b>Parallelogram</b></p> <p>A four-sided polygon having two pairs of parallel sides. The sum of the angles is 360 degrees.</p>
 <p><b>Rectangle</b></p> <p>A four-sided polygon having all angles equal to 90 degrees. The opposite sides are equal.</p>	 <p><b>Square</b></p> <p>A four-sided polygon having equal sides and all angles equal to 90 degrees. The sum of the angles is 360 degrees.</p>	 <p><b>Rhombus</b></p> <p>A four-sided polygon having all four sides of equal length. The sum of the angles is 360 degrees.</p>
 <p><b>Regular Polygon</b></p> <p>A regular polygon is a polygon where all sides are equal and all angles are equal. The sum of the angles is <math>(n-2) \times 180</math> degrees.</p>	 <p><b>Pentagon</b></p> <p>A five-sided polygon. The sum of the angles is 540 degrees.</p>	 <p><b>Hexagon</b></p> <p>A six-sided polygon. The sum of the angles is 720 degrees.</p>
 <p><b>Heptagon</b></p> <p>A seven-sided polygon. The sum of the angles is 900 degrees.</p>	 <p><b>Octagon</b></p> <p>An eight-sided polygon. The sum of the angles is 1080 degrees.</p>	 <p><b>Nonagon</b></p> <p>A nine-sided polygon. The sum of the angles is 1260 degrees.</p>

## ALGEBRAIC IDENTITIES

<p><b>Product of 2 Binomials</b></p>  <p><math>(a + b)(c + d) = ac + ad + bc + bd</math></p>	<p><b>Product of a Binomial and a Binomial</b></p>  <p><math>(a + b)(c - d) = ac - ad + bc - bd</math></p>	<p><b>Multiplication of Binomials</b></p>  <p><math>(a + b)(a - b) = a^2 - b^2</math></p>
<p>The square of a Binomial of the form <math>(a + b)</math> is equal to the square of the first term + square of the 2nd term + twice the product of both the terms.</p>  <p><math>(a + b)^2 = a^2 + 2ab + b^2</math></p>	<p>The square of a Binomial of the form <math>(a - b)</math> is equal to the square of the first term - square of the 2nd term - twice the product of both the terms.</p>  <p><math>(a - b)^2 = a^2 - 2ab + b^2</math></p>	<p>The square of a Binomial of the form <math>(a + b)</math> is equal to the square of the first term + square of the 2nd term - twice the product of both the terms.</p>  <p><math>(a + b)^2 - 4ab = a^2 + b^2</math></p>
<p>The product of the sum and difference of two quantities is equal to the difference of their squares.</p>  <p><math>(a + b)(a - b) = a^2 - b^2</math></p>	<p>The product of the sum and difference of two quantities is equal to the difference of their squares.</p>  <p><math>(a + b)(a - b) = a^2 - b^2</math></p>	<p>The product of the sum and difference of two quantities is equal to the difference of their squares.</p>  <p><math>(a + b)(a - b) = a^2 - b^2</math></p>

MUP01 : Number System

NUMBER SYSTEM	
<b>Natural Numbers</b> Counting numbers starting from 1.	1 2 3 4 5 ...
<b>Whole Numbers</b> When zero is added to Natural numbers, it gives whole numbers.	0 1 2 3 4 ...
<b>Integers</b> System of numbers containing whole numbers and negative of natural numbers is system of integers.	... -3 -2 -1 0 1 2 3
<b>Rational Numbers</b> A number in the form of $\frac{p}{q}$ , where p and q are integers and $q \neq 0$ , is a rational number.	$\frac{100}{17}$ $\frac{21}{31}$ $-\frac{61}{19}$ $-\frac{28}{1}$ $\frac{0}{1}$
<b>Even Numbers</b> Numbers exactly divisible by 2 are even numbers. Unit digit of even numbers is either 0, 2, 4, 6 or 8.	22 164 196 100 8 100
<b>Odd Numbers</b> Numbers which are not divisible by 2. Unit digit of odd numbers is either 1, 3, 5, 7 or 9.	31 197 289 199 83 105
<b>Prime Numbers</b> Numbers which have only two factors either 1 or the number itself. 2 is the smallest prime number.	2 3 5 7 11 13 ...
<b>Composite Numbers</b> Numbers which have more than two factors.	4 6 10 18 23 25 ...

MUP02 : Algebra (Definition & Formulae)

ALGEBRA Definitions & Formulae	
<b>Definitions</b>	
1. A combination of terms connected by sign of + and - is called an Algebraic Expression. 2. A monomial is another name for a term. 3. A binomial is made up of two monomials and a trinomial is made up of three monomials connected by + or signs. 4. A polynomial is made up of more than three terms (monomials) linked by + and - signs. 5. A linear equation is a statement of equality between two expressions of the first degree. 6. The value of a variable in an equation is called its root.	
<b>Formulae</b>	
1. $(a - b)^2 = a^2 + b^2 - 2ab$ 2. $(a + b)^2 = a^2 + b^2 + 2ab$ 3. $a^2 - b^2 = (a + b)(a - b)$ 4. $(a - b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$ 5. $(a - b)^3 = a^3 + b^3 + 3ab(a - b)$ 6. $(a - b)^3 = a^3 - b^3 - 3ab(a - b)$ 7. $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$ 8. $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$ 9. $a^3 + b^3 + c^3 - 3abc = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ca)$ 10. If $a + b + c = 0$ , then $a^3 + b^3 + c^3 = 3abc$	

MUP03 : Addition of Rational Numbers

ADDITION OF RATIONAL NUMBERS	
1	<b>Closure Property</b> :- The sum of two rational numbers is always a rational number. If a and b are two rational numbers and $a + b = c$ , then c is also a rational number.
2	<b>Commutative Property</b> :- Two rational numbers can be added in any order. If a and b are two rational numbers then $a + b = b + a$
3	<b>Associative Property</b> :- Three rational numbers to be added can be grouped in any order. If a, b and c are three rational numbers then $(a + b) + c = a + (b + c)$
4	<b>Addition of Zero</b> :- The sum of any rational number and zero is the rational number itself. 0 is a rational number such that for every rational number 'a', $a + 0 = 0 + a = a$
5	<b>Additive Inverse</b> :- The negative of a rational number added to it makes 0. So, the + and - forms of a rational number are called the additive inverse of each other. For rational number 'a' and -a, $a + (-a) = (-a) + a = 0$ is true. -a is additive inverse of a.
SUBTRACTION OF RATIONAL NUMBERS	
6	<b>Closure Property</b> :- The difference of two rational numbers is a rational number. If a and b are two rational numbers and $a - b = c$ then c is also a rational number.
7	<b>Subtraction is not Commutative</b> :- If a and b are two rational numbers and $a \neq b$ , then $a - b \neq b - a$ . If $a = b$ , then $a - b = b - a = 0$
8	<b>Subtraction is not Associative</b> :- If a, b and c are three rational numbers then $(a - b) - c \neq a - (b - c)$ , $c \neq 0$
9	<b>Subtraction with Zero</b> :- If a is a rational number then $a - 0 = a$ but $0 - a = -a$

MUP04 : Multiplication of Rational Numbers

MULTIPLICATION OF RATIONAL NUMBERS	
1	<b>Closure Property</b> :- The product of two rational numbers is always a rational number. If a and b are two rational numbers and $a \times b = c$ , then c is also a rational number.
2	<b>Commutative Property</b> :- Two rational numbers can be multiplied in any order. If a and b are two rational numbers then $a \times b = b \times a$
3	<b>Associative Property</b> :- Three or more rational numbers can be grouped in any order for multiplication. If a, b and c are three rational numbers then $a \times (b \times c) = (a \times b) \times c$
4	<b>Identity Element</b> :- The product of any rational numbers and 1 is the rational number itself. If a is a rational number then $a \times 1 = 1 \times a = a$ . Therefore 1 is identity element for multiplication.
5	<b>Multiplication with 0</b> :- Any rational number multiplied by 0 is equal to 0. If a is a rational number then $a \times 0 = 0 \times a = 0$
DIVISION OF RATIONAL NUMBERS	
6	<b>Closure Property</b> :- The division of two rational numbers is always a rational number. If a and b are two rational numbers and $a \div b = c$ , then c is also a rational number, $b \neq 0$
7	<b>Division is not Commutative</b> :- If a and b are two rational numbers then $a \div b \neq b \div a$
8	<b>Division is not Associative</b> :- If a, b and c are three rational numbers then $(a \div b) \div c \neq a \div (b \div c)$
9	<b>Division by 1</b> :- If a is a rational number then $a \div 1 = a$ and $1 \div a = \frac{1}{a} \neq a$
10	<b>Division by 0</b> :- If a is a rational number then $a \div 0$ is not possible and $0 \div a = 0$
11	If a, b and c are three rational numbers then 1. $a \div (b \times c) = a \div b \times a \div c = (a \div b) \times (a \div c)$ 2. $a \times (b \div c) = a \times b \div a \times c = (a \times b) \div (a \times c)$ 3. $(a \times b) \div c = a \div c \times b \div c = (a \div c) \times (b \div c)$ 4. $(a \div b) \times c = a \div b \times c = a \div (b \div c)$

MUP05 : Some Geometrical Concepts

SOME GEOMETRICAL CONCEPTS	
<b>Point</b> A dot having no length, width or depth, only fixed position is a point. It is represented by capital letters.	<b>Line</b> Line is a set of continuous points which extends indefinitely. It has no length, no width and no end points. It is represented by small letters written on one side.
<b>Line Segment</b> It is a part of a line. It has two end points. It has fixed length.	<b>Ray</b> A ray is a part of a line which has one end point. It extends indefinitely in one direction. It has indefinite length.
<b>Collinear Points</b> Three or more points lying on a same line are called Collinear Points. Points A, B, C, D, P, Q, and R are collinear.	<b>Non-Collinear Points</b> Points not lying on the same line are Non-Collinear points.
<b>Concurrent Lines</b> Three or more lines passing through the same point are concurrent lines. Point of intersection is called point of concurrence.	<b>Non-Concurrent Lines</b> Three or more lines which do not pass through the same point are non-concurrent lines.
<b>Perpendicular Lines</b> Lines intersecting each other at right angles.	<b>Parallel Lines</b> Two straight lines that are at the same distance and which do not meet each other are called parallel lines.
<b>Intersecting Lines</b> Lines which meet each other at a point are called intersecting lines. Point of meeting is called point of intersection.	<b>Perpendicular Bisector</b> A line which bisects a line segment at right angle.

MUP06 : Angles

ANGLES	
<b>Acute angle</b> Angle of measure less than 90° and greater than 0°.	<b>Right angle</b> Angle of measure of 90°.
<b>Obtuse angle</b> Angle of measure greater than 90° but less than 180°.	<b>Straight angle</b> Angle of measure of 180°.
<b>Reflex angle</b> Angle of measure greater than 180° but less than 360°.	<b>Complete angle</b> Angle of measure of 360°.
<b>Complementary angles</b> If the sum of measures of two angles is equal to 90°, then they are complementary angles.	<b>Supplementary angles</b> If the sum of measures of two angles is equal to 180°, then they are supplementary angles.

MUP07 : Pair of Angles

PAIR OF ANGLES	
<b>ADJACENT ANGLES</b> Two angles having a common vertex and one common side and the other two sides or opposite sides of the common arm are called adjacent angles.	<b>LINEAR PAIR</b> Pair of adjacent angles whose sum is 180°. In linear pair of angles opposite rays form straight line.
<b>VERTICALLY OPPOSITE ANGLES</b> Pair of angles made by two intersecting lines so that no arm is common. Vertically opposite angles are always equal to each other.	<b>CORRESPONDING ANGLES</b> A pair of exterior and interior angles formed when a transversal intersects two lines so that both the angles are on the same side of the transversal and they are not forming linear pair.
<b>ALTERNATE ANGLES</b> A pair of exterior and interior angles formed when a transversal intersects two lines so that the angles are on opposite sides of the transversal and they are not forming linear pair.	<b>INTERIOR ADJACENT ANGLES</b> Pair of interior angles formed on the same side of a transversal when it intersects two lines.

MUP08 : Triangles

TRIANGLES	
A CLOSED FIGURE MADE UP OF THREE LINE SEGMENTS & THREE ANGLES	
<b>WHAT TRIANGLES HAVE</b>	
A. Three sides B. Three angles C. Three vertices D. Total of 6 angles = 360° E. An exterior angle equals the sum of its two interior opposite angles. F. The sum of any two sides of a triangle is greater than the third side.	
<b>WHAT TRIANGLES CANNOT HAVE</b>	
A. Two right angles B. Two obtuse angles C. All angles = 90° D. All angles = 60° E. One obtuse and one right angle	
<b>Equilateral Triangle</b> All sides equal All angles are also equal	<b>Isosceles Triangle</b> Two sides equal Two angles are also equal
<b>Acute Triangle</b> All angles less than 90°	<b>Obtuse Triangle</b> One angle more than 90°
<b>Right Triangle</b> One angle 90°	<b>Pythagoras Theorem</b> In a right triangle, the square of the hypotenuse equals the sum of the squares of its sides.
The altitudes of a triangle are concurrent i.e. they meet at a point called orthocentre.	The three medians of a triangle are concurrent i.e. they meet at a point called centroid.
Angle bisector of a triangle are concurrent and meet at a point called incentre.	Perpendicular bisectors of three sides of a triangle are concurrent and meet at a point called circumcentre.

MUP09 : Quadrilaterals

### QUADRILATERALS

Closed Figure made up of four line segments

**Properties of Quadrilaterals**

- Points A, B, C, D are called the vertices of the quadrilateral.
- Line segments AB, BC, CD and DA are called the sides of the quadrilateral.
- Four angles of the quadrilateral ABCD are  $\angle A, \angle B, \angle C, \angle D$ .
- The two line segments joining the opposite vertices are called diagonals.
- The sum of the angles of a quadrilateral is  $360^\circ$ .

**Convex Quadrilateral**

With each of its angles less than  $180^\circ$ .

**Concave Quadrilateral**

With one angle more than  $180^\circ$ .

**Trapezium**

A quadrilateral with one pair of parallel sides and the other two not parallel.

**Parallelogram**

A quadrilateral with two pairs of parallel sides parallel.

- The opposite sides of a parallelogram are equal and parallel.
- The opposite angles of a parallelogram are equal.
- Diagonals of a parallelogram bisect each other.

**Rhombus**

A quadrilateral with all four sides equal.

The diagonals of a rhombus bisect each other at right angle.

**Rectangle**

A quadrilateral with each of its angles a right angle.

- Opposite sides of a rectangle are equal.
- Opposite angles of a rectangle are equal.
- Diagonals of a rectangle are equal.
- Diagonals of a rectangle bisect each other.

**Square**

- Perimeter is equal to  $4 \times$  side.
- Area of a square is side  $\times$  side.
- Each angle of a square is a right angle.
- The diagonals of a square bisect each other at right angle.

MUP10 : Circle

### CIRCLE

Set of all points equidistant from a fixed point called centre, is a circle.

**Radius** : Fixed distance (OC) between centre and circle.  
**Diameter** : Chord (AB) passing through centre.  
 Diameter = 2  $\times$  radius.

**Circumference**

Perimeter of circle.

$C = 2\pi r$

**Chord**

Line segment joining two points on the circle.

Diameter (PQ) is the longest chord.

**Semicircle**

Perimeter of semicircle =  $\pi r$

Diameter divides the circle in two equal parts and each part is called semicircle.

**Arc**

Continuous piece of a circle is an arc.

PAQ is major arc.  
PBQ is minor arc.

**Sector**

Region lying between an arc and two radii joining end points of arc and centre is called sector. Sector with greater central angle is major sector. Sector with central angle of  $90^\circ$  is quadrant.

**Segment**

Two parts of a circular region divided by a chord are segments. Segment with major arc is major segment. Segment with minor arc is minor segment.

**Area**

Region occupied by the circular disc is called Area of the circle.

Area of a circle =  $\pi r^2$

**Concentric Circles**

Circles with different radii and same centre.

$\pi = 22/7$  or  $3.14$      $r$  = Radius     $\theta$  = Central angle  
 $c$  = Circumference

MUP11 : Congruent Triangles

### CONGRUENT TRIANGLES

Two triangles are congruent if

- Their corresponding sides are equal.
- Their corresponding angles are equal.

**SSS - Congruency**

If the corresponding sides of two triangles are equal, they are congruent.

$\triangle ABC \cong \triangle PQR$  (SSS)

**ASA - Congruency**

If two angles and included side of a triangle is equal to two corresponding sides and included angle of another triangle, then they are congruent.

$\triangle ABC \cong \triangle PQR$  (ASA)

**AAS - Congruency**

If two angles and a side of a triangle is equal to two corresponding angles and a corresponding side of another triangle then they are congruent.

$\triangle ABC \cong \triangle PQR$  (AAS)

**RHS - Congruency**

If the hypotenuse of a right triangle and a side is equal to the hypotenuse and a side of another right triangle, then they are congruent.

$\triangle ABC \cong \triangle PQR$  (RHS)

MUP12 : Properties of Circle

### PROPERTIES OF CIRCLE

Perpendicular drawn from the centre of circle to a chord bisects the chord.

$OM \perp AB$   
 $AM = MB$

In a circle, line joining the centre of circle to the mid point of a chord is perpendicular to the chord.

$AM = MB$   
 $OM \perp AB$

Equal chords of a circle are equidistant from the centre.

$AB = PQ$   
and  $OM = AN, OM = PN$   
 $OM = ON$

Chords of a circle equidistant from the centre are equal.

$OM \perp AB, OM \perp PQ$   
and  $OM = ON$   
and  $OM = OM$   
 $AB = PQ$

Equal chords of a circle subtend equal angles at the centre.

$AB = PQ$   
 $\angle AOB = \angle POQ$

Chords of a circle which subtend equal angles at the centre are equal.

$\angle AOB = \angle POQ = x^\circ$   
 $AB = PQ$

Angle subtended by an arc of a circle at the centre is twice the angle subtended by it at any point of the alternate segment of the circle.

$m \angle AOB = \angle ACB$   
 $\angle AOB = 2 \angle ACB$

Sum of either pair of opposite angles of a cyclic quadrilateral is  $180^\circ$ .

In cyclic quadrilateral ABCD  
 $\angle A + \angle C = 180^\circ$   
 $\angle B + \angle D = 180^\circ$

- Angle in the semi-circle is right angle.
- Angle in the major arc is acute angle.
- Angle in the minor arc is obtuse angle.

MUP13 : Mensuration - I

Figure	Area	Perimeter	Illustrations
	$l \times b$	$2 \times (l + b)$	$l$ = length $b$ = breadth
	$s \times s$	$4 \times s$	$s$ = side
	$\frac{1}{2} \times d \times (h_1 + h_2)$	$p + q + r + s$	$d$ = diagonal $h_1, h_2$ = altitudes $p, q, r, s$ = sides
	$\frac{1}{2} \times b \times h$ or $\frac{s_1(s_2)(s_3)}{2}$	$a + b + c$	$h$ = altitude $a, c$ = sides $b$ = base $s = \frac{a + b + c}{2}$
	$b \times h$	$2 \times (a + b)$	$h$ = altitude $a$ = side $b$ = base
	$\frac{1}{2} \times d_1 \times d_2$ or $h \times s$	$4 \times s$	$d_1, d_2$ = diagonal $h$ = altitude $s$ = side
	$\frac{1}{2} \times (a + b) \times h$	$a + b + c + d$	$a, b$ = parallel sides $c, d$ = non-parallel sides $h$ = altitude
	$\pi r^2$	$2\pi r$	$\pi = 3.14$ or $22/7$ $r$ = radius

MUP14 : Mensuration - II

Figure	Lateral Surface Area	Total Surface Area	Volume	Illustrations
	$2(l + b) \times h$	$2(lb + bh + lh)$	$lbh$	$l$ = length $b$ = breadth $h$ = height
	$4s^2$	$6s^2$	$s^3$	$s$ = Side
	$2\pi rh$	$2\pi r(r + h)$	$\pi r^2 h$	$\pi = 3.14$ or $22/7$ $r$ = Radius $h$ = height
	$\pi rl$	$\pi r(l + r)$	$\frac{1}{3} \pi r^2 h$	$\pi = 3.14$ or $22/7$ $r$ = Radius $h$ = height $l$ = Slant Height $l^2 = r^2 + h^2$
	—	$4\pi r^2$	$\frac{4}{3} \pi r^3$	$\pi = 3.14$ or $22/7$ $r$ = Radius
	—	$3\pi r^2$	$\frac{2}{3} \pi r^3$	$\pi = 3.14$ or $22/7$ $r$ = Radius

MUP15 : Profit & Loss

	PROFIT & LOSS
1	<b>Gain</b> = Selling Price - Cost Price when (Selling Price > Cost Price)
2	<b>Loss</b> = Cost Price - Selling Price when (Cost Price > Selling Price)
3	<b>Gain %</b> = $\frac{\text{Gain} \times 100}{\text{Cost Price}}$
4	<b>Loss %</b> = $\frac{\text{Loss} \times 100}{\text{Cost Price}}$
5	<b>Selling Price</b> = $\frac{(100 + \text{Gain \%}) \times \text{Cost Price}}{100}$
6	<b>Selling Price</b> = $\frac{(100 - \text{Loss \%}) \times \text{Cost Price}}{100}$
7	<b>Cost Price</b> = $\frac{\text{Selling Price} \times 100}{100 + \text{Gain \%}}$
8	<b>Cost Price</b> = $\frac{\text{Selling Price} \times 100}{100 - \text{Loss \%}}$
9	<b>Discount</b> = List Price - Selling Price
10	<b>Discount Rate</b> = <b>Discount %</b> = $\frac{\text{Discount} \times 100}{\text{List Price}}$
11	<b>Selling Price</b> = $\frac{\text{List Price} \times (100 - \text{Discount \%})}{100}$
12	<b>List Price</b> = $\frac{100 \times \text{Selling Price}}{100 - \text{Discount \%}}$



UM001 : Time

# Time

### : TIME PERIODS :

**60 SECONDS** in each **MINUTE**

**60 MINUTES** in each **HOUR**

**24 HOURS** in each **DAY**

**7 DAYS** in each **WEEK**

**4 WEEKS** in each **MONTH**

**12 MONTHS** in each **YEAR**

**100 YEARS** in each **CENTURY**

**1000 YEARS** in each **MILLENNIUM**

**0' Clock**

6:00

**Morning Time**

**Quarter Past**

7:15

**School Time**

**Half Past**

1:30

**Lunch Time**

**Quarter To**

10:45

**Sleeping Time**

### What's The Time

0' CLOCK	FIVE PAST	TEN PAST	QUARTER PAST
TWENTY PAST	TWENTY FIVE PAST	HALF PAST	TWENTY FIVE TO
TWENTY TO	QUARTER TO	TEN TO	FIVE TO

### Converting

12

Hour Clock

to

24

Hour Clock

12 Midnight to 12 Noon (a.m.)	
0000 hrs = 12 Midnight	0600 hrs = 6 a.m.
0100 hrs = 1 a.m.	0700 hrs = 7 a.m.
0200 hrs = 2 a.m.	0800 hrs = 8 a.m.
0300 hrs = 3 a.m.	0900 hrs = 9 a.m.
0400 hrs = 4 a.m.	1000 hrs = 10 a.m.
0500 hrs = 5 a.m.	1100 hrs = 11 a.m.
12 Noon to 12 Midnight (p.m.)	
1200 hrs = 12 Noon	1800 hrs = 6 p.m.
1300 hrs = 1 p.m.	1900 hrs = 7 p.m.
1400 hrs = 2 p.m.	2000 hrs = 8 p.m.
1500 hrs = 3 p.m.	2100 hrs = 9 p.m.
1600 hrs = 4 p.m.	2200 hrs = 10 p.m.
1700 hrs = 5 p.m.	2300 hrs = 11 p.m.

UM002 : Sets

# Sets

A set is a well-defined collection of objects. A set can contain any number of members or objects and these are called **elements**.

Sets are usually denoted by capital letter A, X, Y etc. The elements of a set are written inside curly brackets.

**Set A = {1, 2, 3, 5, 7, 9, 11}**

**Set B = {1, 4, 6, 8, 10, 12}**

**U = Universal set: Elements**

**U = any element of {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}**

### Two Methods of Representing a Set

**ROSTER OR TABULAR FORM:** all elements of a set are listed, separated by commas and enclosed within braces { }.

**SET BUILDER FORM:** all elements of a set possess a single common property not possessed by element outside the set.

**Set P = {x : x = -3, -2, -1, 0, 1, 2, 3, ...}**

**Set Q = {x : x is a month of a year having 30 days}**

**Set R = {-4, -1, 2, 3, 4, 5, 6, 7, 8, 9}**

**Set S = {x : x is an integer and x<sup>2</sup> - 25 = 0}**

**Set T = {x : x = 1/n, where n is a natural number}**

### VENN DIAGRAMS

**UNION (∪):** a union contains all elements from each set.

**INTERSECTION (∩):** means the elements which are common to all sets.

**SUBSETS (⊂):** means that if set B is contained within set A, then B is a subset of A.

**COMPLEMENT (A'):** A means complement of A, i.e. other than all elements which are not in A.

UM102 : HCF and LCM

# HCF and LCM

### Common Factors and Highest Common Factor

When we multiply two or more numbers, we get a product. These numbers are called the factors of the product.

**Factors of 18:** 1, 2, 3, 6, 9, 18

**Factors of 24:** 1, 2, 3, 4, 6, 8, 12, 24

**Common Factors:** 1, 2, 3, 6

**HCF:** 6

### Common Multiples and Least Common Multiple

When we multiply a number by an integer we get a multiple.

**Multiples of 12:** 12, 24, 36, 48, 60, 72, 84, 96, 108, 120, 132, 144, 156, 168, 180, 192, 204, 216, 228, 240, 252, 264, 276, 288, 300, 312, 324, 336, 348, 360, 372, 384, 396, 408, 420, 432, 444, 456, 468, 480, 492, 504, 516, 528, 540, 552, 564, 576, 588, 600, 612, 624, 636, 648, 660, 672, 684, 696, 708, 720, 732, 744, 756, 768, 780, 792, 804, 816, 828, 840, 852, 864, 876, 888, 900, 912, 924, 936, 948, 960, 972, 984, 996, 1008, 1020, 1032, 1044, 1056, 1068, 1080, 1092, 1104, 1116, 1128, 1140, 1152, 1164, 1176, 1188, 1200, 1212, 1224, 1236, 1248, 1260, 1272, 1284, 1296, 1308, 1320, 1332, 1344, 1356, 1368, 1380, 1392, 1404, 1416, 1428, 1440, 1452, 1464, 1476, 1488, 1500, 1512, 1524, 1536, 1548, 1560, 1572, 1584, 1596, 1608, 1620, 1632, 1644, 1656, 1668, 1680, 1692, 1704, 1716, 1728, 1740, 1752, 1764, 1776, 1788, 1800, 1812, 1824, 1836, 1848, 1860, 1872, 1884, 1896, 1908, 1920, 1932, 1944, 1956, 1968, 1980, 1992, 2004, 2016, 2028, 2040, 2052, 2064, 2076, 2088, 2100, 2112, 2124, 2136, 2148, 2160, 2172, 2184, 2196, 2208, 2220, 2232, 2244, 2256, 2268, 2280, 2292, 2304, 2316, 2328, 2340, 2352, 2364, 2376, 2388, 2400, 2412, 2424, 2436, 2448, 2460, 2472, 2484, 2496, 2508, 2520, 2532, 2544, 2556, 2568, 2580, 2592, 2604, 2616, 2628, 2640, 2652, 2664, 2676, 2688, 2700, 2712, 2724, 2736, 2748, 2760, 2772, 2784, 2796, 2808, 2820, 2832, 2844, 2856, 2868, 2880, 2892, 2904, 2916, 2928, 2940, 2952, 2964, 2976, 2988, 3000, 3012, 3024, 3036, 3048, 3060, 3072, 3084, 3096, 3108, 3120, 3132, 3144, 3156, 3168, 3180, 3192, 3204, 3216, 3228, 3240, 3252, 3264, 3276, 3288, 3300, 3312, 3324, 3336, 3348, 3360, 3372, 3384, 3396, 3408, 3420, 3432, 3444, 3456, 3468, 3480, 3492, 3504, 3516, 3528, 3540, 3552, 3564, 3576, 3588, 3600, 3612, 3624, 3636, 3648, 3660, 3672, 3684, 3696, 3708, 3720, 3732, 3744, 3756, 3768, 3780, 3792, 3804, 3816, 3828, 3840, 3852, 3864, 3876, 3888, 3900, 3912, 3924, 3936, 3948, 3960, 3972, 3984, 3996, 4008, 4020, 4032, 4044, 4056, 4068, 4080, 4092, 4104, 4116, 4128, 4140, 4152, 4164, 4176, 4188, 4200, 4212, 4224, 4236, 4248, 4260, 4272, 4284, 4296, 4308, 4320, 4332, 4344, 4356, 4368, 4380, 4392, 4404, 4416, 4428, 4440, 4452, 4464, 4476, 4488, 4500, 4512, 4524, 4536, 4548, 4560, 4572, 4584, 4596, 4608, 4620, 4632, 4644, 4656, 4668, 4680, 4692, 4704, 4716, 4728, 4740, 4752, 4764, 4776, 4788, 4800, 4812, 4824, 4836, 4848, 4860, 4872, 4884, 4896, 4908, 4920, 4932, 4944, 4956, 4968, 4980, 4992, 5004, 5016, 5028, 5040, 5052, 5064, 5076, 5088, 5100, 5112, 5124, 5136, 5148, 5160, 5172, 5184, 5196, 5208, 5220, 5232, 5244, 5256, 5268, 5280, 5292, 5304, 5316, 5328, 5340, 5352, 5364, 5376, 5388, 5400, 5412, 5424, 5436, 5448, 5460, 5472, 5484, 5496, 5508, 5520, 5532, 5544, 5556, 5568, 5580, 5592, 5604, 5616, 5628, 5640, 5652, 5664, 5676, 5688, 5700, 5712, 5724, 5736, 5748, 5760, 5772, 5784, 5796, 5808, 5820, 5832, 5844, 5856, 5868, 5880, 5892, 5904, 5916, 5928, 5940, 5952, 5964, 5976, 5988, 6000, 6012, 6024, 6036, 6048, 6060, 6072, 6084, 6096, 6108, 6120, 6132, 6144, 6156, 6168, 6180, 6192, 6204, 6216, 6228, 6240, 6252, 6264, 6276, 6288, 6300, 6312, 6324, 6336, 6348, 6360, 6372, 6384, 6396, 6408, 6420, 6432, 6444, 6456, 6468, 6480, 6492, 6504, 6516, 6528, 6540, 6552, 6564, 6576, 6588, 6600, 6612, 6624, 6636, 6648, 6660, 6672, 6684, 6696, 6708, 6720, 6732, 6744, 6756, 6768, 6780, 6792, 6804, 6816, 6828, 6840, 6852, 6864, 6876, 6888, 6900, 6912, 6924, 6936, 6948, 6960, 6972, 6984, 6996, 7008, 7020, 7032, 7044, 7056, 7068, 7080, 7092, 7104, 7116, 7128, 7140, 7152, 7164, 7176, 7188, 7200, 7212, 7224, 7236, 7248, 7260, 7272, 7284, 7296, 7308, 7320, 7332, 7344, 7356, 7368, 7380, 7392, 7404, 7416, 7428, 7440, 7452, 7464, 7476, 7488, 7500, 7512, 7524, 7536, 7548, 7560, 7572, 7584, 7596, 7608, 7620, 7632, 7644, 7656, 7668, 7680, 7692, 7704, 7716, 7728, 7740, 7752, 7764, 7776, 7788, 7800, 7812, 7824, 7836, 7848, 7860, 7872, 7884, 7896, 7908, 7920, 7932, 7944, 7956, 7968, 7980, 7992, 8004, 8016, 8028, 8040, 8052, 8064, 8076, 8088, 8100, 8112, 8124, 8136, 8148, 8160, 8172, 8184, 8196, 8208, 8220, 8232, 8244, 8256, 8268, 8280, 8292, 8304, 8316, 8328, 8340, 8352, 8364, 8376, 8388, 8400, 8412, 8424, 8436, 8448, 8460, 8472, 8484, 8496, 8508, 8520, 8532, 8544, 8556, 8568, 8580, 8592, 8604, 8616, 8628, 8640, 8652, 8664, 8676, 8688, 8700, 8712, 8724, 8736, 8748, 8760, 8772, 8784, 8796, 8808, 8820, 8832, 8844, 8856, 8868, 8880, 8892, 8904, 8916, 8928, 8940, 8952, 8964, 8976, 8988, 9000, 9012, 9024, 9036, 9048, 9060, 9072, 9084, 9096, 9108, 9120, 9132, 9144, 9156, 9168, 9180, 9192, 9204, 9216, 9228, 9240, 9252, 9264, 9276, 9288, 9300, 9312, 9324, 9336, 9348, 9360, 9372, 9384, 9396, 9408, 9420, 9432, 9444, 9456, 9468, 9480, 9492, 9504, 9516, 9528, 9540, 9552, 9564, 9576, 9588, 9600, 9612, 9624, 9636, 9648, 9660, 9672, 9684, 9696, 9708, 9720, 9732, 9744, 9756, 9768, 9780, 9792, 9804, 9816, 9828, 9840, 9852, 9864, 9876, 9888, 9900, 9912, 9924, 9936, 9948, 9960, 9972, 9984, 9996, 10000.

**LCM:** 60

UM101 : Fractions, Decimal & Percentage

# Fractions, Decimal & Percentage

### FRACTIONS

A fraction is a part of a whole.

**Mixed Number:** 1 3/4

### PERCENTAGE

Percent simply means **Per Hundred**. Percent is a ratio that compares a number to 100.

### DECIMAL

Decimal Numbers are Another Way of Writing Fraction Numbers.

Not a hundredth	1/100	0.01	1%
A thousandth	1/1000	0.001	0.1%
One and a half percent	1.5/100	0.015	1.5%
Twenty eight percent	28/100	0.28	28%
Two hundred forty nine and three hundredths	249.3/100	2.493	249.3%

### CHANGING FRACTION TO PERCENT TO DECIMAL

**Fraction to Percent:** Multiply by 100, simplify, add % sign.

**Percent to Fraction:** Divide by 100, remove % sign, simplify.

**Fraction to Decimal:** Divide by denominator, simplify.

**Decimal to Fraction:** Multiply by 100, remove decimal point, simplify.

UM103 : Ratio and Proportion

# Ratio and Proportion

### Ratio

A ratio is a comparison of two numbers. These numbers are called the terms of the ratio.

**Apple to Mangoes:** 6 to 7

**Mangoes to the Total Number of Fruits:** 7 to 13

**Apples to the Total Number of Fruits:** 6 to 13

### Proportion

A proportion is an equation showing that two ratios are equal. Ratios that are equal to each other are called equivalent ratios.

**Example:** 2/3 = 4/6

**Example:** 1/2 = 2/4

**Example:** 3/4 = 6/8

### UM104 : Number Patterns

## Number Patterns

A PATTERN IS FORMED WHEN THERE IS A COMMON RELATIONSHIP IN A LIST OF NUMBERS.

**Triangular numbers:** 1, 3, 6, 10, 15, 21, 28, 36, 45, 55, 66, 78, 91, 105, 120, 136, 153, 171, 190, 210, 231, 252, 273, 295, 318, 342, 367, 393, 420, 448, 477, 507, 538, 570, 603, 637, 672, 708, 745, 783, 822, 862, 903, 945, 988, 1032, 1077, 1123, 1170, 1218, 1267, 1317, 1368, 1420, 1473, 1527, 1582, 1638, 1695, 1753, 1812, 1872, 1933, 1995, 2058, 2122, 2187, 2253, 2320, 2388, 2457, 2527, 2598, 2670, 2743, 2817, 2892, 2968, 3045, 3123, 3202, 3282, 3363, 3445, 3528, 3612, 3697, 3783, 3870, 3958, 4047, 4137, 4228, 4320, 4413, 4507, 4602, 4698, 4795, 4893, 4992, 5092, 5193, 5295, 5398, 5502, 5607, 5713, 5820, 5928, 6037, 6147, 6258, 6370, 6483, 6597, 6712, 6828, 6945, 7063, 7182, 7302, 7423, 7545, 7668, 7792, 7917, 8043, 8170, 8298, 8427, 8557, 8688, 8820, 8953, 9087, 9222, 9358, 9495, 9633, 9772, 9912, 10053, 10195, 10338, 10482, 10627, 10773, 10920, 11068, 11217, 11367, 11518, 11670, 11823, 11977, 12132, 12288, 12445, 12603, 12762, 12922, 13083, 13245, 13408, 13572, 13737, 13903, 14070, 14238, 14407, 14577, 14748, 14920, 15093, 15267, 15442, 15618, 15795, 15973, 16152, 16332, 16513, 16695, 16878, 17062, 17247, 17433, 17620, 17808, 17997, 18187, 18378, 18570, 18763, 18957, 19152, 19348, 19545, 19743, 19942, 20142, 20343, 20545, 20748, 20952, 21157, 21363, 21570, 21778, 21987, 22197, 22408, 22620, 22833, 23047, 23262, 23478, 23695, 23913, 24132, 24352, 24573, 24795, 25018, 25242, 25467, 25693, 25920, 26148, 26377, 26607, 26838, 27070, 27303, 27537, 27772, 28008, 28245, 28483, 28722, 28962, 29203, 29445, 29688, 29932, 30177, 30423, 30670, 30918, 31167, 31417, 31668, 31920, 32173, 32427, 32682, 32938, 33195, 33453, 33712, 33972, 34233, 34495, 34758, 35022, 35287, 35553, 35820, 36088, 36357, 36627, 36898, 37170, 37443, 37717, 37992, 38268, 38545, 38823, 39102, 39382, 39663, 39945, 40228, 40512, 40797, 41083, 41370, 41658, 41947, 42237, 42528, 42820, 43113, 43407, 43702, 44000, 44299, 44599, 44900, 45202, 45505, 45809, 46114, 46420, 46727, 47035, 47344, 47654, 47965, 48277, 48590, 48904, 49219, 49535, 49852, 50170, 50489, 50809, 51130, 51452, 51775, 52100, 52426, 52753, 53081, 53410, 53740, 54071, 54403, 54736, 55070, 55405, 55741, 56078, 56416, 56755, 57095, 57436, 57778, 58121, 58465, 58810, 59156, 59503, 59851, 60200, 60550, 60901, 61253, 61606, 61960, 62315, 62671, 63028, 63386, 63745, 64105, 64466, 64828, 65191, 65555, 65920, 66286, 66653, 67021, 67390, 67760, 68131, 68503, 68876, 69250, 69625, 70001, 70378, 70756, 71135, 71515, 71896, 72278, 72661, 73045, 73430, 73816, 74203, 74591, 74980, 75370, 75761, 76153, 76546, 76940, 77335, 77731, 78128, 78526, 78925, 79325, 79726, 80128, 80531, 80935, 81340, 81746, 82153, 82561, 82970, 83380, 83791, 84203, 84616, 85030, 85445, 85861, 86278, 86696, 87115, 87535, 87956, 88378, 88801, 89225, 89650, 90076, 90503, 90931, 91360, 91790, 92221, 92653, 93086, 93520, 93955, 94391, 94828, 95266, 95705, 96145, 96586, 97028, 97471, 97915, 98360, 98806, 99253, 99701, 100150, 100600, 101051, 101503, 101956, 102410, 102865, 103321, 103778, 104236, 104695, 105155, 105616, 106078, 106541, 107005, 107470, 107936, 108403, 108871, 109340, 109810, 110281, 110753, 111226, 111700, 112175, 112651, 113128, 113606, 114085, 114565, 115046, 115528, 116011, 116495, 116980, 117466, 117953, 118441, 118930, 119420, 119911, 120403, 120896, 121390, 121885, 122381, 122878, 123376, 123875, 124375, 124876, 125378, 125881, 126385, 126890, 127396, 127903, 128411, 128920, 129430, 129941, 130453, 130966, 131480, 131995, 132511, 133028, 133546, 134065, 134585, 135106, 135628, 136151, 136675, 137200, 137726, 138253, 138781, 139310, 139840, 140371, 140903, 141436, 141970, 142505, 143041, 143578, 144116, 144655, 145195, 145736, 146278, 146821, 147365, 147910, 148456, 149003, 149551, 150100, 150650, 151201, 151753, 152306, 152860, 153415, 153971, 154528, 155086, 155645, 156205, 156766, 157328, 157891, 158455, 159020, 159586, 160153, 160721, 161290, 161860, 162431, 163003, 163576, 164150, 164725, 165301, 165878, 166456, 167035, 167615, 168196, 168778, 169361, 169945, 170530, 171116, 171703, 172291, 172880, 173470, 174061, 174653, 175246, 175840, 176435, 177031, 177628, 178226, 178825, 179425, 180026, 180628, 181231, 181835, 182440, 183046, 183653, 184261, 184870, 185480, 186091, 186703, 187316, 187930, 188545, 189161, 189778, 190396, 191015, 191635, 192256, 192878, 193501, 194125, 194750, 195376, 196003, 196631, 197260, 197890, 198521, 199153, 199786, 200420, 201055, 201691, 202328, 202966, 203605, 204245, 204886, 205528, 206171, 206815, 207460, 208106, 208753, 209401, 210050, 210700, 211351, 212003, 212656, 213310, 213965, 214621, 215278, 215936, 216595, 217255, 217916, 218578, 219241, 219905, 220570, 221236, 221903, 222571, 223240, 223910, 224581, 225253, 225926, 226600, 227275, 227951, 228628, 229306, 230000, 230695, 231391, 232088, 232786, 233485, 234185, 234886, 235588, 236291, 236995, 237700, 238406, 239113, 239821, 240530, 241240, 241951, 242663, 243376, 244090, 244805, 245521, 246238, 246956, 247675, 248395, 249116, 249838, 250561, 251285, 252010, 252736, 253463, 254191, 254920, 255650, 256381, 257113, 257846, 258580, 259315, 260051, 260788, 261526, 262265, 263005, 263746, 264488, 265231, 265975, 266720, 267466, 268213, 268961, 269710, 270460, 271211, 271963, 272716, 273470, 274225, 274981, 275738, 276496, 277255, 278015, 278776, 279538, 280301, 281065, 281830, 282596, 283363, 284131, 284900, 285670, 286441, 287213, 287986, 288760, 289535, 290311, 291088, 291866, 292645, 293425, 294206, 294988, 295771, 296555, 297340, 298126, 298913, 299701, 300490, 301280, 302071, 302863, 303656, 304450, 305245, 306041, 306838, 307636, 308435, 309235, 310036, 310838, 311641, 312445, 313250, 314056, 314863, 315671, 316480, 317290, 318101, 318913, 319726, 320540, 321355, 322171, 322988, 323806, 324625, 325445, 326266, 327088, 327911, 328735, 329560, 330386, 331213, 332041, 332870, 333700, 334531, 335363, 336196, 337030, 337865, 338701, 339538, 340376, 341215, 342055, 342896, 343738, 344581, 345425, 346270, 347116, 347963, 348811, 349660, 350510, 351361, 352213, 353066, 353920, 354775, 355631, 356488, 357346, 358205, 359065, 359926, 360788, 361651, 362515, 363380, 364246, 365113, 365981, 366850, 367720, 368591, 369463, 370336, 371210, 372085, 372961, 373838, 374716, 375595, 376475, 377356, 378238, 379121, 380005, 380890, 381776, 382663, 383551, 384440, 385330, 386221, 387113, 388006, 388900, 389795, 390691, 391588, 392486, 393385, 394285, 395186, 396088, 396991, 397895, 398800, 399706, 400613, 401521, 402430, 403340, 404251, 405163, 406076, 406990, 407905, 408821, 409738, 410656, 411575, 412495, 413416, 414338, 415261, 416185, 417110, 418036, 418963, 419891, 420820, 421750, 422681, 423613, 424546, 425480, 426415, 427351, 428288, 429226, 430165, 431105, 432046, 432988, 433931, 434875, 435820, 436766, 437713, 438661, 439610, 440560, 441511, 442463, 443416, 444370, 445325, 446281, 447238, 448196, 449155, 450115, 451076, 452038, 453001, 453965, 454930, 455896, 456863, 457831, 458800, 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586878, 587931, 588984, 590038, 591092, 592147, 593202, 594258, 595314, 596371, 597428, 598486, 599544, 600603, 601662, 602722, 603782, 604843, 605904, 606965, 608027, 609089, 610152, 611215, 612279, 613343, 614408, 615473, 616539, 617605, 618672, 619739, 620806, 621874, 622942, 624011, 625080, 626150, 627220, 628291, 629362, 630434, 631506, 632579, 633652, 634726, 635800, 636875, 637950, 639026, 640102, 641179, 642256, 643334, 644412, 645491, 646570, 647650, 648730, 649811, 650892, 651973, 653055, 654137, 655220, 656303, 657387, 658471, 659556, 660641, 661727, 662813, 663900, 664987, 666075, 667163, 668252, 669341, 670431, 671521, 672612, 673703, 674794, 675886, 676978, 678071, 679164, 680258, 681352, 682447, 683542, 684638, 685734, 686830, 687927, 689024, 690122, 691220, 692319, 693418, 694518, 695618, 696718, 697819, 698920, 700021, 701123, 702225, 703327, 704430, 705533, 706636, 707740, 708844, 709949, 711054, 712159, 713264, 714370, 715476, 716582, 717688, 718795, 719902, 721010, 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1124863, 1125979, 1127095, 1128211, 1129327, 1130443, 1131559, 1132675, 1133791, 1134907, 1136023, 1137139, 1138255, 1139371, 1140487, 1141603, 1142719, 1143835, 114



### UM401 : Trigonometry

## Trigonometry

Trigonometry is the study of relationships between the sides and angles of a triangle. The word trigonometry is derived from the Greek words 'tri' meaning three, and 'metron' meaning measure.

Triangle of most interest in trigonometry is right-angled triangle. If an angle of a right-angled triangle is  $\theta$ , then

- Side opposite to angle  $\theta$  is Hypotenuse
- Side adjacent to angle  $\theta$  is Perpendicular
- Side adjacent to angle  $\theta$  is Base

### TRIGONOMETRIC RATIOS OF ACUTE ANGLE $\theta$ IN A RIGHT TRIANGLE

S. No.	Trigonometric Function	Ratio	Symbolic form
1.	Sine $\theta$ or (Sin $\theta$ )	Length of Perpendicular / Length of Hypotenuse	$\frac{P}{H}$
2.	Cosine $\theta$ or (Cos $\theta$ )	Length of Base / Length of Hypotenuse	$\frac{B}{H}$
3.	Tangent $\theta$ or (Tan $\theta$ )	Length of Perpendicular / Length of Base	$\frac{P}{B}$
4.	Cosecant $\theta$ or (Cosec $\theta$ )	Hypotenuse / Perpendicular	$\frac{H}{P}$
5.	Secant $\theta$ or (Sec $\theta$ )	Hypotenuse / Base	$\frac{H}{B}$
6.	Cotangent $\theta$ or (Cot $\theta$ )	Base / Perpendicular	$\frac{B}{P}$

### APPLICATIONS OF TRIGONOMETRY

### UM402 : Trigonometric Ratios and Values

## Trigonometric Ratios and Values

Values of all Trigonometric Ratios for Different Values of Angle ( $\theta$ )

Angle $\theta$	Sin $\theta$	Cos $\theta$	Tan $\theta$	Cosec $\theta$	Sec $\theta$	Cot $\theta$
0°	0	1	0	-	1	-
30°	1/2	√3/2	1/√3	2	2/√3	√3
45°	1/√2	1/√2	1	√2	√2	1
60°	√3/2	1/2	√3	2/√3	2	1/√3
90°	1	0	-	-	-	-

### Unit Circle and the Relation between Degree and Radian

1 radian =  $\frac{180^\circ}{\pi} \approx 57^\circ 16'$  approx.  
1° =  $\frac{\pi}{180}$  radian = 0.01746 radian approx.

### Signs of Trigonometric Functions

Quadrant	Sin	Cos	Tan
I	+	+	+
II	+	-	-
III	-	-	+
IV	-	+	-

### Behaviour of Trigonometric Functions

Function	Domain	Range
Sin $\theta$	$[-\frac{\pi}{2}, \frac{\pi}{2}]$	$[-1, 1]$
Cos $\theta$	$[0, \pi]$	$[-1, 1]$
Tan $\theta$	$(-\frac{\pi}{2}, \frac{\pi}{2})$	$(-\infty, \infty)$
Cosec $\theta$	$(-\frac{\pi}{2}, \frac{\pi}{2})$	$(-\infty, \infty)$
Sec $\theta$	$[0, \pi]$	$(-\infty, \infty)$
Cot $\theta$	$(0, \pi)$	$(-\infty, \infty)$

### UM403 : Trigonometric Identities

## Trigonometric Identities

### Reciprocal Identities

$\sin \theta = \frac{1}{\text{cosec } \theta}$ ,  $\cos \theta = \frac{1}{\text{sec } \theta}$ ,  $\tan \theta = \frac{1}{\text{cot } \theta}$

### Quotient Identities

$\tan \theta = \frac{\sin \theta}{\cos \theta}$ ,  $\cot \theta = \frac{\cos \theta}{\sin \theta}$

### Pythagorean Identities

$\sin^2 \theta + \cos^2 \theta = 1$ ,  $1 + \tan^2 \theta = \sec^2 \theta$ ,  $1 + \cot^2 \theta = \text{cosec}^2 \theta$

### Co-Function Identities

$\sin(\frac{\pi}{2} - \theta) = \cos \theta$ ,  $\cos(\frac{\pi}{2} - \theta) = \sin \theta$ ,  $\tan(\frac{\pi}{2} - \theta) = \cot \theta$ ,  $\cot(\frac{\pi}{2} - \theta) = \tan \theta$

### Periodic Identities

$\sin(\theta + 2\pi) = \sin \theta$ ,  $\cos(\theta + 2\pi) = \cos \theta$ ,  $\tan(\theta + \pi) = \tan \theta$ ,  $\cot(\theta + \pi) = \cot \theta$

### Sign & Difference Identities

$\sin(\theta \pm \phi) = \sin \theta \cos \phi \pm \cos \theta \sin \phi$ ,  $\cos(\theta \pm \phi) = \cos \theta \cos \phi \mp \sin \theta \sin \phi$

### Sum to Product Identities

$\sin A + \sin B = 2 \sin \frac{A+B}{2} \cos \frac{A-B}{2}$ ,  $\sin A - \sin B = 2 \cos \frac{A+B}{2} \sin \frac{A-B}{2}$

### Product to Sum Identities

$\sin A \cos B = \frac{1}{2} [\sin(A+B) + \sin(A-B)]$ ,  $\cos A \sin B = \frac{1}{2} [\sin(A+B) - \sin(A-B)]$

### Double Angle Identities

$\sin 2\theta = 2 \sin \theta \cos \theta$ ,  $\cos 2\theta = \cos^2 \theta - \sin^2 \theta$ ,  $\tan 2\theta = \frac{2 \tan \theta}{1 - \tan^2 \theta}$

### Triple Angle Identities

$\sin 3\theta = 3 \sin \theta - 4 \sin^3 \theta$ ,  $\cos 3\theta = 4 \cos^3 \theta - 3 \cos \theta$

### UM404 : Graph of Trigonometric Functions

## Graph of Trigonometric Functions

**$y = \sin x$**   
Graph of  $y = \sin x$   
Period:  $2\pi$   
Range:  $[-1, 1]$

**$y = \cos x$**   
Graph of  $y = \cos x$   
Period:  $2\pi$   
Range:  $[-1, 1]$

**$y = \tan x$**   
Graph of  $y = \tan x$   
Period:  $\pi$   
Range:  $(-\infty, \infty)$

**$y = \cot x$**   
Graph of  $y = \cot x$   
Period:  $\pi$   
Range:  $(-\infty, \infty)$

**$y = \text{cosec } x$**   
Graph of  $y = \text{cosec } x$   
Period:  $2\pi$   
Range:  $(-\infty, \infty)$

**$y = \text{sec } x$**   
Graph of  $y = \text{sec } x$   
Period:  $2\pi$   
Range:  $(-\infty, \infty)$

### UM501 : Data Handling

## Data Handling

All data give us some sort of information. The collection, recording and presentation of data help us organise our experiences and draw inferences from them.

### ORGANISATION OF DATA

A class teacher organises data of students' performance in maths as follows:

Mark Obtained	Tally Marks	Number of Students	Mark Obtained	Tally Marks	Number of Students
0-10		4	80-90		5
10-20		2	60-70		5
20-30		3	70-80		5
30-40		3	80-90		5
40-50		5	90-100		2

### DISPLAYING DATA

#### Pictographs

#### Line Graphs

#### Bar Graphs

#### Pie Charts (Circle Graph)

### UM502 : Measures of Central Tendency

## Measures of Central Tendency

A measure of central tendency is a single value that attempts to describe a set of data by identifying the central position within that set of data.

### MEAN

The Mean of  $n$  number of observations  $(x_1, x_2, x_3, \dots, x_n)$  is the sum of the values of all the observations divided by the total number of observations ( $n$ ). Mean is denoted by  $\bar{x}$ .

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \dots + x_n}{n}$$

Example: Marks obtained out of 100 by a class in different subjects are:

Subject	Marks
Maths	80
English	92
Geography	92
Biology	92
History	71
Art	55
Music	82

Mean of Marks =  $\frac{80 + 92 + 92 + 92 + 71 + 55 + 82}{7} = \frac{674}{7} = 96.28$

### MEDIAN

Median is the middle-most observation (or) median value. Finding median of the given data of  $n$  values involves the sort of data in ascending order of magnitude.

If  $n$  is an odd number, then Median  $(M_e) = \left(\frac{n+1}{2}\right)^{\text{th}}$  observation.

If  $n$  is an even number, then Median  $(M_e) = \text{Mean of } \left(\frac{n}{2}\right)^{\text{th}} \text{ and } \left(\frac{n}{2} + 1\right)^{\text{th}} \text{ observations}$ .

Example: Marks in different subjects are:

Subject	Marks
Maths	65
Art	71
English	76
History	80
Geography	82
Biology	92
Music	92

Median = Mean of 4th and 5th value, i.e. =  $\frac{80 + 82}{2} = 81$

### MODE

Mode is the most frequently occurring observation in data set.

Example: Marks in different subjects are:

Subject	Marks
Maths	72
Art	92
English	92
History	92
Geography	92
Biology	92
Music	92

Mode  $(M_o) = 92$

### RANGE

The range of a data set is the difference between the highest and the lowest data values.

Example: Marks in different subjects are:

Subject	Marks
Maths	72
Art	92
English	92
History	92
Geography	92
Biology	92
Music	92

Range of Marks =  $92 - 72 = 20$

### UM503 : Probability

## Probability

Probability is used in Everyday Life to Predict the Chance of Things Happening. Probability is measured on a scale of 0 to 1,  $0 \leq P(E) \leq 1$ .

Probability of an impossible event is 0 or zero.  $P(E) = 0$

Probability of an event which is certain to occur is 1.  $P(E) = 1$

### Tree Diagram Showing Probability of an Event

Find a tree diagram here to solve probability problems involving combined events.

When the outcome of one event does not affect the outcome of another, the events are independent.

### UM504 : Interest & Depreciation

## Interest and Depreciation

### SIMPLE INTEREST

Interest Paid on the Principal. Only and not on any Accumulated Interest.

Simple Interest =  $\frac{\text{Principal} \times \text{Time} \times \text{Rate of Interest}}{100} = \frac{PTR}{100}$

### COMPOUND INTEREST

Basic Principle of Compound Interest is Earning Additional Interest on Interest. Once you save your first interest payment, it is added to the principal. Next time the interest that has been added also earns interest.

$A = P \left(1 + \frac{r}{100}\right)^n$ ,  $C.I. = A - P$

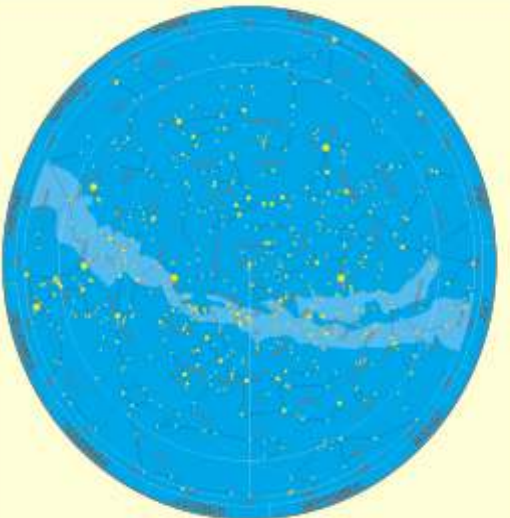
### DEPRECIATION

Decrease in Value of Assets Over a Period of Time.

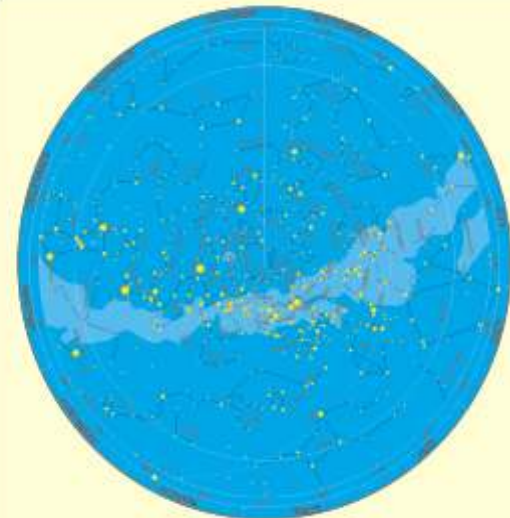
$A = P \left(1 - \frac{r}{100}\right)^n$ ,  $D = P - A$



# HEAVENLY BODIES














**NORTHERN HEAVEN**



**SOUTHERN HEAVEN**

## CONSTELLATIONS

## TYPES OF GALAXIES

THE CART WHEEL GALAXY, M81, THE ANDROMEDA SPIRAL, THE SPIRAL GALAXY M 103

### MILKY WAY GALAXY




Top view




Side view

## OUR SOLAR SYSTEM




### HUBBLE SPACE TELESCOPE


Launched on 24 April, 1990, at a distance of 600 kilometers in space, it orbits earth in a period of 94 minutes. Its length is 13 meters and weight is 11000 kilograms. It is a reflector with 2.4 meter diameter mirror.



# SOLAR SYSTEM



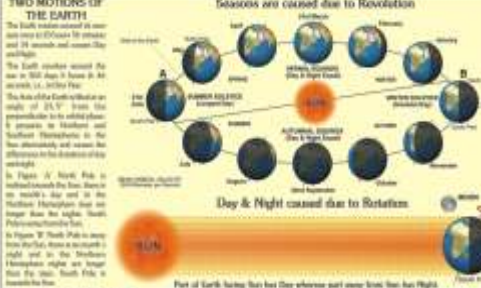
### ORBITS OF THE PLANETS




Planet	Distance from Sun (AU)	Orbit Period (Earth years)	Mass (Earth masses)	Radius (Earth radii)
Mercury	0.39	0.24	0.055	0.38
Venus	0.72	0.61	0.815	0.95
Earth	1.00	1.00	1.000	1.00
Mars	1.52	1.88	0.339	0.53
Jupiter	5.20	11.86	317.8	11.2
Saturn	9.54	29.46	95.2	9.4
Uranus	19.20	84.01	45.9	4.0
Neptune	30.06	164.8	17.1	3.8

# EARTH & ITS MOTIONS


### TWO MOTIONS OF THE EARTH



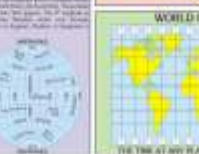
### SEASONS ARE CAUSED DUE TO REVOLUTION




### SOLAR ECLIPSE




### LUNAR ECLIPSE



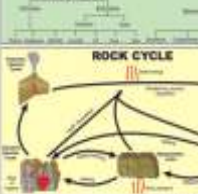
### OCEAN TIDES




### LATITUDES AND LONGITUDES



### THE EARTH IS ROUND




### PHASES OF MOON



### FACTS ABOUT EARTH


- Area: 149,000,000 km<sup>2</sup>
- Volume: 1,083,000,000,000 km<sup>3</sup>
- Population: 6,000,000,000
- Temperature: 15°C
- Gravity: 9.8 m/s<sup>2</sup>

### WORLD CLOCK

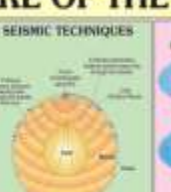


# STRUCTURE OF THE EARTH


### INTERNAL STRUCTURE




### SEISMIC TECHNIQUES




### WEGENER'S THEORY OF CONTINENTAL DRIFT




### SURFACE STRUCTURE




### LANDFORMS




### MAP OF EARTHQUAKES



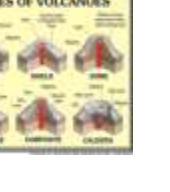
### VOLCANO



### MAP OF VOLCANOES




### SEISMOLOGICAL INSTRUMENTS

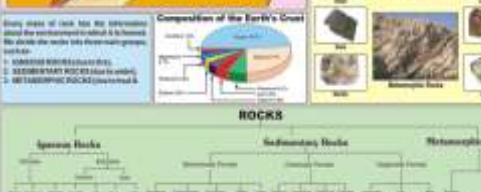


# ROCKS & MINERALS


### ROCKS RELATED TO PLATE TECTONICS




### ROCKS




### ROCK CYCLE



### IGNEOUS ROCK STRUCTURES



### MINERALS



### GCM06S : Atmosphere And Space

## ATMOSPHERE AND SPACE

THE ATMOSPHERE IS A THICK LAYER OF AIR THAT ENVELOPES THE EARTH'S SURFACE.

**Origin of Earth's Atmosphere**  
As the planet Earth cooled, it built up enough energy to capture gases like Hydrogen, Helium, Carbon-dioxide etc. in form of planet's skin.

**Van Allen Radiation Belt**  
A region of space around Earth where high energy charged particles are trapped by Earth's magnetic field.

**Distribution of Solar Energy Through The Atmosphere**  
The amount of solar energy that reaches the Earth's surface varies from place to place due to the angle of incidence of the sun's rays.

**Variations in Atmospheric pressure & temperature**  
The temperature and pressure of the atmosphere vary with height above the Earth's surface.

### GCM07S : Pressure & Winds

## PRESSURE & WINDS

### PRESSURE

**ATMOSPHERE & ITS PRESSURE**  
The atmosphere is a mixture of gases that surrounds the Earth. The pressure of the atmosphere is the force exerted by the weight of the air above a given point.

**MEASUREMENT OF PRESSURE**  
A barometer is used to measure atmospheric pressure. It consists of a glass tube filled with mercury, inverted in a dish of mercury.

**WINDS**  
Winds are caused by differences in atmospheric pressure. Air moves from high pressure areas to low pressure areas.

**WINDS AND WEATHER**  
Winds play a major role in determining the weather. They transport heat and moisture from one place to another.

**WINDS AND CLIMATE**  
Winds influence the climate of a region. Trade winds, for example, bring warm air from the tropics to the subtropics.

### GCM08S : Weather Map Symbols

## WEATHER MAP SYMBOLS

### CLOUD COVER

Clear Sky	1/8 Sky	1/4 Sky
3/8 Sky	1/2 Sky	3/4 Sky
Overcast	Low Medium Cloud	High Cloud

### WIND CONDITIONS

Calm	Light Air	Light Breeze
Breeze	Fresh Breeze	Strong Breeze
Very Strong Breeze	Storm	Thunder

### WEATHER CONDITIONS

Clear Sky	Partly Cloudy	Overcast
Light Rain	Heavy Rain	Snow
Thunder	Thunder with Rain	Thunder with Snow

### SEA CONDITIONS

W	Cm	Sm	Sl	Mod	Ro	VRo	Hi	V.Hi	Ph
Direction of Wave	Color	Height	Number	Length	Very Rough	High	Very High	Phenomenal	

### GCM09S : Ocean

## OCEAN

Oceans are vast water bodies covering 71% of the earth's surface. They play a crucial role in regulating temperature variations & climate.

**TOPOGRAPHY OF OCEAN FLOOR**  
The ocean floor is not flat. It has various features like continental shelves, mid-ocean ridges, and deep-sea trenches.

**VERTICAL DISTRIBUTION OF OCEAN LIFE**  
Different types of organisms live at different depths in the ocean, from the surface to the deep-sea floor.

**MAP OF OCEANIC CURRENTS**  
Ocean currents are large-scale movements of water in the ocean. They are driven by wind and density differences.

**ICEBERG**  
Icebergs are large chunks of ice that have broken off from glaciers or ice shelves. They float in the ocean.

**COASTLINE FEATURES**  
Coastlines are the boundaries between land and water. They can be straight or irregular, depending on the shape of the land.

### GCM10S : Surveying

## SURVEYING

### CHAIN AND TAPE SURVEY

**METHOD OF SURVEYING**  
Chain and tape surveying is a method of measuring the distance between two points on the ground. It involves stretching a chain or tape between the points and measuring its length.

**INSTRUMENTS REQUIRED**  
The instruments required for chain and tape surveying include a chain or tape, a ranging rod, and a peg.

**LAND MEASURING CHAIN**  
A land measuring chain is a chain of links used for measuring land. It is made of metal or wood.

**PLANE TABLE SURVEY**  
Plane table surveying is a method of surveying where a table is placed on the ground and a drawing is made on it. It is used for measuring the area of a plot of land.

### GCM11S : Conventional Signs

## CONVENTIONAL SIGNS

**BOUNDARIES**  
Signs for boundaries include walls, fences, and hedges.

**RAILROADS**  
Signs for railroads include tracks, stations, and signals.

**COMMUNICATION & POWER LINES**  
Signs for communication and power lines include poles, towers, and cables.

**WATER FEATURES**  
Signs for water features include rivers, streams, lakes, and ponds.

**SETTLEMENTS**  
Signs for settlements include houses, schools, and churches.

**PHYSICAL FEATURES**  
Signs for physical features include hills, mountains, and valleys.

**VEGETATION**  
Signs for vegetation include trees, bushes, and grass.

**OTHERS**  
Signs for other features include roads, bridges, and wells.

### GCM12S : Map Projections

## MAP PROJECTIONS

Method of representing spherical objects (like globe) on a plane is called Map Projection. All map projections distort the surface in some fashion. Depending upon the purpose of the map, various map projections exist which preserve some properties of the spherical body while compromising others.

**The Developable Surface**  
Cylinder, Cone, Plane

**Map Projections**  
Mercator Projection, Robinson Projection, Mollweide Projection, Stereographic Projection, Lambert's Cylindrical Equal Area Projection, Sinusoidal Projection, Orthographic Projection.

### GCM13S : Storm and Ocean Current

## Storm and Ocean Current

Tornadoes, hurricanes and cyclones are the most violent storms of nature. They are generated by electrical storms and they take the form of powerful funnel-shaped whirlwinds that extend from the sky to the ground. In these storms, moving air is mixed with soil and other matter rotating at velocities as high as 300 miles per hour (480kmph).

**Beginning of a Tornado**  
Tornadoes begin to form over warm water bodies. The air is heated and rises, creating a low-pressure area. This causes the air to rotate, forming a vortex.

**Rotation**  
The rotation of the air causes a decrease in pressure at the center of the storm, creating a vortex.

**Descent**  
The central rotating column continues to descend, creating a funnel-shaped cloud that extends to the ground.

**Storm and Ocean Current**  
Ocean currents are large-scale movements of water in the ocean. They are driven by wind and density differences.

## PHASES OF THE MOON चन्द्रमा की कलाएँ

**Waning Crescent**  
When the Moon is getting smaller it is said to be waning.  
बढ़ता हुआ चन्द्रमा

**Last Quarter**  
अंतिम चरण

**Gibbous**  
The Moon is three quarters full.  
अधधिक

**Full**  
The side of the Moon that faces Earth is fully lit by the Sun.  
पूर्ण चंद्रमा वह प्रकाशित चंद्रमा की ओर होता है।

**Gibbous**  
अधधिक

**First Quarter**  
प्रथम चरण

**Waxing Crescent**  
बढ़ता हुआ चन्द्रमा

**SUN सूर्य**

The left side of the Moon faces Earth and we cannot see it all.  
अधिकांश चन्द्रमा का अधिकांश भाग हमें नहीं दिखता है।

The right side of the Moon is lit by sunlight.  
चन्द्रमा का दायरी भाग सूर्य के प्रकाश से रोता है।

The Moon is a quarter of the way around its orbit. We see half lit and half dark.  
चन्द्रमा अपने चारों ओर चारों ओर एक चतुर्थांश का एक चक्कर लगा रहा है।

## FACE OF THE MOON

The nearest of the moon that always faces the earth  
चन्द्रमा का वह भाग जो हमेशा पृथ्वी की ओर रहता है।

As the Moon orbits the Earth, we see different amount of its sunlit side. When the Moon lies between the Earth and Sun we do not see it at all, this is known as new Moon. Then it becomes a young crescent and appears low in the western sky in the evening. A few days later it becomes half-illuminated, known as first quarter. The phase between half and full Moon is called Gibbous. After full Moon there are the same phases but in reverse, ending with a crescent Moon rising in the morning sky shortly before the Sun.

जैसे-जैसे चन्द्रमा पृथ्वी के चारों ओर घूमता जाता है, हमें उसका प्रकाशित भाग बदलता हुआ दिखाई देता है। जब चन्द्रमा पृथ्वी और सूर्य के बीच में आ जाता है तो चन्द्रमा का अधिकांश भाग पृथ्वी को खोता है और तब चन्द्रमा दिखाई नहीं देता। वह दिन अमृतस्य कहलाता है। पीछे-पीछे चन्द्रमा का प्रकाशित भाग बढ़ता जाता है। सूर्य के प्रकाशित चन्द्रमा वाले दिन को पूर्णिमा कहते हैं। पूर्णिमा से आगे चन्द्रमा एक पक्ष धीरे-धीरे बढ़ता जाता है। चन्द्रमा की इनकी बदलती कलाओं को चन्द्रमा की कलाएँ कहाँ है।

### MOON DATA

Age	4500 Million Years (Approx.)
Diameter	3475.6 km
Maximum Distance from Earth	406,697 km
Minimum Distance from Earth	356,410 km
Average Distance from Earth	384,400 km
Time to orbit Earth	27.32 days
Time to spin on axis	27.32 days
Interval between successive new moons	29 days 12 hours 44 minutes
Mass	1/81 the Earth's mass
Volume	1/60 the Earth's volume
Surface Gravity	0.125 the Earth's gravity
Average Density	3.3 x water
Surface Temperature	120°C max. to -150°C at night
First Man on Moon	Neil Armstrong on 21st July 1969 in Apollo 11

## SOLAR & LUNAR ECLIPSE सूर्य व चन्द्र ग्रहण

**Solar Eclipse**  
A solar eclipse occurs when the Moon passes between the Sun and Earth, blocking the Sun's light. It can be total, partial, or annular.

**Lunar Eclipse**  
A lunar eclipse occurs when the Earth passes between the Sun and Moon, blocking the Sun's light from reaching the Moon. It can be total, partial, or penumbral.

**Annular Solar Eclipse**  
Occurs when the Moon is too far from Earth to completely cover the Sun, leaving a ring of light visible.

**Total Solar Eclipse**  
Occurs when the Moon is close enough to Earth to completely cover the Sun.

**Partial Solar Eclipse**  
Occurs when the Moon covers only a portion of the Sun.

**Total Lunar Eclipse**  
Occurs when the Earth's shadow completely covers the Moon, making it appear red.

**Partial Lunar Eclipse**  
Occurs when the Earth's shadow partially covers the Moon.

**Penumbral Lunar Eclipse**  
Occurs when the Moon passes through the Earth's penumbra, causing a slight dimming.

## TIDES ज्वार भाटा

**Spring Tides**  
सूर्य पूर्ण ज्वार भाटा

**Neap Tides**  
लघु ज्वार भाटा

The periodic rise and fall of the sea is the result of the combined effect of the Sun and Moon. The Sun's gravity is much stronger than the Moon's, but the Moon is much closer to Earth. The combined effect of the two is what causes the tides.

ज्वार-भाटा का कारण सूर्य और चंद्रमा की गुरुत्वाकर्षण बलों का संयुक्त प्रभाव है। सूर्य की गुरुत्वाकर्षण शक्ति चंद्रमा की तुलना में बहुत अधिक है, लेकिन चंद्रमा हमारे पास बहुत करीब है। इन दोनों का संयुक्त प्रभाव ही ज्वार-भाटा का कारण बनता है।

## SEASONS ऋतु परिवर्तन

The Earth's axis is tilted at an angle of 23.5 degrees to its orbit around the Sun. This tilt causes the seasons. When the Northern Hemisphere is tilted towards the Sun, it is summer. When it is tilted away, it is winter.

पृथ्वी की धुरी सूर्य की ओर झुकी हुई है। इस झुकाव के कारण ऋतुएं बदलती हैं। जब उत्तरी गोलार्ध सूर्य की ओर झुका होता है तो वहाँ गर्मियों का मौसम आता है। जब पृथ्वी सूर्य से दूर होती है तो वहाँ सर्दियों का मौसम आता है।

Month	Season	Temperature	Day Length
January	Winter	Cool	Short
February	Winter	Cool	Short
March	Winter	Cool	Short
April	Spring	Warm	Long
May	Spring	Warm	Long
June	Summer	Hot	Long
July	Summer	Hot	Long
August	Summer	Hot	Long
September	Autumn	Warm	Short
October	Autumn	Warm	Short
November	Autumn	Cool	Short
December	Winter	Cool	Short

## SUN AND PLANETS सूर्य तथा ग्रह

**Structures of Sun**  
सूर्य की संरचना

The Sun is a star made of hot gases. It has a core, a radiative zone, and a convective zone. The outermost layer is the photosphere.

सूर्य एक तारा है जो गर्म गैसों से बना है। इसमें एक केंद्र, एक विकिरण क्षेत्र, एक कंवर्ण क्षेत्र और बाहरी परत फोटोस्फियर है।

Planet	Distance from Sun (km)	Orbit Time (days)	Mass (Earth = 1)	Diameter (Earth = 1)
Mercury	57,909,175	88	0.055	0.38
Venus	108,208,460	225	0.815	0.95
Earth	149,597,870	365	1.000	1.00
Mars	227,939,200	687	0.107	0.53
Jupiter	778,547,000	4,333	318	11.2
Saturn	1,429,400,000	9,453	95	9.5
Uranus	2,874,690,000	29,450	45	4.0
Neptune	4,504,000,000	59,800	17	3.8

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### GCS06 : Water Cycle in Nature

## WATER CYCLE IN NATURE

The water cycle comes from the evaporation of the sea and land, together with transpiration from plants.

Through the water cycle, nature guarantees a regular supply of fresh water to the world. The water cycle is kept in motion by the sun's heat which starts the cycle by evaporating moisture from the oceans, and gravity which ensures that precipitation thickening into snow, sleet, hail, rain, and frost eventually returns from the land to the sea, so completing the cycle. Some moisture seeps into the soil, where it may be absorbed by plants which later release it into the air through transpiration. Other moisture seeps through the rocks directly or indirectly, via springs & rivers to the sea.

### GCS07 : Directions and How to Find Them

## DIRECTIONS AND HOW TO FIND THEM

### दिशाओं का ज्ञान

**COMMON**

**Directions that a watch cannot find:** The watch cannot find the directions of the North and South. These directions are found by the shadow stick method. The shadow stick method is a simple method to find the directions. It involves placing a stick vertically in the ground and observing the shadow it casts. The shadow will move from west to east as the sun moves across the sky. The line between the start and end of the shadow will be a north-south line.

**THE SHADOW STICK METHOD:** This method involves placing a stick vertically in the ground and observing the shadow it casts. The shadow will move from west to east as the sun moves across the sky. The line between the start and end of the shadow will be a north-south line.

### GCS08 : Conventional Signs

## CONVENTIONAL SIGNS

### रुढ़िगत संकेत

This chart lists various conventional signs used in maps and road networks. It includes symbols for different types of roads, buildings, landmarks, and natural features. Each sign is accompanied by its name in both English and Hindi.

### GCS09 : Earth is Round

## Earth Is Round पृथ्वी गोल है

The Earth is round. This is proven by several pieces of evidence. One is that ships disappear over the horizon. Another is that the Earth's shadow on the moon is always circular. A third is that the Earth's circumference is the same in all directions. A fourth is that the Earth's surface is curved. A fifth is that the Earth's gravity pulls everything towards the center.

### GCS10 : Physical Features of Earth

## PHYSICAL FEATURES OF EARTH

### पृथ्वी के भौतिक लक्षण

This chart illustrates the major physical features of the Earth. It includes mountains, plateaus, coastal plains, and oceans. Each feature is labeled in both English and Hindi.

### GCS11 : Day & Night

## DAY & NIGHT

### दिन और रात

The Earth rotates on its axis from west to east. This rotation causes the day and night cycle. When one side of the Earth is facing the sun, it is daytime. When the other side is facing the sun, it is nighttime.

### GCS12 : Earthquake

## Earthquake

### भूकम्प

An earthquake is a sudden shaking of the ground caused by the movement of tectonic plates. This movement creates seismic waves that travel through the Earth's crust. The point where the earthquake starts is called the epicenter.

### GCS13 : Latitude and Longitude

## Latitude and Longitude

Latitude and longitude are a geographical coordinate system used for locating places on the surface of the earth. They are angular measurements expressed as degrees of a circle measured from the centre of the earth. Gridlines are a spherical grid of latitude and longitude.

GCS14 : Types of Clouds

### Types of Clouds मेघों के प्रकार

**High Clouds**  
Clouds are always higher than 5000 meters and composed of crystals. They appear as white streaks or thin veils in the sky.

**Woolly Clouds**  
Clouds are at heights of 1000 to 2000 meters and composed of water droplets.

**Altostratus**  
Clouds consist of large white or grey fleeces that sometimes rain or drizzle.

**Low Clouds**  
Clouds that do not reach 2000 meters in altitude. They are composed of water droplets which are sometimes mixed with ice crystals. They produce continuous rain.

**Sea Fog**  
Fog that forms over the sea.

**Meteorological**  
Clouds and their clouds are categorized in three or four classes according to their height and the nature of their constituent particles.

**Mist**  
Very small droplets of water which are suspended in the air near the ground. It is a form of low stratus cloud.

**Clouds with Vertical Development**  
These clouds have vertical development. They are composed of water droplets and ice crystals.

**Thunderstorm**  
A storm characterized by lightning, thunder, and heavy rain.

**Comets**  
A celestial body consisting of a nucleus of ice and dust surrounded by a coma of gas and dust.

**Comet**  
A celestial body consisting of a nucleus of ice and dust surrounded by a coma of gas and dust.

GCS15 : Hill Features, Contours & Map Setting

### HILL FEATURES, CONTOURS & MAP SETTING

पर्वतीय आकृतियाँ, समाच्च रेखाएँ तथा मानचित्र अध्ययन

**MAP SETTING**  
Map setting has to be done with the help of a magnetic compass, the position of the sun, some prominent place on earth, straight features, local details and other contours.

**समानिच को स्थापित कर दिशासूचक बनाना**  
समानिच को स्थापित करने के लिए दिशासूचक, सूर्य की स्थिति, स्थिति, प्रमुख स्थान, सीधे रेखाएँ, स्थानीय विवरण और अन्य समाच्च रेखाएँ का उपयोग करना पड़ेगा।

**समानिच को स्थापित कर दिशासूचक बनाना**  
समानिच को स्थापित करने के लिए दिशासूचक, सूर्य की स्थिति, स्थिति, प्रमुख स्थान, सीधे रेखाएँ, स्थानीय विवरण और अन्य समाच्च रेखाएँ का उपयोग करना पड़ेगा।

GCS16 : Factors That Affect Climate

### Factors That Affect Climate

जलवायु को प्रभावित करने वाले कारक

**Latitude**  
The amount of solar radiation received by a place depends on its latitude. The amount of solar radiation received by a place is directly proportional to the sine of its latitude.

**Winds & Air Masses**  
Winds and air masses play a major role in determining the climate of a place. They bring air from different parts of the world.

**Ocean Currents**  
Ocean currents are the continuous movement of water in the ocean. They are caused by differences in temperature and salinity.

**Altitude**  
The temperature of a place decreases as the altitude increases. This is because the air becomes thinner as the altitude increases.

**Distance from Water Bodies**  
The climate of a place is affected by its distance from water bodies. Water bodies have a moderating effect on the climate.

GCS17 : Weather Instruments

### WEATHER INSTRUMENTS

**Wind Vane**  
Shows the direction of the wind.

**Windmill**  
Measures the speed of the wind.

**Barometer**  
Measures atmospheric pressure.

**Thermometer**  
Measures temperature.

**Hygrometer**  
Measures relative humidity.

**Psychrometer**  
Measures relative humidity and wet-bulb temperature.

**Windmill**  
Measures the speed of the wind.

**Barometer**  
Measures atmospheric pressure.

**Thermometer**  
Measures temperature.

**Hygrometer**  
Measures relative humidity.

**Psychrometer**  
Measures relative humidity and wet-bulb temperature.

GCS18 : Volcano

### VOLCANO ज्वालामुखी

**Structure of Volcano**  
A volcano consists of a central vent or chimney through which molten rock (magma) is ejected. The magma rises from the mantle and collects in a magma chamber below the vent.

**Classification based on cone structure**  
Volcanoes are classified into three types based on their cone structure: shield volcano, cinder cone, and composite volcano.

**Activity Based Classification**  
Volcanoes are classified into three types based on their activity: active, dormant, and extinct.

**Active Volcanoes of the World**  
A map showing the locations of active volcanoes around the world.

GCS19 : Ocean Currents

### Ocean Currents सागरीय धाराएँ

**Types of Ocean Currents**  
Ocean currents are classified into two types: warm and cold.

**Factors That Influence Ocean Currents**  
The factors that influence ocean currents are wind, temperature, salinity, and the Earth's rotation.

**MAP OF WORLD'S OCEAN CURRENTS**  
A world map showing the major ocean currents.

**Direction and Speed of Ocean Currents**  
The direction and speed of ocean currents are determined by the wind and the Earth's rotation.

**Ekman Spiral**  
The Ekman spiral is a model of the wind-driven circulation in the upper ocean.

GCS20 : Sunlight and Rainbow

### SUNLIGHT AND RAINBOW

**Sunlight takes 8.3 minutes to reach the Earth**  
The total frequency spectrum of electromagnetic radiation given off by the Sun is called sunlight.

**Composition of Sunlight**  
Sunlight is composed of a spectrum of colors from violet to red.

**Sunlight on Earth**  
Sunlight is reflected off the Earth's surface and is scattered in all directions.

**RAINBOW**  
A rainbow is formed when sunlight is refracted, dispersed, and reflected by water droplets in the atmosphere.

**Double Rainbow**  
A double rainbow is formed when light is reflected twice inside the water droplets.

**Colour and Light**  
The color of an object is determined by the light it reflects.

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### CF01 : Changing Face of the Earth

## CHANGING FACE OF THE EARTH

## पृथ्वी का बदलता स्वरूप

**EXTERNAL PROCESSES**

GLACIER हिमनद  
RIVER नदी  
GROUND WATER भूमिगत जल  
WIND पवन

### CF02 : Denudation

## DENUATION अनाच्छादन

The denudation force is attributed and categorized as weathering, soil erosion, mass movement and erosion, and erosion by transportation. The mechanical removal of rock and soil is known as denudation. The chemical processes called Denudation.

अनाच्छादन शक्ति को संज्ञात प्रक्रियाओं के कारक के रूप में वर्गीकृत किया जाता है। ये हैं- अनाच्छादन प्रक्रिया, मृदा अपभ्रंश, अनाच्छादन और अपभ्रंश, और परिवहन द्वारा अनाच्छादन।

### I Weathering अखण्ड

The factor of weathering is with time.

अखण्डन का कारक समय है।

A. **भौतिक अखण्डन (Physical Weathering)**

1. अखण्डन (Disintegration)
2. अखण्डन (Disintegration)
3. अखण्डन (Disintegration)
4. अखण्डन (Disintegration)

B. **रासायनिक अखण्डन (Chemical Weathering)**

1. अखण्डन (Disintegration)
2. अखण्डन (Disintegration)
3. अखण्डन (Disintegration)
4. अखण्डन (Disintegration)

### II Mass-movement मृदा-प्रवाह

A. **धीरे प्रवाह (Slow Movement)**

1. अखण्डन (Disintegration)
2. अखण्डन (Disintegration)
3. अखण्डन (Disintegration)
4. अखण्डन (Disintegration)

B. **तेज़ प्रवाह (Rapid Movement)**

1. अखण्डन (Disintegration)
2. अखण्डन (Disintegration)
3. अखण्डन (Disintegration)
4. अखण्डन (Disintegration)

### III Erosion अपभ्रंश

A. **भौतिक अपभ्रंश (Physical Erosion)**

1. अखण्डन (Disintegration)
2. अखण्डन (Disintegration)
3. अखण्डन (Disintegration)
4. अखण्डन (Disintegration)

B. **रासायनिक अपभ्रंश (Chemical Erosion)**

1. अखण्डन (Disintegration)
2. अखण्डन (Disintegration)
3. अखण्डन (Disintegration)
4. अखण्डन (Disintegration)

### CF03 : Streams (River)

## STREAMS (Rivers) जलधाराएँ (नदियाँ)

A river system consists of a main channel & all of its tributaries. The main channel is called the trunk stream. It is fed by smaller tributaries. The trunk stream is the largest stream in the system.

जलधाराएँ एक मुख्य धारा और उसके सभी सहायक धाराओं से मिलती हैं। मुख्य धारा को तटस्थ धारा कहा जाता है। यह नदी नदी प्रणाली का सबसे बड़ा हिस्सा है।

### CONSEQUENCE FLOW OF WATER IN CURVED CHANNEL

1. **Point Bar**: Deposited on the inner bank of a curve.

2. **Cut Bank**: Eroded on the outer bank of a curve.

### RIVERS BUILD LEVELS

1. **River Bedrock Floor**: The lowest level of the river bed.

2. **River Channel Floor**: The level of the river bed.

3. **River Flood Plain**: The level of the river bed.

### CF04 : River's Landscape

## RIVER'S LANDSCAPE नदी-स्थलाकृतियाँ

### EROSIONAL LANDFORMS अपभ्रंश प्रक्रियाओं द्वारा बनी स्थलाकृतियाँ

Water Fall  
River Meander  
Rapids  
V-Shaped Valleys  
Pot Holes  
River Terraces  
Interlocking Spurs  
River Gorges

### DEPOSITIONAL LANDFORMS निक्षेप प्रक्रियाओं द्वारा बनी स्थलाकृतियाँ

Flood plain & natural levees  
Alluvial Fans & Cones  
Delta

### CF05 : Streams (River's Patterns)

## Streams (River's Patterns) जलधाराएँ (नदियों के प्रतिरूप)

### DRAINAGE PATTERNS

All drainage systems are made up of an interconnected network of streams. Each drainage system has a particular pattern. The nature of a drainage pattern can vary greatly from one type of terrain to another, primarily in response to the kinds of rock on which the streams developed or the structural pattern of faults and folds.

### अपभ्रंश प्रणालियाँ

सभी अपभ्रंश प्रणालियाँ एक ही तरह की संयोजित नदी प्रणालियों से बनी होती हैं। प्रत्येक अपभ्रंश प्रणाली का अपना विशेष प्रतिरूप होता है। नदी प्रणालियों के प्रतिरूप का निर्धारण मुख्य रूप से नदी बहने वाले क्षेत्र में स्थित चट्टानों के प्रकार और संरचनात्मक पैटर्न से होता है।

### TYPES OF DRAINAGE PATTERNS

1. **Rectangular**: Streams flow in straight lines.

2. **Trellis**: Streams flow in a regular grid pattern.

3. **Dendritic**: Streams flow in a tree-like pattern.

4. **Radial**: Streams flow from a central point to the periphery.

5. **Annular**: Streams flow in a circular pattern.

6. **Rectangular**: Streams flow in straight lines.

7. **Trellis**: Streams flow in a regular grid pattern.

8. **Dendritic**: Streams flow in a tree-like pattern.

9. **Radial**: Streams flow from a central point to the periphery.

10. **Annular**: Streams flow in a circular pattern.

### CF06 : Sea Water

## SEA WATER समुद्री जल

### MOVEMENT OF SEA WATER

1. **Surface Currents**: Driven by wind.

2. **Deep Currents**: Driven by density differences.

### WAVE OF SEA WATER

1. **Transverse**: Wave moving perpendicular to the direction of the wind.

2. **Longitudinal**: Wave moving parallel to the direction of the wind.

### DIFFERENT TYPES OF WAVES

1. **Surface**: Waves on the surface of the water.

2. **Deep**: Waves in the deep water.

3. **Internal**: Waves at the interface between two layers of water.

### CF07 : Coastal Landscape

## COASTAL LANDSCAPE समुद्र तटवर्ती भू-आकृतियाँ

### MARINE EROSIONAL LANDFORMS समुद्री अपभ्रंश प्रक्रियाओं द्वारा बनी स्थलाकृतियाँ

1. **Cliff**: Steep bank of a river or sea.

2. **Point Bar**: Deposited on the inner bank of a curve.

3. **Cut Bank**: Eroded on the outer bank of a curve.

### DEPOSITIONAL LANDFORMS निक्षेप प्रक्रियाओं द्वारा बनी स्थलाकृतियाँ

1. **Delta**: Landform at the mouth of a river.

2. **Alluvial Fan**: Landform at the base of a mountain.

3. **Conical Sand Dune**: Landform on a beach.

### CF08 : Sea Water Shorelines

## SEA WATER SHORELINES समुद्री किनारे

### REEFS AND ATOLL

1. **Barrier Reef**: Reef parallel to the shore.

2. **Atoll**: Ring-shaped reef.

### Classification of Shorelines

1. **Active**: Shoreline with a wide beach.

2. **Passive**: Shoreline with a narrow beach.

### CF09 : Wind WIND पवन (EOLIAN SYSTEM)

Glaciers processes performed by the wind are called Eolian processes.

**MAJOR CONCEPTS**

- Wind is not an effective agent of erosion in most areas, but it can transport loose, unconsolidated fragments of rock and sand.
- Wind transport can be enhanced by saltation and deflation. Saltation is a bouncing motion and it can cause high sand dunes to form.
- Wind erosion begins as sand grains are lifted up and over the surface of the soil. The initial structure of a sand dune is determined by the wind direction.
- A typical dune of sand and silt has a windward slope and a leeward slope. The windward slope is steeper and the leeward slope is gentler.
- Wind erosion can be enhanced by saltation and deflation. Saltation is a bouncing motion and it can cause high sand dunes to form.

**EROSIONAL WORK OF WIND**

**DEFLECTOR EFFECT**

**ADAPTIVE STRATAS**

**DEPOSITIONAL WORK**

**TRANSPORTATIONAL WORK**

### CF10 : Wind : Desert Landscape पवन: मरुस्थलीय भू-दृश्य

**EROSIONAL DESERT LANDFORMS**

**DEPOSITIONAL DESERT LANDFORMS**

### CF11 : Glaciers GLACIERS हिमानी (हिमनद)

GLACIER is a large accumulation of natural ice which spreads like a permanent river on dry lands and flows slowly towards the sea.

**PROCESSES CONTRIBUTING TOWARDS GLACIER FORMATION**

- There is accumulation of snow over the area.
- Continuously snow accumulates to the thickness of 100m.
- Pressure causes melting of the snow and ice.
- High temperature and atmospheric humidity cause the ice to melt.

**TYPES OF GLACIERS**

**WORKS OF GLACIERS**

**EROSIONAL WORK**

**DEPOSITIONAL WORK**

**TRANSPORTATIONAL WORK**

**EROSIONAL WORK**

### CF12 : Glacial Landforms GLACIAL LANDFORMS हिमनदीय भू-आकृतियाँ

Glacial landforms are created due to erosion, transportation and glacio-fluvial depositions. In the continental regions, extension of ice sheets and their thickness elongated almost parallel to deposition makes the sliding of glaciers a very slow process.

**EROSIONAL LANDFORMS**

**DEPOSITIONAL LANDFORMS**

### CF13 : Ground Water GROUND WATER भूमिगत जल

Water seeps into the ground through pores spaces in the rock and soil. It passes to the zone of saturation, in which the pores spaces are occupied by water and there is no air.

**WORK OF GROUND WATER**

**EROSIONAL WORK**

**DEPOSITIONAL WORK**

**TRANSPORTATIONAL WORK**

**MAJOR CONCEPTS**

- The movement of ground water is controlled largely by the permeability & porosity of the rocks through which it flows.
- The water table is the surface below which all pores spaces in the rock are saturated with water.
- Ground water moves slowly permeated through the pores spaces in the rocks by the pull of gravity in artesian systems, it is moved by hydraulic pressure.
- The natural discharge of ground water is generally into streams & lakes.
- Artesian water in confined areas, the water is a liquid & occurs in permeable rocks bounded by impermeable strata.

### CF14 : Ground Water GROUND WATER भूमिगत जल

**WELL**

**ARTESIAN WATER**

**ARTESIAN SYSTEM**

**SEVERE**

### CF15 : Ground Water GROUND WATER भूमिगत जल

**KARST LANDFORMS**

**EROSIONAL KARST LANDFORMS**

**DEPOSITIONAL KARST LANDFORMS**

# DIRECTIONS AND HOW TO FIND THEM

## COMPASS

Pole star always points to the north

Directions play a very important part in the study of geography. Without this hypothetical fixation of four main directions i.e. North, South, East and West, we cannot find the situation, have safe navigation, air or road transport nor could we explain other phenomena on earth, e.g. Seasons, Movements of earth, Day and Night etc.

In case we draw an imaginary line between the last two stars (Pointers) of the Great Bear, then at a distance five times more than the distance between these two stars, there is a bright shining star which is known as Pole Star.

Fix a rod on the ground before noon. Taking rod as centre, draw a circle up to the end of the shadow. Nooning noon time the shadow will get shorter and after noon it will become longer and will touch the circle once again. The bisector of the angle formed by both the shadows will point towards north.

Sun always rises in the east

- If you stand facing the rising sun the north is to your left.
- If you stand facing the setting sun the north is to your right.

## THE PRISMATIC COMPASS

Luminous patch used for night-work

Hair line engraved on glass window to take sight on to some object

North pointing arrow-head is luminous for night-work

The head of the tomb in India is to the North

In India Muslims always pray facing the west

Publised by: P.D. WANIL & CO. MOUL, BANGALORE - 560001

# CONVENTIONAL SIGNS रुढ़िगत संकेत

Water	Forest	Highway	Station	Well	Public building
...	...	...	...	...	...

The map is a picture, but all things are represented on a flat surface to which the same scale of height and depth is applied. The scale of height and depth is the same for all things on the map. The scale of height and depth is the same for all things on the map.

# TRUE, GRID AND MAGNETIC NORTH

## OF ALL THE DIRECTIONS, NORTH IS MOST IMPORTANT.

उत्तर को सब दिशाओं में महत्वपूर्ण दिशा माना गया है।

Different types of North उत्तर के प्रकार

The angle of difference between the True North and Magnetic North is called Magnetic Declination.

The angle of difference between the True North and Grid North is called Grid Convergence.

# HILL FEATURES, CONTOURS & MAP SETTING

## पर्वतीय आकृतियाँ, समोच्च रेखाएँ तथा मानचित्र अध्ययन

CONTOUR SETTING: The position of the sun, some prominent places on earth, topographical features, local details and other contours.

MAP SETTING: The position of the sun, some prominent places on earth, topographical features, local details and other contours.

# SECTION DRAWING सैक्शन ड्राइंग

1. Section drawing is a diagram showing the rise & fall of the ground along a given line between two points.

2. In section drawing we have to take two scales - one vertical scale & one horizontal scale. Make the vertical scale same as the contour map.

3. The horizontal scale is the same as the contour map.

4. The vertical scale is the same as the contour map.

5. The horizontal scale is the same as the contour map.



**ME01 : Man & Environment**

### MAN & ENVIRONMENT

#### BIOSPHERE

The biosphere is the zone above the land, in the water, and in the air, where life exists. It is the sum of all living organisms and their interactions with the physical environment. The biosphere is a thin layer on the surface of the Earth, extending from the deepest part of the ocean to the highest part of the atmosphere.

#### ATMOSPHERE

The atmosphere is the layer of gases that surrounds the Earth. It is composed of nitrogen, oxygen, and other gases. The atmosphere is essential for life as it provides oxygen for breathing and protects the Earth from harmful solar radiation.

#### HYDROSPHERE

The hydrosphere is the total amount of water on Earth, including oceans, lakes, rivers, and groundwater. Water is essential for life and plays a crucial role in the Earth's climate system.

#### LITHOSPHERE

The lithosphere is the rigid upper part of the Earth's crust. It is composed of rocks and minerals. The lithosphere is essential for life as it provides a stable surface for plants and animals to live on.

**Importance of the Biosphere:** The biosphere is the zone where life exists. It is the sum of all living organisms and their interactions with the physical environment. The biosphere is a thin layer on the surface of the Earth, extending from the deepest part of the ocean to the highest part of the atmosphere.

**Importance of the Atmosphere:** The atmosphere is the layer of gases that surrounds the Earth. It is composed of nitrogen, oxygen, and other gases. The atmosphere is essential for life as it provides oxygen for breathing and protects the Earth from harmful solar radiation.

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**Importance of the Lithosphere:** The lithosphere is the rigid upper part of the Earth's crust. It is composed of rocks and minerals. The lithosphere is essential for life as it provides a stable surface for plants and animals to live on.

**ME02 : Air & Noise Pollution - Causes**

### AIR & NOISE POLLUTION - CAUSES

#### AIR POLLUTION

Air pollution is caused by the release of harmful substances into the atmosphere. The main sources of air pollution are factories, vehicles, and power plants. These sources release pollutants such as carbon dioxide, sulfur dioxide, and nitrogen oxides.

#### NOISE POLLUTION

Noise pollution is caused by the production of unwanted or excessive sound. The main sources of noise pollution are traffic, construction, and industry. Noise pollution can cause hearing loss, stress, and other health problems.

**Causes of Air Pollution:** The main causes of air pollution are factories, vehicles, and power plants. These sources release pollutants such as carbon dioxide, sulfur dioxide, and nitrogen oxides.

**Causes of Noise Pollution:** The main causes of noise pollution are traffic, construction, and industry. Noise pollution can cause hearing loss, stress, and other health problems.

**ME03 : Air Pollution (Effects & Remedies)**

### AIR POLLUTION (Effects & Remedies)

#### EFFECTS

Air pollution has several effects on the human body and the environment. It can cause respiratory problems, such as asthma and bronchitis. It can also cause damage to the environment, such as acid rain and global warming.

#### REMEDIES

There are several remedies for air pollution. These include using public transport, planting trees, and using energy-efficient appliances. These remedies can help reduce the amount of air pollution and improve the quality of the air.

**Effects of Air Pollution:** Air pollution has several effects on the human body and the environment. It can cause respiratory problems, such as asthma and bronchitis. It can also cause damage to the environment, such as acid rain and global warming.

**Remedies for Air Pollution:** There are several remedies for air pollution. These include using public transport, planting trees, and using energy-efficient appliances. These remedies can help reduce the amount of air pollution and improve the quality of the air.

**ME04 : Flora & Fauna**

### FLORA & FAUNA

#### INDIA IS HOME TO ABOUT 30,000 SPECIES OF WILD PLANTS AND 4,500 SPECIES OF WILD ANIMALS.

India is a rich and diverse country with a wide variety of plants and animals. Some of the most famous Indian species include the tiger, elephant, and peacock. India is also home to many rare and endangered species.

#### ENDANGERED ANIMAL SPECIES

There are many endangered animal species in India. Some of the most endangered species include the tiger, elephant, and rhinoceros. These species are at risk of extinction due to habitat loss and poaching.

**Flora:** India is home to a wide variety of plants, including many rare and endangered species. Some of the most famous Indian plants include the baobab tree and the baobab tree.

**Fauna:** India is home to a wide variety of animals, including many rare and endangered species. Some of the most famous Indian animals include the tiger, elephant, and peacock.

**ME05 : Water Pollution**

### WATER POLLUTION

#### SOURCES OF WATER POLLUTION

Water pollution is caused by the release of harmful substances into water bodies. The main sources of water pollution are industrial waste, agricultural runoff, and sewage.

#### EFFECTS OF WATER POLLUTION

Water pollution has several effects on the environment and human health. It can cause the death of fish and other aquatic life. It can also cause health problems for humans, such as skin irritation and respiratory problems.

**Sources of Water Pollution:** Water pollution is caused by the release of harmful substances into water bodies. The main sources of water pollution are industrial waste, agricultural runoff, and sewage.

**Effects of Water Pollution:** Water pollution has several effects on the environment and human health. It can cause the death of fish and other aquatic life. It can also cause health problems for humans, such as skin irritation and respiratory problems.

**ME06 : Impact of Forests**

### IMPACT OF FORESTS

#### IMPORTANCE OF FORESTS

Forests are important for the environment and human life. They provide oxygen, absorb carbon dioxide, and provide a habitat for many species of plants and animals.

#### EFFECTS OF DEForestation

Deforestation has several effects on the environment and human life. It can cause soil erosion, global warming, and the loss of many species of plants and animals.

**Importance of Forests:** Forests are important for the environment and human life. They provide oxygen, absorb carbon dioxide, and provide a habitat for many species of plants and animals.

**Effects of Deforestation:** Deforestation has several effects on the environment and human life. It can cause soil erosion, global warming, and the loss of many species of plants and animals.

**ME07 : Soil Conservation**

### SOIL CONSERVATION

#### SOIL CONSERVATION

Soil conservation is the practice of using various techniques to prevent soil erosion and maintain soil fertility. Some of the most common soil conservation techniques include terracing, contour plowing, and strip cropping.

#### IMPORTANCE OF SOIL CONSERVATION

Soil conservation is important for agriculture and the environment. It helps to prevent soil erosion, maintain soil fertility, and protect the environment.

**Soil Conservation Techniques:** Soil conservation is the practice of using various techniques to prevent soil erosion and maintain soil fertility. Some of the most common soil conservation techniques include terracing, contour plowing, and strip cropping.

**Importance of Soil Conservation:** Soil conservation is important for agriculture and the environment. It helps to prevent soil erosion, maintain soil fertility, and protect the environment.

**ME08 : Population Explosion**

### POPULATION EXPLOSION

#### 17.4% OF WORLD POPULATION LIVES IN INDIA ON 2.4% OF WORLD LAND AREA.

Population explosion is the rapid increase in the number of people in a population. It has several effects on the environment and human life, including resource scarcity and environmental degradation.

#### EFFECTS OF POPULATION EXPLOSION

Population explosion has several effects on the environment and human life. It can cause resource scarcity, environmental degradation, and social problems.

**Population Explosion:** Population explosion is the rapid increase in the number of people in a population. It has several effects on the environment and human life, including resource scarcity and environmental degradation.

**Effects of Population Explosion:** Population explosion has several effects on the environment and human life. It can cause resource scarcity, environmental degradation, and social problems.

# MAN AND ENVIRONMENT

A set of 10 charts

Laminated, Size 50 x 75 cm (Available in English and Hindi Separately)

## ME09 : Impact of Environment Degradation on Humans

## ME10 : Non-Conventional Sources of Energy

*For Social Studies,  
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Globe



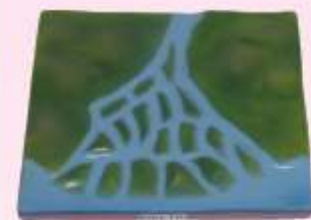
Maps



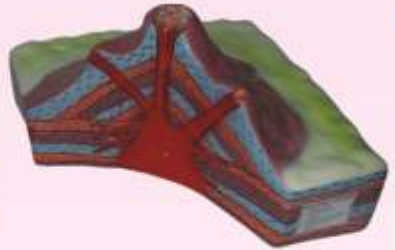
Outline Maps



Tourist Maps



Delta Model



Volcano Model



Specimens Rocks & Minerals



Solar System



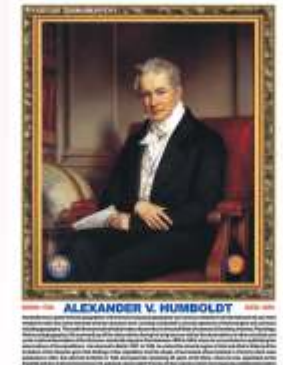
GPS



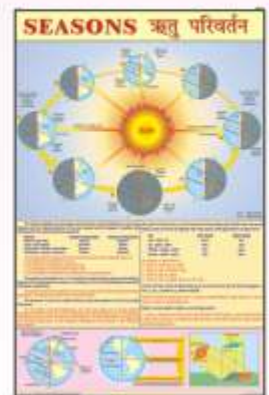
Galaxy Star Finder



Dumpy Level



Great Geographers



Charts

WMI01 : Weather Map of India ( January )



<p><b>Departure of Maximum Temperature From Normal</b></p> <p>Western &amp; Eastern India: +2 to +4 Central India: +1 to +3 South India: +1 to +2</p>	<p><b>General Observations</b></p> <p>Wednesday 6th January 1988, 16 Hours 1500 Galt</p> <p>The western disturbances over North Pakistan and northwestern India are over the Arabian Sea and are moving eastwards. An isolated cyclonic circulation has developed over Rajasthan and northwestern India. Systems are likely to move eastwards. Conditions are likely to be overcast in the west. Conditions are likely to be overcast in the west. Conditions are likely to be overcast in the west.</p>	<p><b>Meteorological Signs</b></p> <p>Wind: → 5 KNOTS → 10 KNOTS → 15 KNOTS → 20 KNOTS</p> <p>Rainfall in cm: → 0.25 to 0.50 → 0.51 to 1.00 → 1.01 to 1.50</p> <table border="1"> <tr> <th>Cloud Amount</th> <th>Weather</th> </tr> <tr> <td>0-20 Sky</td> <td>Clear</td> </tr> <tr> <td>21-30 Sky</td> <td>Partly Clear</td> </tr> <tr> <td>31-40 Sky</td> <td>Partly Cloudy</td> </tr> <tr> <td>41-50 Sky</td> <td>Mostly Clear</td> </tr> <tr> <td>51-60 Sky</td> <td>Mostly Cloudy</td> </tr> <tr> <td>61-70 Sky</td> <td>Overcast</td> </tr> <tr> <td>71-80 Sky</td> <td>Cloudy</td> </tr> <tr> <td>81-90 Sky</td> <td>Very Cloudy</td> </tr> <tr> <td>91-100 Sky</td> <td>Overcast</td> </tr> </table>	Cloud Amount	Weather	0-20 Sky	Clear	21-30 Sky	Partly Clear	31-40 Sky	Partly Cloudy	41-50 Sky	Mostly Clear	51-60 Sky	Mostly Cloudy	61-70 Sky	Overcast	71-80 Sky	Cloudy	81-90 Sky	Very Cloudy	91-100 Sky	Overcast	<p><b>Departure of Minimum Temperature From Normal</b></p> <p>Western &amp; Eastern India: -1 to -2 Central India: -1 to -2 South India: -1 to -2</p>
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WMI02 : Weather Map of India (February)



WMI03 : Weather Map of India (March)



**WEATHER MAPS OF INDIA**  
 A set of 12 maps  
 Synthetic, Size 70 x 100 cm (Available in English only)

# WEATHER MAPS OF INDIA

A set of 12 maps

Synthetic, Size 70 x 100 cm (Available in English only)

WMI06 : Weather Map of India (June)



WMI07 : Weather Map of India (July)



WMI08 : Weather Map of India (August)



WMI09 : Weather Map of India (September)



WMI10 : Weather Map of India (October)



WMI11 : Weather Map of India (November)



WMI12 : Weather Map of India (December)



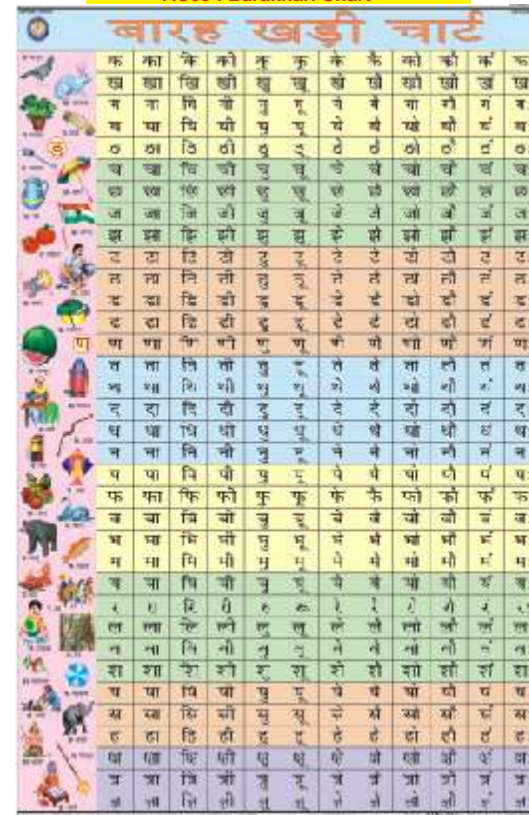
AC01 : English Alphabet



AC02 : Hindi Varnamala



AC03 : Barakhari Chart



AC04 : Tamil Alphabet



AC05 : Telugu Alphabet



AC06 : Tamil Barakhari

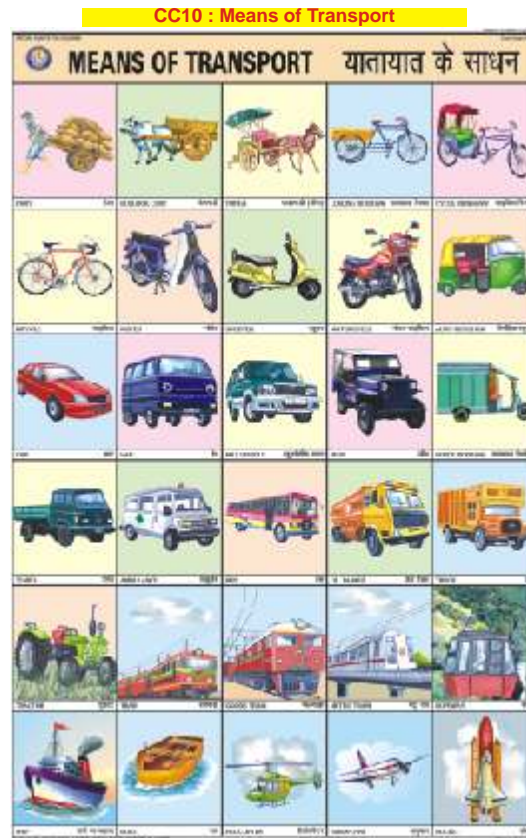
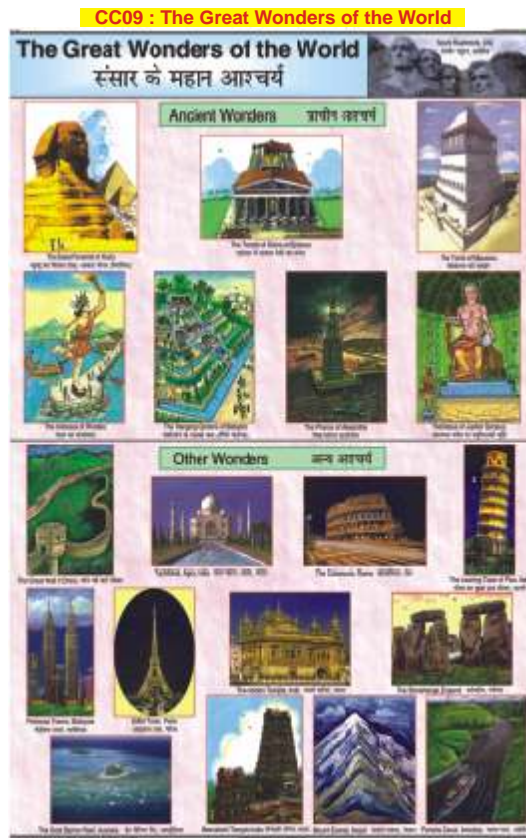


AC07 : Telugu Barakhari



AC08 : Malayalam Alphabet





CC11 : Road Traffic Signs



CC12 : Health Rules



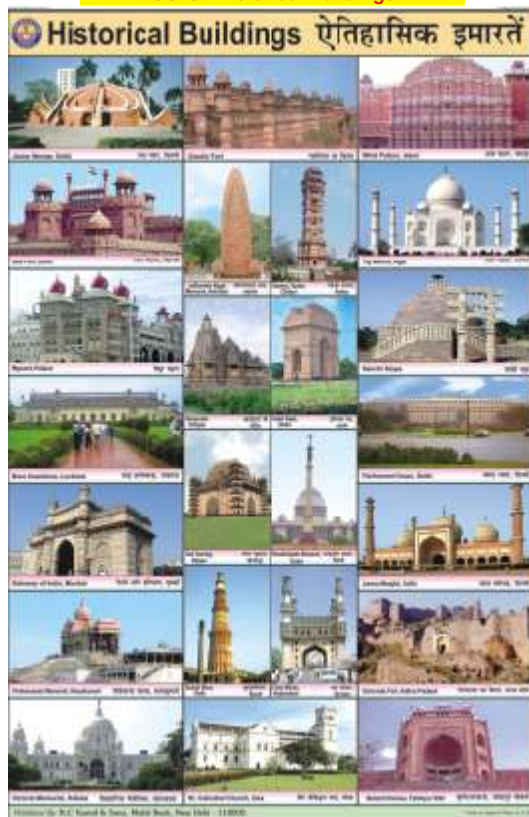
CC13 : Parts of Human Body



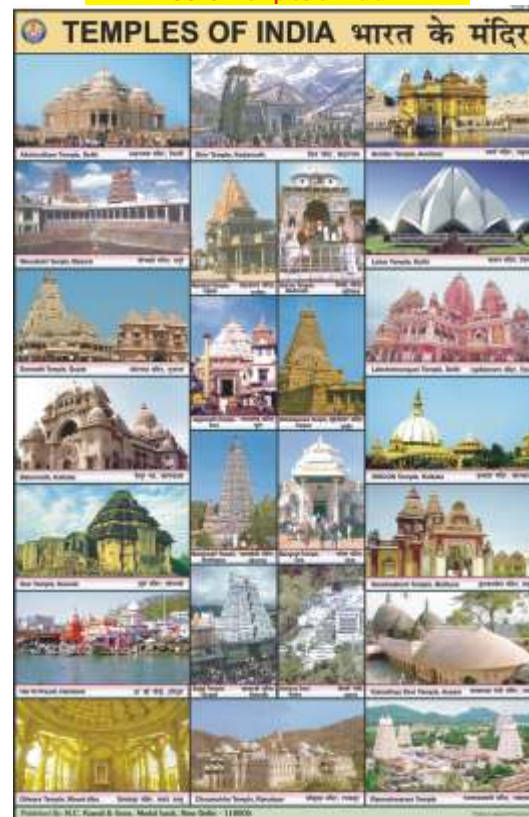
CC14 : Flags of Nations



CC15 : Historical Buildings



CC16 : Temples of India



CC17 : Good Manners



CC18 : Good Habits





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**Abacus**

**Drawing Models**

**Cubes**

**Palm Clock**

**Bucket Balance**

**Jr. Pythagorus Theorem**

**Kitchen Balance**

**Transparencies**

**OCTANT 3-D**

**Charts**

**Portraits of Mathematicians**

**Geometry Box**



CC62 : Computer- An Overview



NEW

CC63 : Yogasanas



NEW

CC64 : Inventions and Their Inventors



NEW

CC65 : Insects



NEW

The following titles are available in size 70 x 100 cm, Laminated, English and Hindi combined

Chart Code	Title
CC51	Animals
CC52	Birds
CC53	Vegetables
CC54	Fruits
CC55	Flowers
CC56	Great Wonders of the world
CC57	Means of Transport
CC58	Road Traffic Signs
CC59	Parts of Body
CC60	Flags of all Nations



SPECIAL CHARTS FOR CHILDREN

Laminated, Size 70 x 100 cm (Available in English and Hindi Combined)

NR01 : Nursery Rhymes - 1

# NURSERY RHYMES - 1

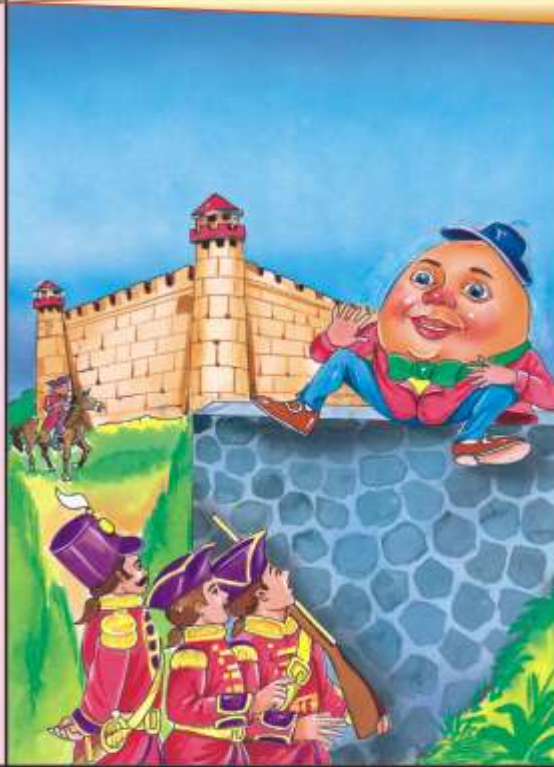


## BAA, BAA, BLACK SHEEP

Baa, Baa, black sheep,  
Have you any wool ?  
Yes sir, yes sir,  
Three bags full  
One for my master,  
One for his dame,  
And one for the little boy,  
Who lives down the lane.

## HUMPTY DUMPTY

Humpty Dumpty sat  
on a wall,  
Humpty Dumpty had  
a great fall.  
All the king's horses  
And all the king's men  
Couldn't put Humpty  
Dumpty together again.



NR02 : Nursery Rhymes - 2

# NURSERY RHYMES - 2



## ONE, TWO, BUCKLE MY SHOE

One - two,  
buckle my shoe ;  
Three - four,  
shut the door ;  
Five - six,  
pick up sticks.  
Seven - eight  
lay them straight ;  
Nine - ten,  
a big fat hen ;  
Eleven - twelve,  
dig and delve.

## PUSSY CAT, PUSSY CAT

Pussy cat, Pussy cat,  
Where have you been ?  
I've been to London  
To look at the queen.  
Pussy cat, Pussy cat,  
What did you there ?  
I frightened a little mouse  
under the chair.



NR04 : Nursery Rhymes - 4

# NURSERY RHYMES - 4



## JOHNNY ! JOHNNY

" Johnny ! Johnny !"  
" Yes Papa "  
" Eating sugar ? "  
" No Papa "  
" Telling a lie ? "  
" No Papa "  
" Open your mouth "  
" Ha, Ha, Ha. "

## CHUBBY CHEEKS

Chubby cheeks, dimpled chin,  
Rosy lips, teeth within.  
Curly hair, very fair,  
Eyes are blue, lovely two,  
Teacher's pet, is that you ?  
Yes ! Yes ! Yes !



NR03 : Nursery Rhymes - 3

# NURSERY RHYMES - 3



## TWINKLE, TWINKLE

Twinkle, Twinkle, little star,  
How I wonder what you are ?  
Up above the world so high,  
Like a diamond in the sky.  
When the blazing Sun is gone,  
When there nothing shines upon,  
Then you show your little light,  
Twinkle, Twinkle, all the night.

## HICKORY, DICKORY, DOCK !

Hickory, Dickory, Dock,  
The mouse ran up the clock ;  
The clock struck one,  
The mouse ran down,  
Hickory, dickory, dock !



NR05 : Nursery Rhymes - 5

# NURSERY RHYMES - 5



## JACK & JILL

Jack & Jill,  
Went up the hill  
To fetch a pail of water ;  
Jack fell down  
And broke his crown  
And Jill came tumbling after.

## DING, DONG, BELL

Ding, dong, bell,  
Pussy's in the well !  
Who put her in ?  
Little Johnny thin.  
Who pulled her out ?  
Little Johnny Stout.  
What a naughty boy was that !  
To worry poor Pussy Cat.





# Thirsty Crow प्यासा कौवा



Once in the month of summer, a thirsty crow was flying here and there in search of water. Suddenly he saw a jug with a very small amount of water. When he tried to drink the water he could not do so as the level of the water was very low.

The crow was very clever and he hit upon an idea. He collected some pebbles and dropped them into the jug. As the level of water rose, he quenched his thirst heartily and flew away.

"Where there is a will, there is a way".

गर्मी के महीने में एक प्यासा कौवा पानी की तलाश में इधर-उधर उड़ रहा था। अचानक उसने एक जग में थोड़ा पानी देखा। उसने जग का पानी पीने की कोशिश की लेकिन पानी का स्तर नीचा होने के कारण वह पानी नहीं पी सका।

कौवा बहुत चालाक था। उसे एक युक्ति सूझी। वह कहीं से छोटे-छोटे कंकर के टुकड़े ले आया और जग में डालने लगा। जैसे ही पानी का स्तर ऊपर आया कौवे ने ऊपर आए पानी से अपनी प्यास बुझाई और उड़ गया।

"जहाँ चाह, वहाँ राह।"

# Hare and the Lion खरगोश और शेर



Once a lion used to kill many animals daily and ate only one or two of them. All the animals trembled that they would be smothered one animal everyday and requested not to kill them. One day it was the turn of a hare who was very clever. He passed by a well and saw his own reflection in the well and hit upon an idea. He reached the cave of the lion a little late and when asked by the lion he told him that there was another lion in the well who also wanted to eat him.

The lion got furious and asked him to show him the other lion. The hare took the lion to the well. The lion looked deep in the well and seeing his own reflection roared. When his roar was echoed from the well he lost his temper and jumped in the well and died.

"The mind is superior to the might"

# Monkeys and the Hawker चन्द्र और सौदागर



Once a hawker was going to a town for selling his caps in the market. On the way he fell down under a tree for a rest. Soon he fell asleep. There were quite a few monkeys on the tree. They came down and opened the box of the caps and put all the caps on their head one by one. The hawker when awake was very much perplexed to see the box empty and the monkeys wearing his caps.

The hawker knew that the monkeys are very prone to copying. He put off his own cap and threw it on the ground. All the monkeys when saw this, put off their caps one by one and threw them on the ground. The hawker collected the caps, put them back in the box and proceeded towards the market pocketing happily over his idea and good luck.

"An idea can solve the problem easily."



# Greedy Dog लालची कुत्ता



A Greedy dog got a piece of bone and enjoying it in a lonely place. He decided to enjoy it in some lonely place and went toward the river. There was a bridge on the river. He went on the bridge and saw his own shadow in the water. He thought, another dog was also holding a bone in its mouth. Being very greedy he decided to snatch that bone also and started barking. He opened his mouth and the bone started falling down. Hearing an loud bang he was very surprised.

"Whoever is a thief"

# Hare & The Tortoise खरगोश और कछुआ



A proud hare used to laugh at a tortoise due to his slow movements. One day the tortoise, being very hurt, challenged the hare for a race. The hare readily accepted. The race was requested to be intense. When the race started, the hare being very fast, left the tortoise far behind. Near the target the hare thought of a little rest. Soon the full asleep due to the cool breeze of the jungle. The tortoise continued his race slow and steady and passed by the sleeping hare. The hare when woke ran very fast but reached the target only to see that the tortoise had already reached there. The tortoise was declared the winner.

"Slow and steady wins the race."

Laminated, Size 50 x 75 cm (Available in English and Hindi Combined)

# MORAL STORY

A set of 35 charts

MS06 : Fox and the Crow

### Fox and the Crow लोमड़ी और कौवा

Once a crow got a piece of bun and settled on a branch of tree to eat it. A fox chanced to come that way and when he saw the crow he wanted to grab the bun. The fox thought of a plan. He started praising the crow "Your skin is very soft and your voice also should be very sweet. I hope that you are king of all the birds. Please, can you sing a song for me". The crow was completely taken in by the false praise and began to sing "Caw, Caw". When the crow opened his mouth, the piece of bun fell on the ground. The fox took the bun and ran away. The crow regretted on his folly but to no avail.

एक बार एक कौवा ने एक टुकड़ा ब्रेड खाया और उसे एक शाखा पर बैठकर खा रहा था। एक लोमड़ी उससे गुजर रही थी। उस लोमड़ी को कौवा के ब्रेड से लोभ आ गया। वह सोचने लगा कि मैं कौवा को प्रशंसा करूँ तो वह खुश होकर ब्रेड को गिरा देगा। उसने एक योजना बनाई और कौवा को प्रशंसा करने लगा। उसने कहा "आपकी त्वचा बहुत नरम है और आपकी आवाज़ भी बहुत मीठी है। मैं मानता हूँ कि आप पक्षियों का राजा हैं। क्या आप मेरे लिए एक गीत गा सकते हैं?" कौवा उसकी प्रशंसा से खुश हो गया और ब्रेड को छोड़कर गीत गाने लगा। "काँ, काँ"। कौवा ने मुँह खोलकर ब्रेड गिरा दिया। लोमड़ी ने ब्रेड उठाया और दौड़कर भाग गया। कौवा को अपनी गलती का पता चला, लेकिन उसे वापस ब्रेड पाने में असमर्थता का दर्द था।

"You've got flattened!"  
"मुझे ब्रेड के टुकड़े मिले हैं!"

MS07 : Grapes are Sour

### Grapes are Sour अंगूर खट्टे हैं

A fox in search of food reached a beautiful garden where bunches of grapes were hanging. The grapes looked very ripe and sweet. Fox's appetite increased and he tried to get at the grapes. He held the grape vine firmly and tried to shake it so that the grapes might fall down but even one grape did not fall. Then he jumped again and again with all his might but could not reach the grapes. Being tired he decided to give up the efforts and went away saying "Grapes are sour. I don't like to eat them".

एक भूख से भरा लोमड़ी ने खाने के लिए एक खूबसूरत बगीचे में पहुँचा। वहाँ लोमड़ी को अनेक लंबी लंबी अंगूरों का गुच्छा मिल गया। अंगूरों का रंग बहुत लाल था जो उसे बहुत ही आकर्षित कर रहा था। उसने सोचा कि ये अंगूर तो बहुत ही मीठे और खट्टे होंगे। उसने अपनी पूंछ से अंगूरों का गुच्छा पकड़ लिया और उसे हिलाने की कोशिश करने लगा। लेकिन अंगूर गिरने में तैयार नहीं हुए। लोमड़ी ने फिर से कोशिश की, उसने जोर से कूद किया, लेकिन अंगूर नहीं गिर सके। लोमड़ी थक गया और उसने सोचा कि ये अंगूर तो खट्टे होंगे। उसने हार मान ली और दौड़कर भाग गया। उसने कहा "अंगूर खट्टे हैं, मैं उन्हें खाने से नहीं चाहता।"

"An unattainable person resorts to false excuses!"  
"जहाँ तक नहीं पहुँचें वहाँ झूठे बहाने बनाएँ!"

MS08 : Unity is Strength

### Unity is Strength एकता में बल है

Once a hunter spread his net and scattered some food grains on it. Quite a few pigeons were caught in. Realising their folly, the pigeons struggled hard to escape but could not. An old wise crow suggested that they should work in unison and can fly with the net. Being encouraged by the advice, the pigeons flew together with the net. The hunter was bewildered and disappointed. The birds cut the net to a mouse who helped them by cutting the net with his sharp tooth.

एक शिकारी ने एक जाल बिछाया और उस पर कुछ अनाज की दानियाँ बिखारीं। कई कौवा पकड़ लिए गए। जब उन्होंने अपनी गलती समझी, तो वे भागने की कोशिश करने लगे, लेकिन वे जाल से छूटने में असमर्थ थे। एक बुद्धिमान कौवा ने सुझाव दिया कि वे एक साथ काम करें और जाल को उड़ान दें। कौवों को इस सलाह से प्रभावित हो गया और वे एक साथ उड़ने लगे। शिकारी को यह देखकर हैरत और निराशा हुई। कौवों ने जाल को काट दिया, और एक चूहे ने जाल को काटने में मदद की।

"Unity is strength."  
"एकता ही बल है।"

MS09 : Who will bell the Cat

### Who will bell the Cat बिल्ली के गले में घंटी कौन बांधेगा

Once all the rats gathered together to discuss their safety from their enemy 'The Cat'. After a long discussion, one rat stood up and suggested "We should tie a bell around the neck of the cat and whenever she is around, we will come to know". Every one greeted the idea with a prolonged applause but when the question came up who will bell the cat, no one dared to come forward. They were pondering over the idea when suddenly the cat appeared there. All the rats ran for their lives.

एक बार कौवों ने मिलकर अपनी आम की सुरक्षा के विषय में एक बैठक बुलाई। एक लम्बी चर्चा के बाद एक कौवा ने प्रस्ताव रखा कि हम बिल्ली के गले में घंटी बांध देंगे, तो हमें पता चलेगा कि वह कहाँ है। सभी कौवों ने इस विचार से बहुत प्रशंसा की, लेकिन जब सवाल आया कि कौन बिल्ली को घंटी बांधेगा, तो कोई कौवा आगे नहीं बढ़ा। वे सोचने में व्यस्त थे कि बिल्ली का सामना कैसे करना है। तभी बिल्ली वहाँ पर आ गई। सभी कौवों ने दौड़कर भागने की कोशिश की।

"Don't make cookies in the air!"  
"हवा में बिस्किट मत बनाओ!"

MS10 : Lion and the Mouse

### Lion and the Mouse शेर और चूहा

Once a lion was sleeping outside his cave. A mouse comes there and started playing on his back. Being disturbed the lion became furious and caught him. Reporting on his folly the mouse begged "Please spare me, I will help you some day". The lion laughed and said that his tiny creature like a mouse could help him. One day a hunter spread his net and the lion was caught in it. He did his best to free himself but could not. Lamenting his helplessness the little mouse came out and cut the net with his sharp teeth. The mouse paid back the kindness shown by the lion.

एक शेर एक गुहा के बाहर सो रहा था। एक चूहा वहाँ आया और शेर के पीछे खेलने लगा। शेर को यह देखकर क्रोध आया और उसने चूहा को पकड़ लिया। चूहा ने अपनी गलती का इलाज करने के लिए शेर से मदद माँगी। शेर ने हँसकर कहा कि मैं एक छोटी सी चीज को कैसे मदद कर सकता हूँ। एक दिन एक शिकारी ने जाल बिछाया और शेर उसमें पकड़ गया। शेर ने बहुत कोशिश की, लेकिन उसे निकलने में असमर्थता का दर्द था। तभी वहाँ से एक छोटी सी चूहा निकल आया और उसने अपने दाँतों से जाल काट दिया। चूहा ने शेर को उसकी मदद का बदला दिया।

"No you may, no small can help."  
"आप नहीं कर सकते, छोटी चीज नहीं कर सकती।"

MS11 : Hen that laid Golden Eggs

### Hen that laid Golden Eggs सोने का अण्डा देने वाली मुर्गा

Once a villager named Renu bought a hen from the market. When he brought the hen home he was surprised to know that his hen laid a golden egg each day. By selling the golden eggs, he became the richest person of the village. Renu was a very greedy person and wanted to become more and more rich. One day he thought why he should not get all the eggs stored in the hen's stomach at one stroke and become the richest person of the state. He brought a sharp knife from the kitchen and cut open the stomach of the hen. To his utter disappointment he could find only blood and flesh there. He repeated upon his folly but now it was of no use.

एक गाँव में रणु नाम का एक किसान था। उसने एक मुर्गा खरीदा। जब उसने मुर्गा को घर लाया तो उसे यह पता चला कि उसकी मुर्गा रोज सोने के अण्डे देती है। रणु ने सोचा कि मैं इन अण्डों को बेचकर बहुत धनी बन सकता हूँ। एक दिन उसे एक बहुत ही बड़ा सोने का अण्डा मिला। उसने सोचा कि मैं इसे बेचकर और धनी बन सकता हूँ। उसने एक बड़ा तलवाड़ा लेकर मुर्गा के पेट को काट दिया। लेकिन वहाँ से केवल रक्त और मांस ही निकल आया। रणु को अपनी गलती का पता चला, लेकिन अब उसे कुछ करने के लिए बचता नहीं था।

"We should think before we act."  
"हमें सोचने के बाद ही काम करना चाहिए।"

MS12 : Selfish Friendship

### Selfish Friendship स्वार्थपूर्ण मित्रता

Once a mouse saw a cat caught in a hunter's net and being overjoyed started playing around him. Suddenly the rat saw a mongoose ready to jump at him. Seeing the impending danger, the mouse requested the cat to save his life in exchange of freeing her from the net. The cat agreed and the mouse cut the net and all took to their heels. A few days later, the cat feeling very hungry, came near the hole of the mouse and challenged him for a game. The mouse wisely replied "I sought your friendship only to save my life. Now you may take your way".

एक बार एक चूहा ने एक बिल्ली को शिकारी के जाल में पकड़ने देखा। बिल्ली को देखकर चूहा बहुत खुश हुआ। तभी चूहा ने एक मंगोस्त को देख लिया जो चूहा पर कूदने की कोशिश करने लगा। चूहा को खतरा लगा कि मैं अपनी जान बचाव के लिए बिल्ली को जाल से निकाल दूँगा। बिल्ली ने सहमत होकर जाल काट दिया और दोनों भागने लगे। कुछ दिनों बाद बिल्ली बहुत भूख से परेशान थी। उसने चूहा के घर के पास जाकर उसे चुनौती दी कि मैं तुम्हारे साथ खेलूँगा। चूहा ने समझा कि मैंने बिल्ली को अपना मित्रता के लिए नहीं बुलाया था, इसलिए मैं इसे छोड़ दूँगा।

"A selfish friend can cheat at any time."  
"स्वार्थपूर्ण मित्रता किसी भी क्षण धोखा दे सकती है।"

MS13 : Wolf and the Lamb

### Wolf and the lamb भेड़िया और मेमना

Once a lamb got separated from his flock and reached the bank of the stream. There he started drinking water. A wolf was also drinking water up stream. He wanted to eat the lamb and shouted "Why are you spoiling my water?" The poor lamb trembled and replied humbly "Sir! The water is coming from your side, how can I spoil it?" The wolf again made a lame excuse and shouted "You abused me a year back!" The poor lamb answered, "Sir! I am only four months old". The wolf had no intention to listen, he pounced upon the poor lamb saying "It must have been your father" and ate him up.

एक बार एक भेड़िया एक मेमना से अलग होकर एक नदी के किनारे पहुँचा। वहाँ वह पानी पी रहा था। एक लोभ से भरा भेड़िया भी वहाँ आया और पानी पी रहा था। भेड़िया को भेड़िया के पानी पीने से क्रोध आया और उसने भेड़िया से कहा "तुमने मेरे पानी को खराब क्यों किया?" भेड़िया ने हँसकर कहा "श्रीमान, पानी तो आपकी तरफ से ही आ रहा है, मैं कैसे खराब कर सकता हूँ?" भेड़िया ने फिर से एक बहाना बनाया और कहा "तुमने एक साल पहले मुझे धोखा दिया था!" भेड़िया ने कहा "श्रीमान, मैं केवल चार महीने का हूँ।" भेड़िया को भेड़िया के पानी पीने से कोई भी मतलब नहीं था, इसलिए उसने भेड़िया को पकड़ लिया और उसे खा लिया।

"An evil person makes lame excuses to justify his deeds."  
"एक बुरा व्यक्ति अपने बुराई के लिए बहाने बनाता है।"

MS14 : United we stand; Divided we fall

### United we stand; Divided we fall एकता में जीवन - विभाजन में मृत्यु

An old man lived in a village with his four sons. His sons, instead of doing some work, used to quarrel among themselves. One day the old man fell seriously ill and called his sons near him. He asked them to bring a bundle of sticks. When the bundle was brought, he asked his sons one by one to break it. Everyone tried his best but no body could break the bundle.

Then the old man asked them to try to break the sticks one by one. Everyone could do so very easily. The old man thus asked them to learn the lesson that if they would live united, nobody will be able to overpower them but if they go on quarrelling, anybody would be able to subdue them one by one. The boys learnt the lesson and lived together thereafter and prospered well.

एक वृद्ध व्यक्ति अपने चार बेटों के साथ एक गाँव में रहता था। उसके बेटों के बीच एक-दूसरे के साथ काम करने के बजाय वे झगड़ते रहते थे। एक दिन वह गंभीर रूप से बीमार पड़ा और अपने बेटों को बुलाकर उनका एक गुच्छा लकड़ी का बंडल लेने को कहा। जब बंडल लाया गया तो वह एक-एक करके बेटों को बंडल तोड़ने के लिए कहा। बेटों ने अपनी-अपनी कोशिश की, लेकिन किसी को बंडल तोड़ने में सफलता नहीं मिली।

तब वृद्ध व्यक्ति ने उनसे कहा कि वे बंडल को तोड़कर एक-एक लकड़ी के टुकड़े में तोड़ दें। सबने आसानी से लकड़ी के टुकड़े तोड़ दिए। वृद्ध ने उन्हें एक पाठ सीखाने के लिए कहा कि यदि वे एक-दूसरे के साथ मिलकर रहेंगे, तो कोई भी उन्हें पराजित नहीं कर पाएगा। बेटों ने उस पाठ को सीखा और वे एक-दूसरे के साथ मिलकर रहने लगे और सफल हुए।

"Unity makes the family and the country strong."  
"एकता ही ही जीवन और देश को मजबूत बनाती है।"

MS15 : Ant and Dove

### Ant and Dove कबूतर और चींटी

A dove used to live on a tree near the bank of a river. One day he saw a little ant struggling for her life in the river. He decided to help her and placed a leaf of the tree near the ant. The ant climbed up the leaf and the dove caught hold of the leaf with its beak and flew to a safer place and saved the life of the ant.

One day it so happened that a hunter came there and aimed at the dove. The ant seeing her saviour in danger, immediately climbed on the foot of the hunter and stung it with all its might. The hunter being stung missed his aim and the life of the poor dove was saved.

एक कबूतर एक पेड़ की शाखा पर रहता था। एक दिन उसने नदी में एक चींटी को अपने-अपनी को बचाने के लिए एक पत्ती का उपयोग करने को देखा। चींटी पत्ती को चढ़ गई और कबूतर ने पत्ती को अपने मुँह में पकड़ लिया और उसे सुरक्षित स्थान पर ले गया।

एक दिन ऐसा हुआ कि एक शिकारी वहाँ आया और कबूतर को निशाना बनाया। चींटी ने देखा कि कबूतर को खतरा है, इसलिए वह शिकारी के पैर पर चढ़ गई और उसने शिकारी को काँटों से काँटा। शिकारी का पैर दर्द होने लगा और वह कबूतर को छोड़कर भाग गया।

"This good turn deserves another."  
"एक अच्छा कार्य, दूसरे अच्छे कार्य को आमंत्रित है।"

MS16 : Live and Let Live

### Live and let Live जीयो और जीने दो

Once a woodcutter while starting to cut a tree in a jungle heard an ant's. Please don't cut this tree. I will give you one cent to reward and you will get something, you require from this tree as well. The woodcutter was surprised and asked the ant what she wanted. The ant said she wanted a piece of bread. The woodcutter gave her a piece of bread and she went away.

The next day when he went to cut the tree, he found that the ant had come back with a snake. The snake was coiled round the tree and was ready to bite the woodcutter. He was very scared and ran away. The ant was laughing and saying, 'Live and let live.'

एक दिन एक लकड़हारा एक पेड़ काटने के लिए जंगल में गया। उसे एक चींटी ने रोका। चींटी ने उसे एक सेंट देने का वादा किया और उसे कुछ चीजें देने का अनुरोध किया। लकड़हारे ने चींटी को एक टुकड़ा रोटी दे दी।

अगले दिन जब वह वहाँ वापस आया तो उसने देखा कि पेड़ के चारों ओर सर्प लपेटे हुए हैं। लकड़हारे को बहुत डर हुआ और वह भाग गया। चींटी हँस रही थी और कह रही थी, 'जीयो और जीने दो।'

"Live and let live."  
"जीयो और जीने दो।"

MS17 : Two Cats and a Monkey

### Two Cats and a Monkey दो बिल्लियाँ और एक बन्दर

Once two cats found a piece of bread and started quarrelling over their share. Being unable to settle, they went to a monkey and requested him to do justice. The monkey divided the bread into two uneven pieces and started to weigh them. When he found one piece heavier, he bit it making the other piece heavier. Then he took the other piece and bit it and so on till only a very small piece was left. The monkey ate the small piece also saying that this was for the payment of his services. The cats ate the whole bread and went away repenting over their quarrel.

एक बार दो बिल्लियाँ एक टुकड़ा रोटी मिली और उसका हिस्सा बाँटने में झगड़ने लगीं। वे एक बंदर को बुलाकर उसे न्याय करने के लिए बोलीं। बंदर ने रोटी को दो असमान हिस्सों में बाँटा और एक हिस्सा तौलने लगा। जब वह देखा कि एक हिस्सा थोड़ा भारी है, तो उसने उस हिस्से का एक टुकड़ा काट लिया। फिर वह दूसरा हिस्सा तौलने लगा और देखा कि यह भी थोड़ा भारी है, तो उसने उस हिस्से का एक टुकड़ा काट लिया। इस तरह वह रोटी को बहुत छोटी छोटी टुकड़ों में बाँट गया। बंदर ने छोटी-छोटी टुकड़ों को खा लिया और बिल्लियाँ पूरी रोटी खा गईं।

"The quarrel among ourselves is disastrous."  
"हमारी झगड़त हमें बर्बाद करती है।"

MS18 : The Shepherd Boy

### The Shepherd Boy झूठा गडरिया

One shepherd boy named Raju used to go to a forest for grazing his sheep. One day he thought to play a mischief and started shouting "LION! LION!". Listening his cries the villagers came there alongwith their sticks and other weapons to save him. Reaching there the villagers could not see any lion and Raju was laughing at them. Reproaching Raju the villagers returned back. One day it so happened that a lion actually came there. Raju was frightened and began shouting "LION! LION!". The villagers thought that he was again making a fool of them and nobody came to his rescue. The lion pounced upon the shepherd boy and ate him up.

एक चरानु गाँव का बच्चा राजू जंगल में अपनी बंदी बकरों को चराने जाता था। एक दिन उसे एक झूठा खतरा हुआ। वह जंगल में जाकर बिल्लियाँ बजाकर 'शेर आया, शेर आया' कहने लगा। गाँव के लोग अपने-अपने हथियार लेकर वहाँ पहुँच गए। लेकिन वहाँ कोई शेर नहीं था। राजू हँसने लगा और गाँव वाले उसे बर्बाद करने के लिए लौटने को कहने लगे।

एक दिन ऐसा हुआ कि एक शेर वास्तव में वहाँ आया। राजू बहुत डर गया और 'शेर आया, शेर आया' कहने लगा। गाँव वाले सोचें कि वह फिर से झूठा खतरा बजा रहा है, इसलिए वे वहाँ नहीं आए। शेर ने राजू को खा लिया।

"Always speak truth."  
"हमेशा सच बोलो।"

MS19 : Two Friends and a Bear

### Two Friends and a Bear दो मित्र और शेर

Once two friends Monu and Sonu were passing through a jungle. Suddenly they saw a bear coming towards them. Monu asked Sonu "Climb up the tree if you want to save your life" saying so Monu immediately climbed up the tree leaving Sonu bewildered as he did not know how to climb.

Sonu knew that the bear does not eat the dead person. He laid down and pretended to be dead and stopped breathing. The bear came close to Sonu, sniffed him and taking him to be dead went away. Monu came down, laughed at Sonu and asked "What did the bear say in your ears?" Sonu replied that the bear had said that he was not a friend in need was not a friend indeed.

एक बार दो मित्र मोनु और सोनु जंगल में गुजर रहे थे। तभी वहाँ एक शेर आया। मोनु ने सोनु से कहा, 'यदि तू अपनी जान बचावना चाहता है तो पेड़ पर चढ़ जा'। मोनु ने तुरंत पेड़ पर चढ़ गया, लेकिन सोनु को पेड़ चढ़ने में पता नहीं था। सोनु ने ज़मीन पर गिर पड़ा और साँस रोक ली। शेर उसकी ओर बढ़ा और उसे सूँघने लगा। शेर सोनु को मृत मानकर वहाँ से चला गया। मोनु नीचे उतर आया और सोनु से कहा, 'शेर ने तुम्हारे कानों में क्या कहा?' सोनु ने जवाब दिया कि शेर ने कहा कि 'जब तुम मुझे मदद करने की जरूरत में हो, तो मैं तुम्हारा मित्र नहीं हूँ।'

"Friend in need is a friend indeed."  
"जब तू मुझे मदद करने की जरूरत में हो, तो मैं तुम्हारा मित्र नहीं हूँ।"

MS20 : Slave and the Lion

### Slave and the Lion गुलाम और शेर

Once a slave escaped from the prison of the king and reached a dense forest. There suddenly he heard the painful howl of a lion. Gathering courage, he reached near the lion and look out the lion. The lion felt relaxed, looked at the slave with gratitude and asked away.

Some days later the king's soldiers caught the slave and produced him before the king. The king ordered that he be put before the hungry lion. The lion when released from the cage recognized the slave and started licking his feet. Everyone was astonished and the king asked the slave the reason behind the strange episode. The slave narrated the story and the king being pleased ordered his release from slavery.

एक दिन एक गुलाम राजा की जेल से भाग निकला और जंगल में आ गया। वहाँ उसे एक शेर की रोना सुनी। उसने हिम्मत करके शेर के पास जाकर देखा कि शेर उसे देखकर खुश हो रहा है।

कुछ दिनों बाद राजा के सैनिकों ने गुलाम को पकड़ लिया और उसे राजा के सामने ले गए। राजा ने गुलाम को शेर के सामने ले जाने का आदेश दिया। शेर ने गुलाम को देखकर उसे पहचान लिया और उसकी चरोंबों को लicking करने लगा। सब लोग हैरत में थे। राजा ने गुलाम से पूछा कि ऐसा क्यों हुआ। गुलाम ने अपनी कहानी सुनाई और राजा को खुश हो गया।

"As you sow, so shall you reap."  
"जैसे तू बोएगा, वैसे तू कटेंगा।"

MS21 : The Fox and the Crane

### The Fox and the Crane लोमड़ी और सारस

Once upon a time a friendship grew between a fox and a crane. One day the fox invited the crane for a dinner. Being mischievous by birth, the Fox thought to play a hoax. When the crane reached Fox's home, he served the dinner in a very wide plate. Crane with his long beak could not eat it properly and remained hungry.

The Crane decided to pay back. He also invited the fox for a dinner and when he came, the Crane served the meal in a very narrow and long jar. The fox could not put his mouth in the jar, remained hungry and also realized the folly of making a fool of his friend.

एक समय एक लोमड़ी और सारस में मित्रता हो गई। एक दिन लोमड़ी ने सारस को खाने के लिए बुलाया। लोमड़ी ने खाने के लिए एक बहुत बड़ा और चौड़ा प्लेट तैयार की। सारस की लंबी चोंच प्लेट में खाना खाने में असमर्थ थी।

सारस ने बदला लेने की सोची और उस दिन लोमड़ी को खाने के लिए बुलाया। सारस ने खाने के लिए एक बहुत लंबी और पतली जार तैयार की। लोमड़ी अपनी चोंच जार में डालने में असमर्थ थी और वह भी भूख से परेशान हो गया।

"As you sow, so shall you reap."  
"जैसे तू बोएगा, वैसे तू कटेंगा।"



MS30 : Honesty is the Best Policy



Honesty is the Best Policy ईमानदारी सर्वोत्तम नीति है



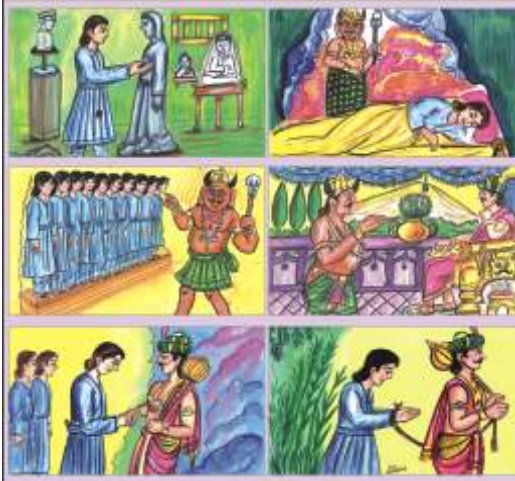
**MS30 : Honesty is the Best Policy**

एक दिन एक बच्चा एक बैग खोजा और उसे एक पुराने व्यक्ति को दे दिया। वह व्यक्ति उसे धन से पुरस्कृत किया।

एक दिन एक बच्चा एक बैग खोजा और उसे एक पुराने व्यक्ति को दे दिया। वह व्यक्ति उसे धन से पुरस्कृत किया।

MS31 : Pride has a fall

Pride has a fall भूल कहां होती है



**MS31 : Pride has a fall**

गोपाल दास एक पूर्ण कृषक और बहुत ही गर्वमयी था। एक दिन उसे अपने घर के बाहर एक गड्ढा खोना पड़ा।

गोपाल दास एक पूर्ण कृषक और बहुत ही गर्वमयी था। एक दिन उसे अपने घर के बाहर एक गड्ढा खोना पड़ा।

MS32 : Gold from the Mother Earth

Gold from the Mother Earth जमीन में दबा सोना



**MS32 : Gold from the Mother Earth**

एक गाँव में एक किसान रामदेव रहता था। एक दिन उसे एक खेत में सोना मिलने का संकेत मिला।

एक गाँव में एक किसान रामदेव रहता था। एक दिन उसे एक खेत में सोना मिलने का संकेत मिला।

MS33 : King Mayadas

King Mayadas लालची राजा मायादास



**MS33 : King Mayadas**

The Greek king Mayadas was very greedy. One day when he was looking at his treasures an angel appeared and appreciated his wealth.

The Greek king Mayadas was very greedy. One day when he was looking at his treasures an angel appeared and appreciated his wealth.

MS34 : The Great Scholar



The Great Scholar महान ज्ञानी



**MS34 : The Great Scholar**

In ancient times, some students were studying together in a gurukul. One of them was very intelligent and hardworking.

In ancient times, some students were studying together in a gurukul. One of them was very intelligent and hardworking.

MS35 : Brahmin and the Boatman



Brahmin and the Boatman ब्राह्मण और नाविक



**MS35 : Brahmin and the Boatman**

Once a learned Brahmin tried to cross the river. On the way the Brahmin asked the boatman, "Do you know how to read and write?"

Once a learned Brahmin tried to cross the river. On the way the Brahmin asked the boatman, "Do you know how to read and write?"

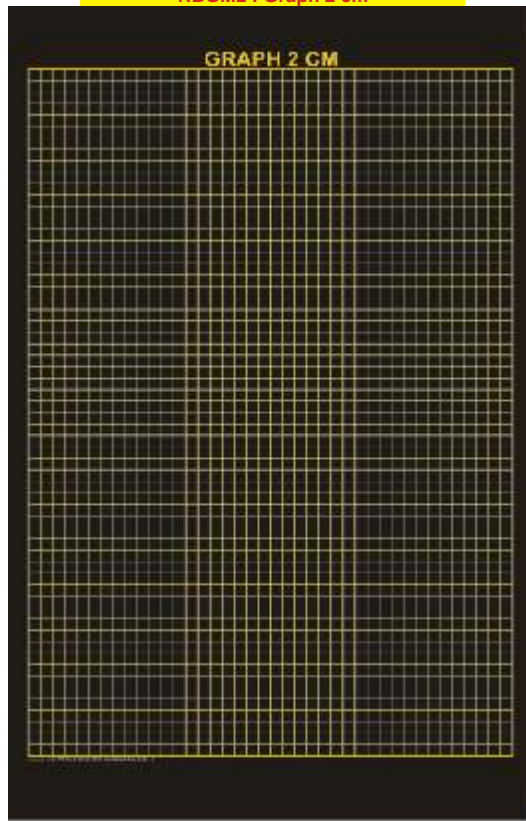
Laminated, Size 50 x 75 cm (Available in English and Hindi Combined)

MORAL STORY

A set of 35 charts



RBGM2 : Graph 2 cm



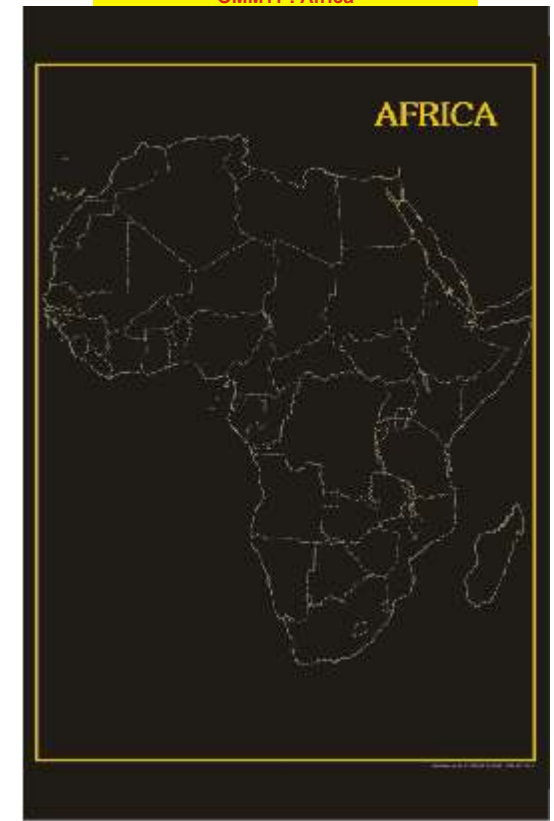
RBLM4 : Four Lines



RBLM2 : Two Lines



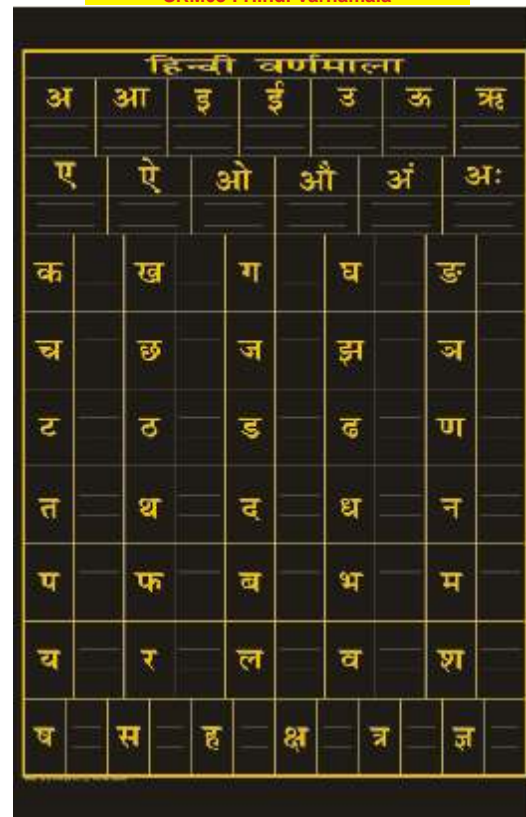
OMM11 : Africa



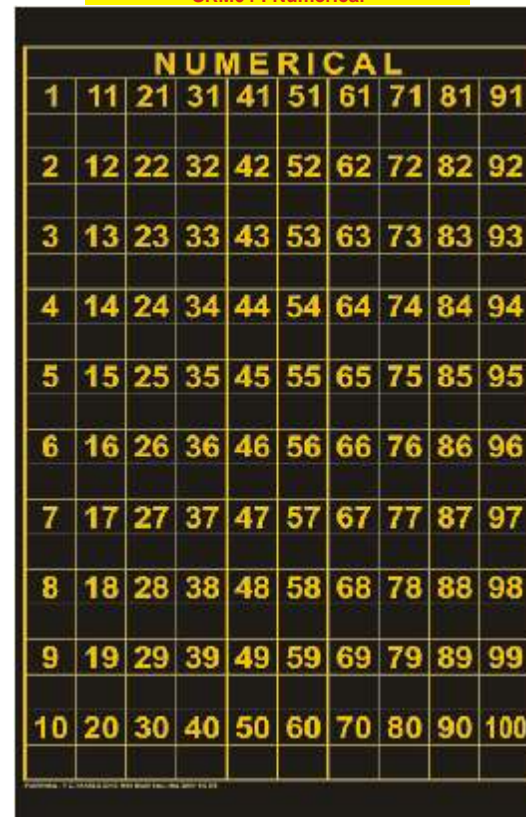
SRM01 : English Alphabet



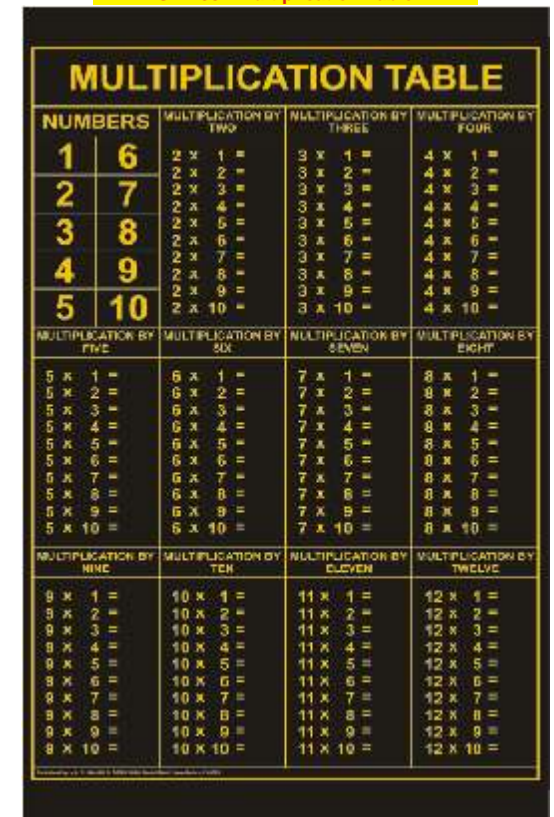
SRM03 : Hindi Varnamala



SRM04 : Numerical



SRM05 : Multiplication Table









### SF01 : Impact of British Rule

## IMPACT OF BRITISH RULE

Ruin of Agriculture & Industry, Social Ignorance & Miserable condition of Peasantry

The British imposed a heavy burden on the Indian economy and society. They destroyed the traditional handicraft industries and replaced them with machine-made goods. The peasants were exploited through high taxes and land revenue. The British also introduced Western education, which created a class of educated Indians who were alienated from their own culture. The social structure was disrupted, and the poor became even poorer. The British also introduced a system of land revenue that was based on the value of the land, which led to the ruin of many peasants. The British also introduced a system of taxation that was based on the value of the land, which led to the ruin of many peasants. The British also introduced a system of taxation that was based on the value of the land, which led to the ruin of many peasants.

### SF02 : Social Reformers

## SOCIAL REFORMERS

Awakened the masses against Untouchability, Blind Faith & Superstitions

Social reformers in India were concerned about the social conditions of the country. They wanted to improve the lives of the poor and the oppressed. They fought against untouchability, caste discrimination, and superstitions. They also advocated for women's rights and education. Some of the prominent social reformers were Jyotiba Phule, Mahadevi Varadachari, and Bal Gangadhar Tilak. They used various methods to spread their message, including writing, speaking, and organizing social movements.

### SF03 : The Revolt of 1857 - Causes

## THE REVOLT OF 1857 - CAUSES

Annexation of Kingdoms, Improvement & Exploitation Caused All Round Disaffection

The Revolt of 1857 was a significant event in Indian history. It was caused by a combination of factors, including the annexation of kingdoms, the introduction of new military weapons, and the exploitation of the Indian people. The British had annexed several kingdoms, including the Kingdom of Oudh, which led to the disaffection of the Indian rulers. The British also introduced new military weapons, such as the Enfield rifle, which led to the anger of the Indian soldiers. The British also exploited the Indian people, which led to the anger of the Indian masses.

### SF04 : The Revolt of 1857 - Events

## THE REVOLT OF 1857 - EVENTS

They Struggled Hard to Free Humanity from Injustice & Exploitation

The Revolt of 1857 was a struggle for Indian independence. The Indian people fought hard to free themselves from British rule. The revolt started in Meerut and spread to other parts of India. The British tried to suppress the revolt, but the Indian people continued to fight. The revolt was eventually suppressed, but it led to the end of British rule in India.

### SF05 : Emergence of Nationalism

## EMERGENCE OF NATIONALISM

Unsuccessful Revolt of 1857 Infused A Spirit of Sacrifice for the Nation

The Revolt of 1857 had a profound impact on the Indian people. It inspired a sense of nationalism and a desire for independence. The Indian people began to realize that they were a nation and that they should fight for their freedom. This led to the emergence of nationalism in India. The Indian people began to organize themselves into political parties and to demand self-rule.

### SF06 : Indian National Congress

## INDIAN NATIONAL CONGRESS

To Provide a Constitutional Outlet to the Discontentment and Aroused Consciousness

The Indian National Congress was founded in 1885. It was a political party that represented the Indian people. The Congress was founded by Bal Gangadhar Tilak and others. The Congress fought for the rights of the Indian people and for self-rule. The Congress was the first Indian political party to demand self-rule.

### SF07 : National Movement

## NATIONAL MOVEMENT

The Partition of Bengal led to the growth of EXTREMISM & SPLIT in the Congress.

The National Movement in India was a struggle for independence. It was led by various leaders, including Bal Gangadhar Tilak, Mahatma Gandhi, and others. The National Movement was a struggle for the rights of the Indian people and for self-rule. The National Movement was the first Indian political party to demand self-rule.

### SF08 : Militant Nationalism

## MILITANT NATIONALISM

ATROCITIES AT JALANWALA BAGH & DEATH OF LALLU LAJPAT RAU GAVE BIRTH TO MILITANT NATIONALISM

Militant nationalism in India was a form of nationalism that was based on violence. It was led by leaders like Bal Gangadhar Tilak and others. Militant nationalism was a response to the British rule in India. Militant nationalists believed that the Indian people should fight for their freedom by any means necessary.



NI01 : India- One Great Nation

## INDIA-ONE GREAT NATION भारत एक महान राष्ट्र

In every citizen is that India has anything else. Out of five persons of the world live in India. India, a nation with an area of 3,287,263 sq. Km. Rich in abundant agricultural & mineral resources with 100 million people of diverse cultural, religious & ethnic background is now leading towards new technology to expedite development.

इसका हर एक नागरिक उसी भारत का हिस्सा है, फिर कुछ और किसी भी देश का नागरिक ही।

भारत, एक बहुत बिकला क्षेत्रफल 3,287,263 वर्ग किलोमीटर है और विश्व की पाँच और अधिक जनसंख्या का एक हिस्सा है। विभिन्न सांस्कृतिक, धार्मिक और जातीय पृष्ठभूमि के साथ, भारत नए तकनीक की दिशा में विकास कर रहा है, जो हमें तेजी से विकास करने में मदद करेगा।

Spread the message of love & unity. Being a citizen of diverse people & cultures, India is united into one harmonious unity by religious factors. On any beloved country, our services like in discipline in there, you are our contribution to the progress of the nation & progress.

प्यार की भाँति एकता का संदेश फैलाएँ। विभिन्न जातियों और संस्कृतियों के लोगों के बीच एकता के लिए हमें एक ही धर्म और संस्कृति के कारणों से एकता मिलेगी। किसी भी प्रिय देश के लिए, हमारे देश में अनुशासन और प्रगति का प्रयास ही हमारे देश के विकास के लिए हमारे योगदान है।

एक झंडा	ONE FLAG	एक मुद्रा	ONE CURRENCY
एक राष्ट्र गीत	ONE ANTHEM	एक समय	ONE STANDARD TIME
एक संसद	ONE PARLIAMENT	एक राष्ट्रगीत	ONE CULTURE
एक सर्वोच्च न्यायालय	ONE SUPREME COURT	एक ही भोजन	COMMON FOOD
एक राष्ट्र भाषा	ONE NATIONAL LANGUAGE	एक ही अभिवादन	COMMON GREETING
एक शहरी वस्त्र	ONE URBAN DRESS	एक ही त्योहार	COMMON FESTIVALS
एक ग्रामीण वस्त्र	ONE RURAL DRESS	एक ही मानक	COMMON STANDARDS

NI02 : India is One

## INDIA IS ONE भारत एक है

**FREEDOM**  
We the people of India, having attained freedom from external control and self-government, solemnly affirm our faith in liberty, equality and fraternity as the principles of state conduct.

**UNIFORMITY**  
We the people of India, having attained freedom from external control and self-government, solemnly affirm our faith in liberty, equality and fraternity as the principles of state conduct.

**PROHIBITION OF DISCRIMINATION**  
The State shall not discriminate on the basis of religion, race, caste, sex, place of birth or any other grounds.

**STRIKES & BANDHS**  
The State shall prohibit strikes and bandhs in public services and essential services.

**PROTECTION OF PROPERTY**  
The State shall protect the public property and ensure the protection of the private property.

NI03 : Beware of Dangers

## BEWARE OF DANGERS खतरों से सावधान

**PROSECUTION** - अदालत में मुकदमा  
**COMMUNAL DISSENT** - जातीय असहमति  
**PROSECUTION & LINGUISM** - अदालत में मुकदमा और भाषावाद  
**PROSECUTION & LINGUISM** - अदालत में मुकदमा और भाषावाद  
**STRIKES & BANDHS** - हड़तालें और बंद  
**PROSECUTION & LINGUISM** - अदालत में मुकदमा और भाषावाद  
**PROSECUTION & LINGUISM** - अदालत में मुकदमा और भाषावाद

NI04 : Symbols of National Unity

## Symbols of National Unity राष्ट्रीय एकता के चिन्ह

NATIONAL ANTHEM राष्ट्रगान	NATIONAL SONG राष्ट्रीय गीत
जन-गण-मन अधिनायक जय हे भारत-भाय्य विधाता। पञ्जाब-विंध-गुजरात-मराठा- द्रविड उल्कल बंग, विन्ध्य-हिमालय-समुद्र-गंगा उत्कल-जलधि-तरंग। तव शुभ नामे जागे, तव शुभ आशिष मागे, चाहे तव जय पाव्ये। जन-गण-मणलयायक जय हे, भारत-भाय्य विधाता। जय हे, जय हे, जय हे, जय जय जय जय हे।।	वंदे मातरम्। सुजलां सुफलां मलयज शीतलाम् शश्वश्यामलां मातरम्। शुभ्र ज्योत्स्नां-पुलकित यामिनीम् पुलकितसुमित-दुमदल शोभिनीम् सुहासिनीं सुमधुर भाषिणीम् सुखदां, यरदां मातरम्।। वंदे मातरम्...

NI05 : National Discipline

## NATIONAL DISCIPLINE राष्ट्रीय अनुशासन

**DISCIPLINE** - अनुशासन  
**DISCIPLINE** - अनुशासन  
**DISCIPLINE** - अनुशासन  
**DISCIPLINE** - अनुशासन  
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**DISCIPLINE** - अनुशासन  
**DISCIPLINE** - अनुशासन  
**DISCIPLINE** - अनुशासन

NI06 : Unity in Diversity

## UNITY IN DIVERSITY विभिन्नता में एकता

ALL THE RELIGIONS & CASTES ARE VARIOUS BRANCHES OF THE SAME TREE  
विभिन्न धार्मिक और जातीय एक ही वृक्ष (राष्ट्र) की शाखाएँ हैं।

**ISLAM & ALFAH are different names of one omnipotent God.**  
इस्लाम और अल्लाह के अलग-अलग नाम हैं, परन्तु वे एक ही सर्वशक्तिमान् ईश्वर के अलग-अलग नाम हैं।

**THE WORLD IS ONE FAMILY. ALL ARE CHILDREN OF ONE FATHER GOD. SO ALL ARE BROTHERS AND SISTERS.**

NI07 : Unity For National Development

## UNITY FOR NATIONAL DEVELOPMENT राष्ट्रीय विकास के लिए एकता

**UNITY FOR NATIONAL DEVELOPMENT**  
राष्ट्रीय विकास के लिए एकता

**FORMULAE FOR HARMONY AND PEACE**  
1. Have love & respect for the well-being of others.  
2. Justice & fair play in our dealings.  
3. Tolerance & Compassion.  
4. Regard for the dignity & legitimate rights of our partners.  
5. Firm commitment to non-violence.  
6. Simple & happy life, useful for others.  
7. Be clean, honest and cautious.  
8. Realize that all religions are based on the universal brotherhood of man.

**WE ARE ONE COUNTRY, ONE PEOPLE. WE ARE INDIAL.**

**PLEASE NOTE YOU ARE TO:**  
1. Uphold & protect the sovereignty, unity and integrity of India.  
2. Preserve the common heritage of all the people of India & renounce any practice derogatory of the dignity of any citizen.  
3. Preserve the rich heritage of the nation's composite culture.  
4. Be clean, honest, and cautious.  
5. Realize that all religions are based on the universal brotherhood of man.

**LAYING FOUNDATIONS FOR NATIONAL UNITY AND INTEGRATION**

**UNITY IS NATION'S STRENGTH. UNITED WE STAND, DIVIDED WE FALL...**

NI08 : Reconciliation of Differences

## RECONCILIATION OF DIFFERENCES भेदभाव समन्वय

**RECONCILIATION OF DIFFERENCES**  
भेदभाव समन्वय

**UNDERSTAND THE REALITY**  
समझें वास्तविकता

**ALL THE RELIGIONS LOVE THE MESSAGE OF LOVE**  
सभी धर्मों में प्रेम का संदेश है।

**ALL THE RELIGIONS LOVE THE MESSAGE OF LOVE**  
सभी धर्मों में प्रेम का संदेश है।

**ALL THE RELIGIONS LOVE THE MESSAGE OF LOVE**  
सभी धर्मों में प्रेम का संदेश है।

NI09 : Prosperity Through Public Cooperation

**PROSPERITY THROUGH PUBLIC COOPERATION**  
**सामाजिक सहयोग से राष्ट्रीय विकास**  
 DEVELOPMENT OF AGRICULTURE, COMMUNICATIONS, SOCIAL SERVICES & INDUSTRIES. DEVELOP SCIENTIFIC THINKING & HUMANISM.  
 कृषि, संचार, समाज सेवाएं तथा उद्योगों का विकास करें। विज्ञान तथा मानवता की भावना का विकास करें।

**AGRICULTURE** कृषि **COMMUNICATION** संचार

**DEVELOP INDUSTRIES** उद्योगों का विकास करें

**SOCIAL SERVICES** समाजिक सेवाएं

NI10 : Give and Take

**GIVE AND TAKE** इस हाथ दो उस हाथ लो

**BASIC NEEDS** मूल आवश्यकताएँ

**GIVE DEDICATED** समर्पण से तैयार  
 समर्पण करें  
 जहाँ सेवा की आवश्यकता है

**TAKE BASIC NEEDS** मूल आवश्यकताएँ  
 शिक्षा, स्वास्थ्य & सुरक्षा  
 प्राप्त करें। सेवाएं प्राप्त करें।  
 सेवा, सेवा ही सेवा

**FEEL YOUR UNITY** एकता का अनुभव करें  
 एकता का अनुभव करें।  
 एकता ही एकता

**AVOID STRIKES** हड़ताल से बचें।  
 हड़ताल से बचना ही  
 एकता का अनुभव है

**LOVE AND SERVICE** प्रेम से सेवा करें।  
 प्रेम से सेवा करें।  
 प्रेम ही प्रेम

**ROOT OUT** भ्रष्टाचार को निकालें।  
 भ्रष्टाचार को निकालें।  
 भ्रष्टाचार ही भ्रष्टाचार

**PAY TAXES** कर चुकाएँ।  
 कर चुकाएँ।  
 कर ही कर

**RESPECT NATIONAL SYMBOLS** राष्ट्रीय प्रतीकों का सम्मान करें।  
 राष्ट्रीय प्रतीकों का सम्मान करें।  
 सम्मान ही सम्मान

**SAVE NATIONAL REVENUE** राष्ट्रीय आय को बचाएँ।  
 राष्ट्रीय आय को बचाएँ।  
 बचत ही बचत

**LEAVE** अशुभ प्रथाओं से बचें।  
 अशुभ प्रथाओं से बचें।  
 शुभ ही शुभ

**DEVELOP RESOURCES** संसाधनों का विकास करें।  
 संसाधनों का विकास करें।  
 विकास ही विकास

**WORK** मेहनत करें।  
 मेहनत करें।  
 मेहनत ही मेहनत

*For Social Studies,  
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Globe



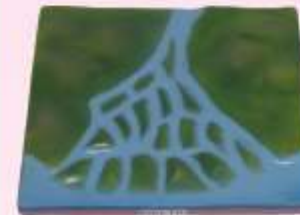
Maps



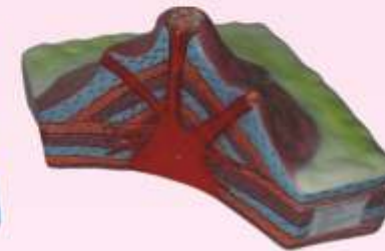
Outline Maps



Tourist Maps



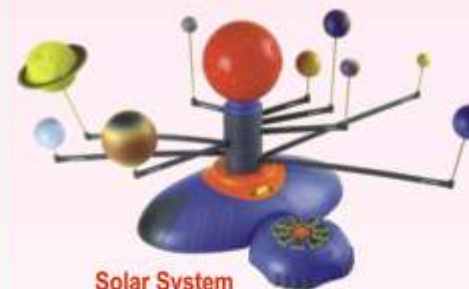
Delta Model



Volcano Model



Specimens Rocks & Minerals



Solar System



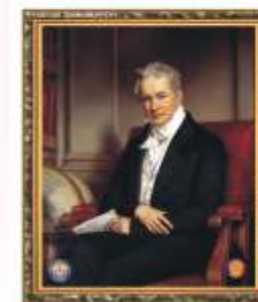
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Dumpy Level



Great Geographers



Charts

Laminated, Size 50 x 75 cm (Available in English and Hindi Combined)

**NATIONAL INTEGRATION**  
 A set of 10 charts







ET01 : English Teaching Charts (Lesson 1)

## English Teaching Charts 1 Lesson

**Part A - Vocabulary**

boy fan pen cow bag  
bat box dog man map

**This That Is A**

**Part B - Substitution table**

This	is	a	boy	bat
That			fan	box
			pen	dog
			cow	man
			bag	map

**Part C - Sentences to read**

This is a pen.  
 That is a map.  
 This is a bag.  
 That is a bat.  
 This is a box.  
 That is a dog.

ET02 : English Teaching Charts (Lesson 2)

## English Teaching Charts 2 Lesson

**Part A - Vocabulary**

book doll shoe girl bell  
desk bank tree bird

**Part B - Substitution table**

This	is	a	book	desk
That			girl	shoe
			bank	lion
			doll	bird

**Part C - Sentences to read**

This is a book.  
 That is a doll.  
 This is a shoe.  
 That is a desk.  
 This is a girl.  
 That is a tree.

ET03 : English Teaching Charts (Lesson 3)

## English Teaching Charts 3 Lesson

**Part A - Vocabulary**

hen horse doll table ball  
inkpot nose watch pen sheep

**My Your His Her**

**Part B - Substitution table**

This	is	my	doll	hen
That		your	map	ball
It		his	inkpot	cow
		her	watch	sheep
			house	book
			pen	bag

**Part C - Sentences to read**

This is your inkpot.  
 That is my hen.  
 This is your watch.  
 That is my map.  
 This is his sheep.  
 It is her doll.

ET04 : English Teaching Charts (Lesson 4)

## English Teaching Charts 4 Lesson

**Part A - Vocabulary**

cat rat mat bed  
almirah house cage shed

**is on the is in the is under the**

**Part B - Substitution table**

Your	cat	is on the	table	bed
My	book	is under the	desk	shed
His	pen			
Her	doll	is in the	almirah	house

**Part C - Sentences to read**

My cat is on the bed.  
 Her doll is under the bed.  
 Your cat is in the house.  
 My inkpot is under the desk.  
 His pen is on the table.  
 Your bag is in the almirah.

ET05 : English Teaching Charts (Lesson 5)

## English Teaching Charts 5 Lesson

**Part A - Vocabulary**

orange egg aeroplane elephant  
apple umbrella eye inkpot

**Is An My**

**Part B - Substitution table**

This	is	an	orange	egg
That		my	aeroplane	apple
It		your	elephant	inkpot
		his	umbrella	
		her		

**Part C - Sentences to read**

This is her orange.  
 That is an egg.  
 This is an elephant.  
 That is my inkpot.  
 This is your inkpot.  
 That is an aeroplane.  
 This is his apple.

ET06 : English Teaching Charts (Lesson 6)

## English Teaching Charts 6 Lesson

**Part A - Vocabulary**

book pen ball bag bat  
books pens balls bags bats

**These are Those are**

**Part B - Substitution table**

These	are	books	bags
Those		balls	bats
		pens	hats

**Part C - Sentences to read**

These are bags.  
 Those are bats.  
 These are books.  
 Those are pens.  
 These are balls.

ET07 : English Teaching Charts (Lesson 7)

## English Teaching Charts 7 Lesson

**Part A - Vocabulary**

chair table desk dog cow  
chairs tables desks dogs cows

**Our Their**

**Part B - Substitution table**

These	are	her	boxes
Those		my	chairs
		your	desks
		our	tables
		his	dogs
		their	cows

**Part C - Sentences to read**

These are their chairs.  
 Those are their dogs.  
 These are your desks.  
 Those are our cows.  
 These are his boxes.  
 Those are our tables.

ET08 : English Teaching Charts (Lesson 8)

## English Teaching Charts 8 Lesson

**Part A - Vocabulary**

umbrella tree box desk  
bags pens bats dogs

**What Where Is Are**

**Part B - Substitution table**

What	is	this ?	that ?
Where	are	these ?	those ?

**Part C - Sentences to read**

What is this? What are these?  
 This is an umbrella. These are bats.  
 What is that? What are those?  
 That is a tree. Those are bags.  
 Where is this? Where are these?  
 This is in the box. These are behind the wall.  
 Where is that? Where are those?  
 That is on the desk. Those are near the tree.



ET09 : English Teaching Charts (Lesson 9)

### English Teaching Charts 9 Lesson

**Part A - Vocabulary**

nose eye arm leg tongue  
head eyes arms legs mouth

**Part B - Substitution table**

This is	my	head	mouth
That is	your	nose	tongue
	his	leg	arm
	her		

These are	my	eyes	arms
Those are	your	legs	ears
	his	hands	feet
	her		

**Part C - Sentences to read**

This is my head.  
That is her nose.  
These are my eyes.  
Those are your arms.

ET10 : English Teaching Charts (Lesson 10)

### English Teaching Charts 10 Lesson

**Part A - 'Look and Say' Words**

touch show open shut

**Part B - Substitution table**

Touch	my	head	ear
Show	your	eyes	leg
	his	mouth	nose
	her		hand

I	my	hands	leg
You	show	nose	head
We	touch	mouth	eyes
They	her	ear	

**Part C - Sentences to read**

Touch my head.  
Show your tongue.  
I touch his nose.  
You touch her hand.  
They show their legs.

ET11 : English Teaching Charts (Lesson 11)

### English Teaching Charts 11 Lesson

**Part A - Vocabulary**

train bird bell camel horse  
goat basket shirt shoe

**Part B - Substitution table**

There	a	train	horse
Here	is	my	basket
	your	bird	shirt
			goat

**Part C - Sentences to read**

Here is a bird.  
There is a horse.  
Here is a goat.  
There is my basket.  
Here is your shirt.

ET12 : English Teaching Charts (Lesson 12)

### English Teaching Charts 12 Lesson

**Part A - Vocabulary**

postman driver doctor guard student  
washerman teacher gardener tailor farmer

**Part B - Substitution table**

He is	doctor	farmer
I am	postman	guard
You are	driver	tailor
	student	teacher

**Part C - Sentences to read**

He is a doctor.  
I am a farmer.  
You are a tailor.  
He is a driver.  
I am a guard.  
You are a student.

ET13 : English Teaching Charts (Lesson 13)

### English Teaching Charts 13 Lesson

**Part A - Vocabulary**

son daughter uncle mother father  
sister brother aunt cousin

**Part B - Substitution table**

He is	my	father	my	daughter
	our	brother	our	mother
	your	son	your	sister
	their	uncle	their	aunt
	his	cousin	his	cousin
	her		her	

**Part C - Sentences to read**

He is your father.  
She is my aunt.  
He is his uncle.  
She is your sister.  
He is our brother.  
She is my mother.

ET14 : English Teaching Charts (Lesson 14)

### English Teaching Charts 14 Lesson

**Part A - Vocabulary**

school hospital post office office bank

**Part B - Substitution table**

It	a	school	office
That	is	my	bank
	your	post office	hospital
	our		

Where	is	the	school ?
		my	hospital ?
		your	house ?
		our	bank ?
		their	office ?

**Part C - Sentences to read**

Where is their school?  
It is our school.  
That is their hospital.  
It is our office.

ET15 : English Teaching Charts (Lesson 15)

### English Teaching Charts 15 Lesson

**Part A - Vocabulary**

room door window black board  
lock key

**Part B - Substitution table**

I	open	the	room	box
We	close	our	door	desk
You	shut	your	book	eyes
They	clean	their	window	mouth
			office	

**Part C - Sentences to read**

I close the room.  
They open their book.  
We clean our desk.  
You shut your mouth.  
Open the lock with the key.

ET16 : English Teaching Charts (Lesson 16)

### English Teaching Charts 16 Lesson

**Part A - Vocabulary**

reading writing playing running jumping  
eating drinking walking sitting

**Part B - Substitution table**

I am	reading	sitting	running
You are	writing	drinking	jumping
They are	playing	walking	eating
We are			

He	is	writing	sitting
She		playing	walking
It			

**Part C - Sentences to read**

You are reading your book.  
I am eating my lunch.  
We are reading our books.  
They are playing football.  
He is writing in his book.

### EG01 : Sentence

## SENTENCE

A Sentence Is a Group of Words Conveying a Complete Sense.

**Assertive Sentence** States a fact. It ends with a full stop.

**Interrogative Sentence** Asks a question. It ends with a question mark.

**Imperative Sentence** Expresses a command, request or advice. It ends with a full stop.

**Exclamatory Sentence** Shows a strong feeling. It ends with an exclamation mark.

**Optative Sentence** Shows a wish. It ends with an exclamation mark or full stop.

### EG02 : Noun : Kinds

## NOUN : Kinds

Noun is a Naming Word That Can Name a Person, Place, Thing, Quality, State, Idea etc.

**KINDS OF NOUN**

- Common Noun** : A noun that is shared by every member of the same class.
- Proper Noun** : Name of a particular person or thing.
- Collective Noun** : Name of a group of people or collection of things of same kind.
- Abstract Noun** : Name of a quality, state or idea.

### EG03 : Noun : Gender

## NOUN : Gender

**MASCULINE GENDER** Denotes male.

**FEMININE GENDER** Denotes female.

**COMMON GENDER** Denotes both a male or a female.

**NEUTER GENDER** Denotes a non living thing or a thing that is neither male nor female.

**FORMATION OF FEMININE NOUN**

Using entirely different words.

By adding -ness, -ity, etc.

By placing a word after or before or changing some word.

### EG04 : Noun : Number

## NOUN : Number

Noun Can be Singular or Plural. Singular Nouns Denote One Person or Thing Whereas Plural Nouns Denote More Than One Person or Things.

**SINGULAR NOUNS**

**PLURAL NOUNS**

**PLURAL FORMATION**

**COUNTABLE NOUNS**

**UNCOUNTABLE NOUNS**

### EG05 : Noun : Case

## NOUN : Case

**Nominative Case** Nouns are used as the subject of a verb.

**Objective Case (Accusative)** Nouns are used as the direct object of verbs.

**Dative Case** Nouns are used as an indirect object.

**Possessive Case** Nouns are used to show possession.

**Case is Apposition** When noun nouns are used for the same purpose, place or thing in a sentence, then the second noun is Case in Apposition of the first noun.

**Vocative Case** Nouns used in remembrance of address are vocative cases.

### EG06 : Pronouns - I

## PRONOUNS - I

Words Which are Used in Place of Nouns are Pronouns.

**Personal Pronouns**

**First Person**

**Second Person**

**Third Person**

**Possessive Pronouns**

**Reflexive Pronouns**

**Emphatic Pronouns**

### EG07 : Pronouns - II

## PRONOUNS - II

Pronouns are the Words Used in Place of Nouns.

**Demonstrative Pronouns**

**Distributive Pronouns**

**Indefinite Pronouns**

**Interrogative Pronouns**

**Relative Pronouns**

**Reciprocal Pronouns**

### EG08 : Conjunction

## CONJUNCTION

Conjunction is a Word That Joins Two Words, Clauses or Sentences.

**Coordinating Conjunction**

**Subordinating Conjunction**

**INTERJECTION**

Interjection is a Word Which Expresses Some Sudden Feeling or Emotion.

### EG09 : Adjective

## ADJECTIVE

Adjective is a Word That Adds Something to the Meaning of a Noun or a Pronoun.

**Formation of Adjectives**

From Nouns		From Verbs		From Other Adjectives	
Glory	Glorious	Move	Movable	Black	Blackish
Dirty	Dirty	Love	Loveable	Whole	Wholesome
Hope	Hopeful	Thin	Thinness	Sick	Sickly
Fool	Foolish	Careless	Careless	Comic	Comical
Gold	Golden	Talk	Talkative	Correct	Corrective

**Degree of Comparison**

Positive (no comparison)	Comparative (Comparison between two)	Superlative (Comparison among more than two)
This bowl is large.	Green bowl is larger than the red.	Green bowl is the largest of all.

Positive	Comparative	Superlative	Positive	Comparative	Superlative
Tall	Taller	Tallest	Bold	Bolder	Boldest
Brave	Braver	Bravest	Wise	Wiser	Wisest
Thin	Thinner	Thinnest	Hot	Hotter	Hottest
Heavy	Heavier	Heaviest	Easy	Easier	Easiest
Gay	Gayier	Gayest	Merry	Mrier	Mriest
Larger	Larger	Largest	Late	Latter	Latest
Good	Better	Best	Fore	Former	Foremost
Little	Less	Least	Bad	Worse	Worst

### EG10 : Adjective : Kinds - I

## ADJECTIVE : Kinds-I

**Adjectives of Quality (Descriptive Adjectives)**  
Show the kind or quality of person or thing. Answer the question : of what kind ?

**Adjectives of Quantity**  
Show how much of a thing is meant. Answer the question : how much ?

**Adjectives of Number**  
Show how many persons or things are meant or in what order persons or things stand.

**Proper Adjectives**  
Adjectives derived from proper nouns.

### EG11 : Adjective : Kinds - II

## ADJECTIVE : Kinds-II

**Demonstrative Adjectives**  
Adjectives which point out which person or thing is meant. These answer the question : which ?

**Interrogative Adjectives**  
Adjectives used with nouns to ask questions.

**Possessive Adjectives**  
Adjectives which show belonging or possession.

**Emphasizing Adjectives**  
Adjectives which add emphasis to a noun.

**Exclamatory Adjectives**  
Adjectives which help to express a strong emotion.

### EG12 : Adverb

## ADVERB

An Adverb is a Word That Modifies the Meaning of a Verb, an Adjective or Another Adverb.

**KINDS OF ADVERBS**

Adverbs of Time	Adverbs of Frequency	Adverbs of Reason
We bought this car recently.	The person called again.	He felt sad because he did not study hard.
Adverbs of Affirmation & Negation	Adverbs of Degree or Quantity	Adverbs of Place or Position
We will watch this car of you.	We are not coming.	The meeting will be held here.
Adverbs of Manner	Relative Adverbs	Interrogative Adverbs
The girl slept loudly.	That is the place where we will set the first bank.	Who will be the teacher here ?

### EG13 : Articles

## ARTICLES

**Indefinite Articles (A, An)**

A is used before a singular noun beginning with a consonant sound.

An is used before a singular noun beginning with a vowel sound.

**Definite Article (The)**

The is used to point out some particular person or thing.

The is used with a singular noun meant to represent a whole class.

The is used with names of rivers, seas, mountains ranges etc.

The is used with common nouns which are already referred.

The is used before adjectives which are used as nouns.

### EG14 : Preposition

## PREPOSITION

Preposition is a Word Placed Before a Noun or a Pronoun to Show the Relation Between the Person or Thing Denoted by it and Something else Mentioned in the Sentence.

**Simple Preposition**  
at, by, for, from, in, off, on, out, through, till, to, up, with etc.

**Compound Preposition**  
about, above, across, along, around, before, behind, below, beside, beyond, inside, outside, within etc.

**Phrase Preposition**  
according to, along with, by virtue of, for the sake of, in addition to, in front of, in place of, in spite of, instead of, in account of, with reference to, with regard to etc.

**Participial Preposition**  
having, concerning, during, pending, regarding etc.

**Relations Expressed by Prepositions**

Time	Place	Agency
I have known him for five years.	She sits herself behind the wall.	Milk is sold by this method.
Manner	Cause/Purpose/Reason	Possession
He was paid daily for his work.	His mother is suffering from grief.	The boy will get help in my hand.
Measure/Rate/Value	Contrast/Concession	Inference/Motive/Origin
Mangoes are sold at the Rs 60 per kg.	For all his wealth, he is not content.	His skills come from practice.

### EG15 : Verbs

## VERBS

Verb is a Word That Says or Asserts Something About a Person or Thing. No Sentence Can Exist Without a Verb.

**A Verb Will Tell**

- What a person or thing does.
- What a person or thing is.
- What is done to a person or thing.
- What a person or thing has.

**Transitive Verb** : Action passes over from the doer to an object.

**Intransitive Verb** : Action does not pass over to an object.

**Verbs of Incomplete Predication** : Needs another word to make complete sense.

**Auxiliary Verb** : A helping verb which helps main verb in forming tense, mood or voice.

### EG16 : Non-Finites : Infinitives

## NON-FINITES : Infinitives

Infinitives Work as Nouns, Adjectives or Adverbs in the Sentence.

**FORM : to + verb in its first form**

**SIMPLE INFINITIVES** : Infinitives used as nouns

As subject of a verb, As object of a verb, As complement of a verb, As object of a preposition.

**GERUNDIAL INFINITIVES** : Infinitives used as adjectives or adverbs

Qualify a verb, Qualify an adjective, Qualify a noun, Qualify a sentence.

**INFINITIVES WITHOUT TO** : Bare Infinitives

After the verbs let, make, bid, see, hear, feel, help etc.

After need/care in negative sentences.

After the expressions had better, would rather, sooner than, rather than, had rather.

**ENGLISH GRAMMAR CHARTS**  
 A set of 20 charts  
 Laminated, Size 50 x 75 cm

**EG17 : Non-Finites : Gerunds & Participles**

### NON-FINITES : Gerunds & Participles





Swimming is a great exercise.     He is very good at skiing.     The tower at the shopping mall.

**GERUNDS** Gerunds act as nouns in the sentence and are formed by adding -ing in the first form of the verb.

General as a Subject	General as Complement of Verb	General as an Object	General as the object of Preposition
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**PARTICIPLES** Participles act as verbal adjectives in the sentence.

**Present Participles :** Form : first form of verb + ing

As Adjective	As Subject Complement	As Object Complement	As an Absolute Phrase
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**Past Participles :** Represent completed action or state of the thing spoken of

As Adjective	As Subject Complement	Object Complement
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**EG18 : Present Tense**

### PRESENT TENSE

A Verb That Refers to Present Time is in Present Tense.

**Present Indefinite Tense**

Action is simply mentioned and there is nothing being said about its completeness.

**Sentence**     **Verb form**

Statement: 1st form of verb or 1st form of verb + s/es

Negative: do/does + not + 1st form

Interrogative: Do/Does + subject + 1st form...?

**Present Continuous Tense**

Action is still going on in the present time.

**Sentence**     **Verb form**

Statement: Is/Am/are + 1st form of verb + ing

Negative: Is/Am/are + not + 1st form of verb + ing

Interrogative: Is/Am/Are + subject + 1st form of verb + ing...?

**Present Perfect Tense**

Action is completed or has ended recently.

**Sentence**     **Verb form**

Statement: has/have + 3rd form of verb

Negative: has/have + not + 3rd form of verb

Interrogative: Has/Have + subject + 3rd form of verb...?

**Present Perfect Continuous Tense**

Action is started for sometime and is still going on.

**Sentence**     **Verb form**

Statement: Has/Have + been + 1st form of verb + ing

Negative: Has/Have + not + been + 1st form of verb + ing

Interrogative: Has/Have + subject + been + 1st form of verb + ing...?

**EG19 : Past Tense**

### PAST TENSE

A Verb That Refers to Past Time is Said to be in Past Tense.

**Past Indefinite Tense**

The action is simply mentioned and understood to have taken place in the past.

**Sentence**     **Verb form**

Statement: was/were + 1st form of verb

Negative: did + not + 1st form of verb

Interrogative: Did + subject + 1st form of verb...?

**Past Continuous Tense**

The action was ongoing till a certain time in the past.

**Sentence**     **Verb form**

Statement: was/were + 1st form of verb + ing

Negative: was/were + not + 1st form of verb + ing

Interrogative: Was/Were + subject + 1st form of verb + ing...?

**Past Perfect Tense**

Expresses something that happened before another action in the past.

**Sentence**     **Verb form**

Statement: had + 3rd form of verb

Negative: had + not + 3rd form of verb

Interrogative: Had + subject + 3rd form of verb...?

**Past Perfect Continuous Tense**

Expresses something that started in the past and continued until another time in the past.

**Sentence**     **Verb form**

Statement: had + been + 1st form of verb + ing

Negative: had + not + been + 1st form of verb + ing

Interrogative: Had + subject + been + 1st form of verb + ing...?

**EG20 : Future Tense**

### FUTURE TENSE

A Verb That Refers to the Future Time is Said to be in Future Tense.

**Future Indefinite Tense**

Action which is planned to be in future. Nothing is said about the time in the future.

**Sentence**     **Verb form**

Statement: will/shall + 1st form of verb

Negative: will/shall + not + 1st form of verb

Interrogative: Will/ Shall + subject + 1st form of verb...?

**Future Continuous Tense**

Expresses action ongoing at a particular moment in the future.

**Sentence**     **Verb form**

Statement: will/shall + be + 1st form of verb + ing

Negative: will/shall + not + be + 1st form of verb + ing

Interrogative: Will/ Shall + subject + be + 1st form of verb + ing...?

**Future Perfect Tense**

Expresses action that will occur in the future before another action in the future.

**Sentence**     **Verb form**

Statement: will/shall + have + 3rd form of verb

Negative: will/shall + not + have + 3rd form of verb

Interrogative: Will/ Shall + subject + have + 3rd form of verb...?

**Future Perfect Continuous Tense**

Expresses an ongoing action before some point in the future.

**Sentence**     **Verb form**

Statement: will/shall + have + been + 1st form of verb + ing

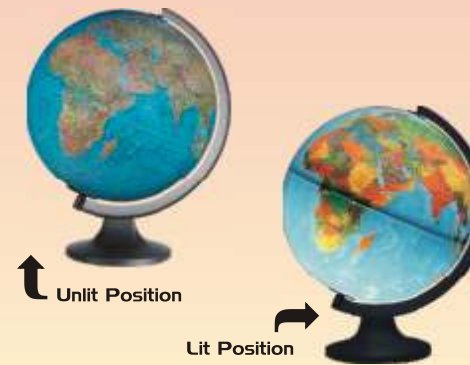
Negative: will/shall + not + have + been + 1st form of verb + ing

Interrogative: Will/ Shall + subject + have + been + 1st form of verb + ing...?

# ILLUMINATING GLOBES

Manufactured by Replogle Globes, USA  
 World's largest globe manufacturing company

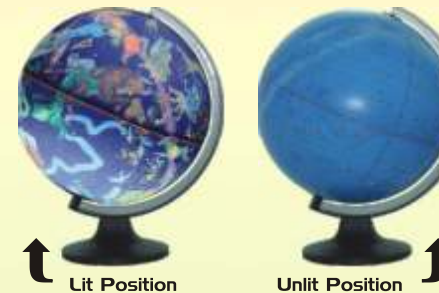
## POLITICAL-CUM-PHYSICAL GLOBE



**Salient Features:**

- ★ Illuminated.
- ★ More than 4000 locations.
- ★ Time dial at the North Pole.
- ★ Unlit position shows Physical features.
- ★ Lit position shows Political features.
- ★ Black colour base, Smoked semi-meridian.
- ★ Certified by Survey of India.
- ★ Code IG01 Copenhagen Blue 30 cm dia
- ★ Code IG02 Sweden Blue 25 cm dia
- Special Limited Edition - Raised Relief  
(Product Code IG06)
- ★ 3-dimensional effect.
- ★ Mountains are raised relief.
- ★ Better visualization of mountains and plains.
- ★ Most popular type of globe.
- ★ Code IG06 Copenhagen Blue 30 cm dia (RR)

## CONSTELLATION GLOBE



**Salient Features:**

- ★ Breathtaking splendor.
- ★ 30 cm dia.
- ★ Illuminated.
- ★ Unlit position shows stars, constellations & nebulae.
- ★ Lit position shows luminous beauty of 70 celestial images.
- ★ Black colour base, Smoked semi-meridian.
- ★ Product Code IG04

## GLOBE4KIDS

Here is the Globe4Kids designed for fun. The capacity to wonder is not learned. It's there from the beginning. This globe is a perfect companion to any child's imagination.

**Salient Features:**

- ★ 25 cm dia.
- ★ Illuminated.
- ★ More than 100 drawings of people, landmarks and animals.
- ★ Deep blue moulded plastic base and semi-meridian.
- ★ Packed in decorative carton.
- ★ Product Code IG03



## MOON GLOBE

Moon globe has been enjoyed by students, astronomers, scientists and professors as well as anyone that has interest in the Moon. This Moon globe from Replogle Globes is the classic reference for our mother planet's natural satellite.

**Salient Features:**

- ★ 30 cm dia.
- ★ Depicts the geographical features of the Earth's Moon.
- ★ Shows craters, "seas" and mountains.
- ★ Highly detailed and accurate.



**प्रवेशिका पाठशाला-1**

पाठ.1 स्वर  
अ आ इ ई उ ऊ  
ए ऐ ओ औ अं अः

पाठ.2 व्यंजन  
क ख ग घ ङ, च छ ज झ व  
ट ठ ड ढ ण, त थ द ध न  
प फ ब भ म, य र ल व श  
ष स ह, क्ष त्र ज्ञ

पाठ.3 अ की मात्रा तथा अक्षरों की पहचान  
रथ घर फल बस  
बतख डर मत घर चल  
रथ पर चढ़ बन सब नर

**प्रवेशिका पाठशाला-5**

पाठ.10 ऐ की मात्रा=  $\text{ऐ} = \text{ट} + \text{ऐ} = \text{ट} + \text{ऐ} = \text{टै}$   
ऐनक बैल थैला सैनिक  
किसान खेत में हल चला रहा है  
बैठ पैसा मैदान पैदल  
भैया मेल जैसा बैरागी  
मैना बैठक तैसा फैशन

पाठ.11 ओ की मात्रा=  $\text{ओ} = \text{क} + \text{ओ} = \text{क} + \text{ओ} = \text{को}$   
ओखली घोड़ा केला खाओ मोर देखो  
सोनिया कपड़े की गुड़िया बनाती है  
गोल खोल तोल मोहन  
सोना डोली बोल सोहन  
होली तोड़ चोर धोबन

**प्रवेशिका पाठशाला-2**

पाठ.4 आ की मात्रा=  $\text{आ} = \text{क} + \text{आ} = \text{क} + \text{आ} = \text{का}$   
आम गाय अनार लड़का  
आम खा अनार ला मदन भला था  
खाना खा हमारा भारत राम पढ़  
मामा नाना दादा चाचा आना पाना  
लाला आया ताला लाया रामायण

पाठ.5 इ की मात्रा=  $\text{इ} = \text{ल} + \text{इ} = \text{ल} + \text{इ} = \text{लि}$   
किताब हिरन चिड़िया किसान  
लिख मिल दिया पिता आया  
लिया पिया गिन हिल दिल  
खिला किसका इस दिन

**प्रवेशिका पाठशाला-6**

पाठ.12 औ की मात्रा=  $\text{औ} = \text{क} + \text{औ} = \text{क} + \text{औ} = \text{कौ}$   
औरत कौवा पंथा तौलिया  
दो मानव नौका से नदी पार कर रहे हैं  
बौना फौजी दौड़ा और  
चौक कौन मौसा लौकी  
पकौड़े बिछौना रौनक गौशाला

पाठ.13 अं की मात्रा=  $\text{अं} = \text{क} + \text{अं} = \text{क} + \text{अं} = \text{कं}$   
अंगूर पतंग पंखा झंडा  
गंगा किनारे मंदिर यह हमारा झंडा है  
तंग आंख रंग भंग बंदर  
शंख पंख गेंद जंगल  
गांधी पंछी टंडा बसंत

**प्रवेशिका पाठशाला-3**

पाठ.6 ई की मात्रा=  $\text{ई} = \text{च} + \text{ई} = \text{च} + \text{ई} = \text{ची}$   
हाथी छतरी मछली चीता  
सीटी बीन रीछ दादी तीन  
खीर सीख पानी रानी  
कील ठीक चाची सीता  
कमीज़ अमीर नानी खीर रख आ

पाठ.7 उ की मात्रा=  $\text{उ} = \text{फ} + \text{उ} = \text{फ} + \text{उ} = \text{फु}$   
फुटबाल बुढ़ापा धनुष गुड़िया  
बुढ़ापा बुरा सुनीता चली गई बुलबुल आई  
खुश दुम धनुष पुल पर चल  
कुश कुल सुन सुख  
सुराही बुनाई यह नदी का पुल फुलवारी

**प्रवेशिका पाठशाला-7**

पाठ.14 विसर्ग : ओर संयुक्त अक्षर  
प्रातः उठ इन्जन पत्ता बच्चा  
प्रातः चक्की कुत्ता बाल्टी स्कूल  
मुन्ना प्यारा पत्थर अम्मा ज्ञान  
दिल्ली प्याला लट्टू  
उन्हें अग्नि लैम्प

पाठ.15 संयुक्त अक्षर  
काली बिल्ली बड़ी छबोली,  
जाने को वह बैठी दिल्ली।  
दूध धरा था प्याले में,  
पहुँच गई वह आले में।  
चप चप कर है वह पी जाती,  
चूहों को भी है खा जाती।  
प्यारा भारत देश हमारा

**प्रवेशिका पाठशाला-4**

पाठ.8 ऊ की मात्रा=  $\text{ऊ} = \text{प} + \text{ऊ} = \text{प} + \text{ऊ} = \text{पू}$   
कबूतर फूल चूहा भालू  
सूरज निकला पूजा आभूषण चुन  
धूप सूर धूल चूना शूल  
पूर्व जूता मूली चूरन भूरा  
भूल गुलाब खूब पढ़ ऊन चूड़ियां

पाठ.9 ए की मात्रा=  $\text{ए} = \text{ल} + \text{ए} = \text{ल} + \text{ए} = \text{ले}$   
शेर पड़ मेड़ सब  
पेड़ पर आम ठेला चला राम खेल  
पेट चेला तेल गणेश  
मीठे देख रेल महेश  
भेड़ आई किसान खेत में

**प्रवेशिका पाठशाला-8**

पाठ.16 संयुक्त अक्षर  
च-च = अच्छा क-क = क्या  
स-स = बस्ता ष-ष = पुष्पा  
श-श = श्याम ध-ध = ध्यान

प्रातः काल प्रणाम प्रथम  
प्रार्थना प्रतिज्ञा स्कूल

प्रातः काल सवेरे उठो।  
अपना बिस्तर स्वयं इकट्ठा करो।  
प्रथम माता पिता को प्रणाम करो।  
फिर हाथ मुँह धो डालो।  
शीतल जल के छींटे मारकर आखें  
साफ करो। दांत साफ कर स्नान करो।  
बस्ता लेकर स्कूल जाओ।  
श्याम पुष्पा के पास बैठो।  
क्यारी में काम करो।  
अच्छे लड़के लड़की बनो।

**HT09 : Hindi Teaching (Chart 9)**

### बालगीत - 1

<p><b>मछली</b></p> <p>मछली जल को पती है। जीवन हर जगह पर है। राज्य तमिलो इत नमोपै। बहार निकलने पर जलपै।</p> 	<p><b>सड़क</b></p> <p>लम्बी-चौड़ी सड़क पत्थरी, दिखती है का बड़ी पत्थरी। उस पर मोटर गाड़ी है, चू-चू सेती जाती है। सड़क खेप का फलन हुन, चलते हैं मजदूरा हुन। घाट गाड़ी वो खाली, फिर चोकें पछावाली।</p> 
<p><b>कैक</b></p> <p>मेरा कम विषय एक अना, मेरी मित्रि का बुलगाणा। पान खर फेक सरीला, खर्चा वाला नम गरीला। जुरिय उनी भगी लई, खान नाम फुली न लगी। जम्मी टपू लू, प्यरे, कपड़े पहने ज्यारे ज्यारे।</p> 	<p><b>राखी</b></p> <p>मेरी छोटी भाई है, सुन्दर राखी भाई है। बारी छैल-छबोली है, हाल तुलसी पोली है। आंखों को पूँयवाली है, सपने का को भागी है। दीदी ने यजनई है, बरबसे मुझे खिलाई है। भुंकर तुम्हा कपड़े लाई, डिब्बा एक फिलाई का। कन-कन चम्कते तूने नोबे, कलम एक कलमाई बर।</p> 

**HT13 : Hindi Teaching (Chart 13)**

### लोमड़ी और कौवा


#### झूठी प्रशंसा में मत आओ

एक कौवा कहीं से एक रोटी का टुकड़ा ले आया और वृक्ष पर जा बैठा। एक लोमड़ी ने कौवे से रोटी छीननी चाही। बोली "कौवे भाई, तुम बहुत अच्छा गाते हो, तुम्हारे राग को सभी प्रशंसा करते हैं। कौवे सुन्दर गीत सुनाओ।"

कौवा लोमड़ी की झूठी प्रशंसा में आकर खुरी से वृक्ष की डाल पर नाचने लगा लोमड़ी बोली - "बाह, कैसा सुन्दर नाच है। जरा नाच के साथ गाना भी सुनाओ।" कौवा कांथ कांथ करने लगा।

जैसे ही कौवे ने गाना गाने के लिए मुँह खोला, रोटी का टुकड़ा उसके मुँह से नीचे गिर गया।

लोमड़ी चपाती उठा कर भाग गई, और जाते जाते बोली "कौवे भाई, कल फिर रोटी खाना, और मुझे गीत सुनाना"। कौवा पछताने लगा। अब क्या हो सकता था। जब चिड़िया चुग गई खेत।



**HT10 : Hindi Teaching (Chart 10)**

### बाल गीत - 2

<p><b>घोड़ा</b></p> <p>गाँव में घोड़े हैं सुन्दर। और सड़कों में हैं लड़कें। बादल की है इस का चढ़ावा। सामने चूड़ें कभी न अड़कें। सबके में वे खेल रिखला। पास चने खुन होकर खाता।</p> 	<p><b>तोता</b></p> <p>हरियाल तोता बड़ा निराला, "तोता राम" कहलाता है। आप, लीची, सेब, जामुने, घाट में वे खाता है। पिहारे में वो खुरी से रहता, घन-घन फिर भयम करवाता।</p> 
<p><b>रेल</b></p> <p>टुक टुक करती जाती रेल। आप और पाणी का खेला। दूर दूर की ओर करती। जिरी, जरी पाए करती। किनी को दफन, पर प्यारी। विहारी को वे पुन: मिलाती।</p> 	<p><b>वायुयान</b></p> <p>इस में सर-ना उड़ान करा। बैठ-जयन्त, जय, जयन्त। जयन्त हो तो च-उड़ान करा। मुझे ही भेट में च-उड़ान करा। तुम्हें में यह नम कायन, चलो में अन्य च-उड़ान करा। तभी यह कायन करवाता। इस में सर-ना उड़ान करा।</p> 
<p><b>रक्षा बन्धन</b></p> <p>रक्षा बन्धन का त्योहार। धूम धाम से जाता है। भाई बहिनों का यह प्यार। सौत अनोखे पाता है।</p> 	

**HT14 : Hindi Teaching (Chart 14)**

### एकता में बल है

#### शिकारी और कबूतर

एक शिकारी ने वन के पक्षियों को पकड़ने के लिये अपना जाल फैलाया था।

कुछ ही समय में आस पास के कबूतर उसमें आकर फँस गये। हर कबूतर अपने आप को छुड़ाने का प्रयत्न करता परन्तु विफल हो जाता।

इतने में वहाँ से एक कौवा जा रहा था। वह पक्षियों को जाल में फँसा देखकर सीधा उनके पास गया और कहा कि वह सब मिलकर जोर लगायें तथा जाल के साथ ही उड़ जायें।


कबूतरों ने कौवे की शिक्षा मानी और अपनी पूर्ण शक्ति के साथ जाल ले उड़े। शिकारी हाथ मलता ही रह गया।

**'एकता में बल है'**



**HT11 : Hindi Teaching (Chart 11)**

### बाल गीत - 3

<p><b>गाय</b></p> <p>प्यारी-प्यारी गाय हमारी, दूध हमें वे देती है। इसके बरले में केवल बस, चाट-पाणी लेती है। इसके बरले में बेल बने हैं, खेत में हल चलते हैं। उन्की ही मेहनत से फिर, अनाम हम फले हैं।</p> 	<p><b>बन्दर</b></p> <p>बन्दर आया, बन्दर आया। सगरी को संघ बन्दर आया। खी: खी: कलके हमें डराये। मुँह विषकामे कभी खुजामे। सीता देखें टोपी पहने। बन्दरिया ने भी पहने पहने।</p> 
<p><b>कार</b></p> <p>मेरी प्यारी प्यारी कार। वहाँ कभी रहती बँकर। आप को दफन ले जाती। और शाम को घर ले जाती। छट्टी के दिन हम सक्की चढ़। पिबनिका को है पड़े दिखती।</p> 	<p><b>सेब</b></p> <p>सभी फलों में सेब है न्याता। साल साल आ प्यारे प्यारे। एक सेब जो रोज़ है खाता। डॉक्टर को यह दूरा पचाता। मम्मी मुसको सेब खिला रो। बरलन एपलन खुर फिला रो।</p> 
<p><b>बालक</b></p> <p>माँ में पढ़ने को जाऊँगा। छट्टी होने पर आऊँगा। सौत भोला को जाऊँगा। चोर चहादुर काहलाऊँगा।</p> 	

**HT15 : Hindi Teaching (Chart 15)**

### शेर और खरगोश

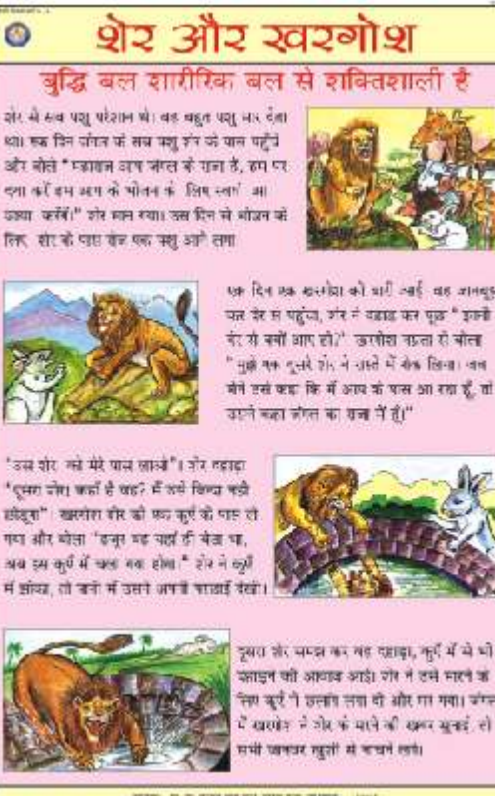
#### बुद्धि बल शारीरिक बल से शक्तिशाली है

शेर से सब पशु परेशम थे। वह बहुत पशु पर दंता था। एक दिन जंगल के सब पशु शेर के पास पहुँचे और बोले "प्राणन जय जयल के राज है, हम पर दया करे हम अंग के मोनन के लिए स्वर्ग आ उखा करे।" शेर मन गया। उस दिन से मोनन के लिए शेर के पास सब एक म्हु उगे तथा

एक दिन एक खरगोश को गरी-बई वह जानपुत्र पर देर से पहुँचा, शेर ने बड़ा कर पूछ "इसके रंग ये क्यों गाए हो?" खरगोश कलता रो बोले "मुझे एक दुःखे शेर ने उन्से में केक खिला। जब बने एवं कद कि मैं आप के पास आ रहा हूँ, तो उन्से कहा जंगल का राज मैं हूँ।"

"उस शेर से मेरे पास जानने"। शेर दहाड़ा "दुसा जेहा कहीं है यह?" शेर के लिए कदरे छोड़ना" खरगोश शेर को कद कुर के पास रो गया और बोला "इन्ना यह प्यारे ही सेब था, अब इस कुर में यह एक रोसा" शेर ने कुर में जाय, तो जने में उन्से जयने चहाई देवे।

दुखत शेर पपत्र कर वह पहाड़ा, कुर में वे को जाइने को आवाज अडे। शेर ने एने मलने के लिए कुर में उन्हावे लता रो और गा गया। जंगल में खरगोश ने शेर के पाले की खबर सुनई, तो सभी खरगोश मुठ्ठी से कचने लगे।



**HT12 : Hindi Teaching (Chart 12)**

### स्वच्छता

प्यारे बच्चों स्वच्छ रहो।  
जान से मन से स्वच्छ रहो।  
जय में ऊँचा नाम करो।  
स्वच्छता का पाठ पढ़ो।

सूखोपन से पहले उठो।  
जाने जाल से स्वच्छ करो।  
औरों भी नित स्वच्छ करो।  
माखुने को नहीं बहाओ।

दाँत साफ, नाखून साफ।  
कपड़े साफ, बरला साफ।  
शिक्षा पाने का कमरा साफ।  
पर और आंगन देखे साफ।  
बन्दरी कहीं फैलाओ मत।  
स्वच्छता को भुलाओ मत।  
कचरा कुड़ेदान में डालो।  
अच्छी आदती को पुन पालो।  
जैसी आदत चुभ डालोगे।  
जैसे ही तुम बन जाओगे।

भारत-बन्दन।  
प्यार प्यार जय से न्याता।  
भारत देरा हमारा है।  
इसका समक दन्म विभाता।  
इसके बारा भी रहा सागर।  
संघा यजुना को धारावे।  
बल्लो लंहे भरी निरा बास।  
हम सबकी अँखों का जारा।  
भारत देरा हमारा है।  
हम कुन को जना भुमि या।  
सुलसी खुर हमी को जवावे।  
बुद्ध, महात्मा बांधी जैसे।  
पुन इसी के हैं काहलावे।  
धरती का सौभाग्य विभाता।  
भारत देरा हमारा है।

कौनक घने पर इत जने।  
जय सेब पर उखार में हम।  
जिब जेबन मुलत सब कने।  
हम देन दुखी मिलते मिलते।  
वे सेबक बन सागर हरे।  
जो हैं अलके फले फलके।  
उन्को तौर खुर नर जने।  
हम देन देन काहकड़ खुर।  
अन्धक से निरा जिन पु लो।  
जिब जय मन मारत का।  
पुन भवन रहे अधिपत हो।  
जोय हो गुड मलत आन।  
सुमि प्रेम सुखाक बरलने।  
जिन देन जने में जय जय।  
कोरन उनी पर हो जने।








**HT16 : Hindi Teaching (Chart 16)**

### भारत माता

भारत पू को करे वंदना, यही हमारी माता है।  
यही कर्म है, यही धर्म है, सबको भाव्य-विधाता है।  
तुच्छ स्वार्थ से ऊपर उठकर, नव-नव संकलन कार्य करे।  
मिल-जुल कर सब रहें प्रेम से, सब का ही उत्थान करे।  
जाति-पाति के बंधन तोड़े, वर्ग भेद को चूर करे।  
मिल-जुलकर सब बँटें खाएँ, मेरा-मेरा सब दूर करे।  
भारत माता सबको साँझी, सबको प्यार लुटती है।  
मेरा सब कुछ इसको अर्पण, सब कुछ इसकी धाती है।

देश मेरा है मेरा मन्दिर, एकता यहाँ लाएँ।  
अम से सींच इस माटी को, स्वर्न यहाँ हम लाएँ।  
फिर भरती सोना उगलेगी, यह देश सुखी हो जायेगा।  
नया संसार बनायेंगे, एकता समरता लाएँगे।  
देश मेरा है मेरा मन्दिर, एकता यहाँ लाएँगे।

**हमारा नारा**

राष्ट्र हित कार्य करना ही विरद्व की आराधना है।  
किसको नातु भुमि प्राणी से अधिक प्यारी नहीं वह नर नहीं पशु है।  
विभिन्न जातियाँ धर्म व सम्प्रदाय एक ही वृक्ष की शाखाएँ हैं।  
एक है अपनी जमी एक है अपना मन।  
सारी दुनिया एक है एक है अपना सतन।

भारत को मिटते मत स्वर्न है, भारत को कलचय में ही मेरा कल्याण है।  
है शोक यही अरमान यही, हम फूल कर दिखलाएँ।  
मरने वाली दुनियाँ में हम, अमरी में नाम लिखाएँ।  
जो लोग हार कर बैठे हैं, उम्मीद मारकर बैठे हैं।  
हम उनके बुझे दिमागों में, फिर से उत्साह जागाएँ।













SS01 : SANSKRIT SHIKSHAN (CHARTS 1)

वर्ण माला							
अ	आ	इ	ई	उ	ऊ	ऋ	ॠ
लृ	ए	ऐ	ओ	औ	अं	अः	
संज्ञ							
क	ख	ग	घ	ङ			
च	छ	ज	झ	ञ			
ट	ठ	ड	ढ	ण			
त	थ	द	ध	न			
प	फ	ब	भ	म			
य	र	ल	व				
श	ष	स	ह	क्ष	त्र	ज्ञ	

SS02 : SANSKRIT SHIKSHAN (CHARTS 2)

संख्या:		
	१	एकम्
	२	द्वे
	३	त्रीणि
	४	चत्वारि
	५	पञ्च
	६	षट्
	७	सप्त
	८	अष्ट
	९	नव
	१०	दश

दश, विंशतिः, त्रिंशत्, चत्वारिंशत्, पञ्चाशत्, षष्टिः, सप्ततिः, अशीतिः, नवतिः, शतम्, सहरत्रम्

SS03 : SANSKRIT SHIKSHAN (CHARTS 3)

प्रथमः पुरुषः		
पुल्लिङ्ग तथा स्त्रीलिङ्ग एकवचन, द्विवचन और बहुवचन		
	सः धावति। बालः धावति।	तौ धावतः। बालौ धावतः।
	ते धावन्ति। बालाः धावन्ति।	सा लिखति। लता लिखति।
	ते लिखतः। लता रमा च लिखतः।	ताः लिखन्ति।

SS04 : SANSKRIT SHIKSHAN (CHARTS 4)

मध्यमः पुरुषः	
पुल्लिङ्गम् एवं स्त्रीलिङ्गम् (एकवचनम्, द्विवचनम् और बहुवचनम्)	
	त्वं किं क्रीडसि? त्वं बालकः। त्वं श्वेशः। त्वं कन्दुकं क्रीडसि।
	युवा किं क्रीडथः? युवा फुटबालं क्रीडथः।
	युव्यं किं क्रीडथः? युव्यं रावा क्रीडथ एव, न पठथ।
	स्वं किं खावसि? स्वं प्रातःप्रातः खावसि वा?
	युवां किं खावथः? युवां रावा खावथः, युवां भोजनं न पचथः।
	युव्यं प्रातःकाले प्रातःप्रातः खावथ।

SS05 : SANSKRIT SHIKSHAN (CHARTS 5)

उत्तमः पुरुषः	
पुल्लिङ्ग तथा स्त्रीलिङ्ग एकवचन, द्विवचन और बहुवचन	
	वृष्टं (पश्य)
	अहम् पश्यामि।
	गम् (गच्छ)
	आवाम् पश्यावः।
	पा (पिब)
	वयम् पश्यामः।
	स्था (तिष्ठ)
	१ अहम् पत्रम् पठामि। अहम् लेखम् लिखामि।
	२ आवाम् शालाम् गच्छावः। आवाम् गणेशम् नमावः।
	३ वयम् दुग्धम् पिबामः। वयम् देशम् रक्षामः।

SS06 : SANSKRIT SHIKSHAN (CHARTS 6)

कारक	
क्रियायाः जनकत्वं कारकत्वम्। क्रिया के जनक को कारक कहते हैं।	
कर्ता कारक (प्रथमा विभक्ति)	
	अश्वः चरति।
	प्रभा पचति।
	दीपः प्रज्वलति।

SS07 : SANSKRIT SHIKSHAN (CHARTS 7)

कर्म-कारकम् (द्वितीया विभक्तिः)	
कर्तुः क्रियायाः आप्तुमिच्छतम् कारकं कर्मसंज्ञं स्यात्। कर्ता अपनी क्रिया द्वारा जिसे विशेष रूप से प्राप्त करना चाहता है, उसे 'कर्म' कहते हैं।	
	बटका जलं पिबति। →
	← छात्राः गुरुं नमन्ति।
	रमा मोवकं खावति। →
करण-कारकम् (तृतीया विभक्तिः)	
साधकत्वं करणम्। क्रिया की सिद्धि में जो सबसे अधिक सहायक हो, उसे 'कारक' कहते हैं।	
	← रमेशः कलमेन लिखति।
	पुत्रेण सह आगतः पिता। →
	← रामः प्रादेन खञ्जः।

SS08 : SANSKRIT SHIKSHAN (CHARTS 8)

सम्प्रदान कारक (चतुर्थी विभक्ति)	
कर्मणा यमभिप्रेति स सम्प्रदानम्। दान आदि के योग में चतुर्थी विभक्ति का प्रयोग होता है।	
	गृहिणी भिक्षुकाय भिक्षां यच्छति।
	रामाय तस्मै नमः।
	राजा याचकेभ्यः फलं यच्छति।
अपादान कारक (पंचमी विभक्ति)	
ध्रुवमपाये अपादानम्। अलग होने में या डर के योग में पंचमी विभक्ति का प्रयोग होता है।	
	वृक्षात् पत्राणि पतन्ति।
	हिमालयात् गंगा प्रभवति।
	वीरः रणात् पलायते।

SS09 : SANSKRIT SHIKSHAN (CHARTS 9)

**सम्बन्ध कारक (षष्ठी विभक्ति)**

सम्बन्धे षष्ठी।  
संबंध दर्शाने के लिए षष्ठी का प्रयोग होता है।

सूर्यस्य आतपः प्रसरति।  
इदम् गोपालस्य पुस्तकं अस्ति।  
छात्राणाम् समूहः गच्छति।

**अधिकरण कारक (सप्तमी विभक्ति)**

आधारे अधिकरणम्।  
आधार या स्थान के योग में सप्तमी का प्रयोग होता है।

सिंहः वने वसति।  
ऋषयः आश्रमेषु वसन्ति।  
भारतवर्षस्य समीपे लंका अस्ति।

SS13 : SANSKRIT SHIKSHAN (CHARTS 13)

**युष्मद् अस्मद् सर्वनाम**

उभय लिंग  
युष्मद् और अस्मद् शब्दों का रूप तीनों लिंगों में समान होता है।

प्रथमा  
त्वम् किं पठसि? अहम् पुस्तकं पठामि।  
युवाम् किं पठथः? आवाम् पुस्तकं पठावः।  
यूयम् किं पठथ? वयम् पुस्तकं पठामः।

द्वितीया  
स त्वाम् अपि हसति, माम् न हसति।  
रमेशः युवाम् पश्यति, आवाम् अपि पश्यति।  
विमा युष्मान् पश्यति, अस्मान् न पश्यति।

एतत्, किम्, यत्, तत्, युष्मद् और अस्मद् शब्दों की सभी विभक्तियों के रूप याद कीजिए और इन्हें अपने वाक्यों में प्रयुक्त कीजिए।

SS10 : SANSKRIT SHIKSHAN (CHARTS 10)

**सम्बोधन**  
अकारान्त पुल्लिङ्ग, अकारान्त स्त्रीलिङ्ग

हे विजय! किम् त्वम् नित्यं क्रीडसि?  
हे लते! किम् त्वम् नित्यं खादसि?  
हे पुत्र! किमर्थं त्वं अद्य पाठशालां न गच्छसि?

१ हे रमेश! त्वम् कुत्र गच्छसि?  
२ भो सुरेश! कतिवादन - समयो जातः?  
३ हे सरले! त्वं कदा अहमदावाद नगरं गमिष्यसि?  
४ भो दिनेश! किं त्वं मया सह आगमिष्यसि?  
५ भो राकेश! कुशलोऽस्ति भवान्?  
६ भो अध्यापकाः! अध्यापनात् माऽप्रमदितव्यम्।

SS14 : SANSKRIT SHIKSHAN (CHARTS 14)

**आज्ञार्थ लोट्**

रोशनः पुस्तकं पठतु।  
बालो ओदनं खादताम्।  
छात्राः छात्रावासेषु एव वसन्तु।  
त्वं प्रतिदिनं शिवं भज।

युवाम् प्रातः सायं स्मरतम्।  
यूयम् सदा सत्यं वदत।  
किम् अहम् वनं गच्छामि?  
किम् आवाम् दुग्धं पिबाव?  
किम् वयम् लिखाम?

SS11 : SANSKRIT SHIKSHAN (CHARTS 11)

**सर्वनाम शब्द**

एतत् और किम् पुल्लिङ्ग प्रथमा  
एषः कः धावति?  
एतौ कौ धावतः?  
एते के छात्राः धावन्ति?

स्त्रीलिङ्ग प्रथमा  
एषा का क्रीडति?  
एते के क्रीडतः?  
ताः काः क्रीडन्ति?

नपुंसकलिङ्ग प्रथमा  
एतत् किम् अस्ति? एतत् फलम् अस्ति।  
एते के स्तः? एते फले स्तः।  
एतानि कानि सन्ति?  
एतानि फलाणि सन्ति।

SS15 : SANSKRIT SHIKSHAN (CHARTS 15)

**संख्यावाची शब्द प्रयोग**

१ ईश्वरः एकः अस्ति।  
२ द्वौ कर्णौ भवतः।  
३ त्रयः लोकाः सन्ति।  
४ चत्वारः वेदाः सन्ति।  
५ हस्ते पञ्च अंगुलयः भवन्ति।  
६ भारतवर्षे षट् ऋतवः भवन्ति।  
७ सप्ताहे सप्त दिवसाः भवन्ति।  
८ चत्वारि चत्वारि च अष्ट भवन्ति।  
९ ग्रहाः नव भवन्ति।  
१० दिशः दश भवन्ति।

SS12 : SANSKRIT SHIKSHAN (CHARTS 12)

यत् और तत् सर्वनाम पुल्लिङ्ग प्रथमा, द्वितीया  
यः अत्र पठति सः राकेशः अस्ति।  
यो अत्र पठतः तौ बालकौ स्तः।  
ये अधुना पठन्ति ते परीक्षार्थिनः सन्ति।

यम् त्वम् नमसि तम् अहम् नमामि।  
यो त्वम् पश्यसि तौ अहम् पश्यामि।  
यान् त्वम् वदसि तान् आवाम् वदावः।

स्त्रीलिङ्ग प्रथमा, द्वितीया  
या प्रातः लिखति सा सायं न लिखति।  
ये सायम् लिखतः ते प्रातः न लिखतः।  
याः अत्र लिखन्ति ताः तत्र न लिखन्ति।

याम् सीता पश्यति, ताम् उर्मिला न पश्यति।  
ये त्वम् नमसि ते राधा न नमति।  
याः रामः वदति ताः श्यामः न वदति।

नपुंसकलिङ्ग प्रथमा, द्वितीया  
यत् फलम् अहम् खादामि तत् पववम् न अस्ति।  
ये फले करण्डके स्तः ते मम न स्तः।  
यानि फलानि तत्र सन्ति तानि बालकाः सन्ति।

यत् फलम् त्वम् खादसि तत् अहम् अपि खादामि।  
ये फले मोहनः खादति ते प्रभा न खादति।  
यानि फलानि रामः नयति तानि त्वम् न पश्यसि।

SS16 : SANSKRIT SHIKSHAN (CHARTS 16)

**शिक्षाप्रदाः श्लोकाः**

अष्टादशपुराणेषु व्यासस्य वचनमुच्यते।  
परोपकारः पुण्यस्य पापाय परपीडनम् ॥

विद्वेषेण धर्मं विद्या, व्यसनेन धर्मं मतिः।  
फलके धर्मं धर्मः, शीलं सर्वत्र वै धनम् ॥

यथा ह्येकेन चक्रेण न रथस्य गतिर्भवेत्।  
एवं पुरुषकारेण किना देवं न सिद्ध्यति ॥

धौंश्च श्रुतेषु न कुण्डलेन, धानेन चाणिः न तु कर्हकपीनः।  
विभाति कल्पः कल्पवृक्षात्कम्, परोपकारेण न चन्दनम् ॥

उद्यमः साहसं वैर्यं बुद्धिः शक्तिः पराक्रमः।  
षडैते वाचं वर्तन्ते तत्र देवः सहायकः ॥

एक एव सुहृद् धर्मो निम्बनेऽप्यनुयाति चः।  
शरीरेण सर्वं नश्यं सर्वमन्यन् गच्छति ॥

त्यज दुर्वनमर्षं भज सधुसमागमम्।  
कुरु पुण्यमहोरात्रं स्मर नाम इरेः सदा ॥

आत्मस्य हि मनुष्याणां शरीरस्यो महारिपुः।  
नास्त्पुण्यमस्यो बन्धुः कुन्वायं नावशेदति ॥

सुखार्थिनः कृते विद्या कृते विद्यार्थिनः सुखम्।  
सुखार्थी वा स्वजेद् विद्या विद्यार्थी वा स्वजेद् सुखम् ॥

यं माता-पितरौ क्लेशं सहेते सम्भवे पुण्यम्।  
न तस्य विधुक्तिः शक्या कर्तुं वर्षशतैरपि ॥

पिता चच्छति पुत्राय चात्मे विद्याधनं महत्।  
पिताऽप्य किं तपस्तेषु इत्युक्तिस्तत्कृतज्ञता ॥

अज्ञान-निमित्तमस्य ज्ञानाज्जन-शलाकया।  
चक्षुःकर्मोत्थितं येन तस्मै श्री गुरवे नमः ॥

CD01 : Your Duties During War

### YOUR DUTIES — DURING WAR युद्ध काल में आप के कर्तव्य

<b>GIVE FULL SUPPORT &amp; RESPECT TO THE SERVICEMEN</b> सैनिकों को सम्पूर्ण सहायता और सम्मान प्रदान करें।	<b>RAIDED WASTE</b> सैनिकों को कचरे से साफ रखें।	<b>SHARE YOUR NECESSITIES WITH YOUR COMRADES</b> अपने आवश्यकताओं को अपने साथियों के साथ बाँटें।
<b>STOP AT THE FIRST SIGNAL</b> सैनिकों के पहिले से रुक जायें।	<b>HEALTHY PRESENCE FROM HELLS AND FACTORIES</b> सैनिकों को हेल्लों और कारखानों से दूर रहना चाहिए।	<b>PUT YOUR WEAPONS AND VEHICLES AT DISPOSE</b> अपने हथियारों और वाहनों को सही तरीके से छोड़ दें।
<b>RESERVE INTERNAL ACTIVITY</b> अपनी आंतरिक गतिविधियाँ बचावें।	<b>DO NOT GO IN FOR BIG PARTIES</b> बड़े पार्टियों में न जाएँ।	<b>UNDER COVERT AND TRAINING</b> अपनी गतिविधियाँ गुप्त और प्रशिक्षण के तहत करें।
<b>AVOID STRAINS AND HAZARDS</b> सैनिकों को तनाव और खतरों से बचें।	<b>CONTRIBUTE LIBERALLY TO THE DEFENSE FUNDS</b> सैनिकों को अपने धन से बचाव को सहायता दें।	<b>JOIN THE MISSING CLASSES</b> अपनी गतिविधियाँ खोने से बचें।
<b>BREATH IN THROUGH NOSE</b> सैनिकों को साँस लेना सीखें।	<b>AVOID IN SMALL SPACES</b> सैनिकों को छोटे-छोटे स्थानों में न जाएँ।	<b>KEEP A SHARP EYE ON ENEMY AGENTS</b> अपनी आँखों से दुश्मन के एजेंटों पर नज़र रखें।
<b>KEEP THE WEAPONS MOVING</b> सैनिकों को अपने हथियारों को चलाना सीखें।	<b>CHANGE BLOOD FOR THE WEARER</b> सैनिकों को अपने कपड़ों को बदलें।	<b>DISPOSE OF SARGASS</b> अपनी गतिविधियाँ सही तरीके से करें।
<b>BUY AS LITTLE SUGGESTS AS POSSIBLE</b> सैनिकों को जितना कम खरीदें उतना खरीदें।	<b>STRICTLY OBEY ALL RULES AND REGULATIONS</b> सैनिकों को सभी नियमों और विनियमों का पालन करें।	<b>HELP THE FAMILIES OF THE MISSING</b> अपनी गतिविधियाँ खोने से बचें।
<b>KEEP FEED &amp; RELAYING</b> सैनिकों को खाने और रिले करने से बचें।	<b>JOIN H.O.C. AND REPORT ON ALL SURE</b> सैनिकों को H.O.C. के साथ मिलें और सभी सुनिश्चित करें।	<b>BE PROUD OF YOUR TALENTS</b> अपनी गतिविधियाँ खोने से बचें।
<b>DO NOT HEARD</b> सैनिकों को न सुनने से बचें।	<b>JOIN THE ARMED FORCES</b> सैनिकों को सशस्त्र बलों में शामिल हों।	

CD02 : Air Raid Precautions Before the Raid

### Air Raid Precautions Before the Raid हवाई हमले से बचाव हमले से पहले

Before an air raid, it is essential to take precautions. This includes checking for gas leaks, fire hazards, and ensuring that all exits are clear. It is also important to have a plan in place for evacuation and to practice it regularly.

Check for gas leaks in your home or office. Turn off the gas supply if you detect any leaks. Do not use matches or lighters until you are sure there is no gas.

Check for fire hazards in your home or office. Make sure that all electrical wiring is in good condition and that there are no flammable materials near heat sources.

Check that all exits are clear and that you know the route to the nearest exit. Practice evacuation drills regularly.

Practice evacuation drills regularly. This will help you to know what to do in an emergency and to evacuate quickly and safely.

CD03 : Air Raid Precautions During the Raid

### AIR RAID PRECAUTIONS DURING THE RAID हवाई हमले से बचाव हमले के दौरान

During an air raid, it is essential to take cover. This includes going to a trench, bunker, or other protected area. It is also important to stay low to the ground and to avoid standing in open areas.

Go to a trench, bunker, or other protected area. Stay low to the ground and avoid standing in open areas.

Stay low to the ground and avoid standing in open areas. Do not use matches or lighters until you are sure there is no gas.

Do not use matches or lighters until you are sure there is no gas. If you must use them, do so quickly and carefully.

If you must use matches or lighters, do so quickly and carefully. Do not use them if you are in a trench or other protected area.

CD04 : Black Out Instructions

### BLACK OUT INSTRUCTIONS रोशनी गुल के निर्देश

During a black out, it is essential to cover all windows and light sources. This includes using black paper or other materials to cover windows and to turn off all lights.

Cover all windows with black paper or other materials. Turn off all lights and avoid using matches or lighters.

Turn off all lights and avoid using matches or lighters. Do not use matches or lighters until you are sure there is no gas.

Do not use matches or lighters until you are sure there is no gas. If you must use them, do so quickly and carefully.

If you must use matches or lighters, do so quickly and carefully. Do not use them if you are in a trench or other protected area.

CD05 : Life Saving First Aid Instructions

### Life Saving First Aid Instructions जीवन बचाने के प्राथमिक उपचार

GENERAL INSTRUCTIONS: **कामान निर्देश**

1. Check for consciousness and breathing. If the victim is unconscious and not breathing, start artificial respiration.

2. If the victim is bleeding, apply direct pressure to the wound. If the bleeding is severe, use a tourniquet.

3. If the victim has a fracture, immobilize the limb. Do not move the victim unless it is absolutely necessary.

4. If the victim has a burn, cool the burn with water. Do not use ointments or lotions.

5. If the victim has a head injury, do not move the victim. Call for medical help.

6. If the victim has a snake bite, immobilize the limb and call for medical help.

7. If the victim has a heart attack, call for medical help and start CPR.

8. If the victim has a stroke, call for medical help and do not move the victim.

9. If the victim has a seizure, do not restrain the victim. Call for medical help.

10. If the victim has a fainting spell, lay the victim down and raise their feet.

CD06 : Rescue Work After the Raid

### RESCUE WORK चायलों की निकासी

After an air raid, it is essential to perform rescue work. This includes checking for survivors, providing first aid, and clearing debris.

Check for survivors in the rubble. Provide first aid to any injured survivors.

Clear debris from the rubble. Do not use matches or lighters until you are sure there is no gas.

Do not use matches or lighters until you are sure there is no gas. If you must use them, do so quickly and carefully.

If you must use matches or lighters, do so quickly and carefully. Do not use them if you are in a trench or other protected area.

CD07 : Fire Fighting

### FIRE FIGHTING आग से सुरक्षा

During a fire, it is essential to use a fire extinguisher. This includes pulling the pin, aiming the nozzle at the base of the fire, and squeezing the handle.

Use a fire extinguisher to put out small fires. Pull the pin, aim the nozzle at the base of the fire, and squeeze the handle.

Do not use a fire extinguisher on large fires. Call for fire help.

Call for fire help if you cannot put out the fire. Do not use matches or lighters until you are sure there is no gas.

If you must use matches or lighters, do so quickly and carefully. Do not use them if you are in a trench or other protected area.

Laminated, Size 70 x 100 cm (Available in English and Hindi Combined)

Set of 7 charts CIVIL DEFENCE CHARTS



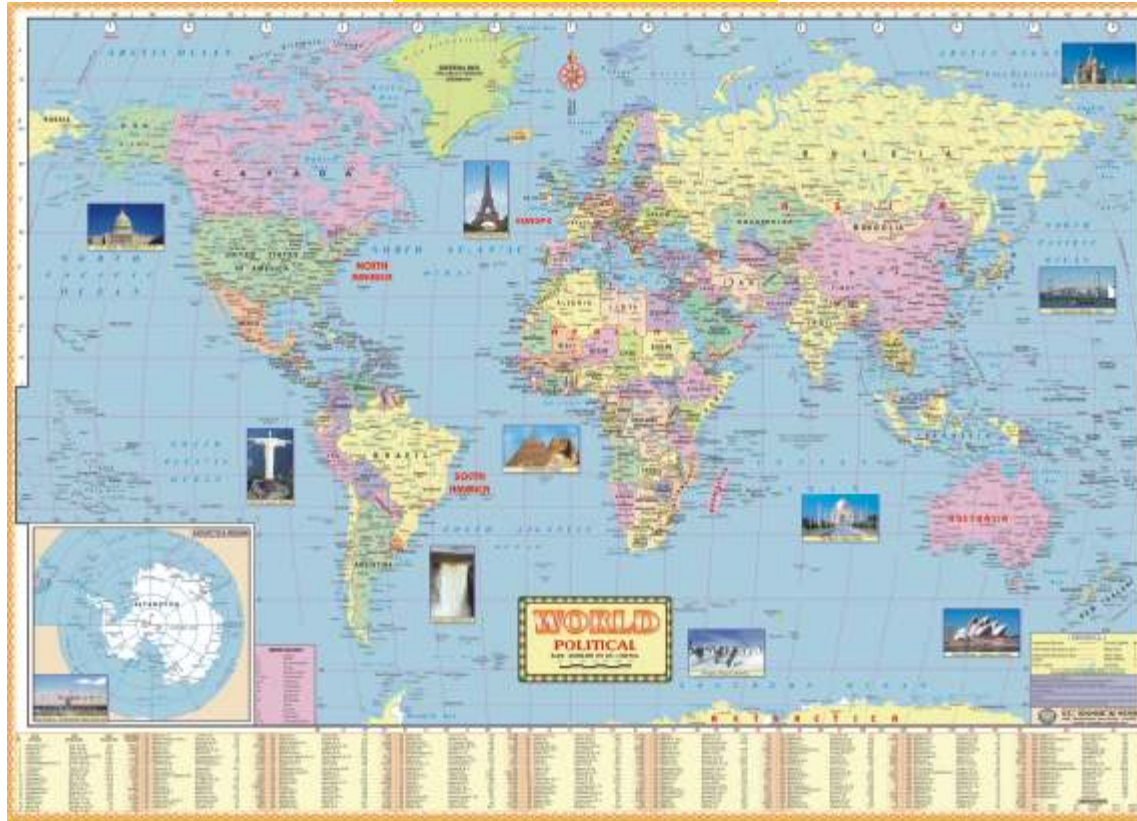




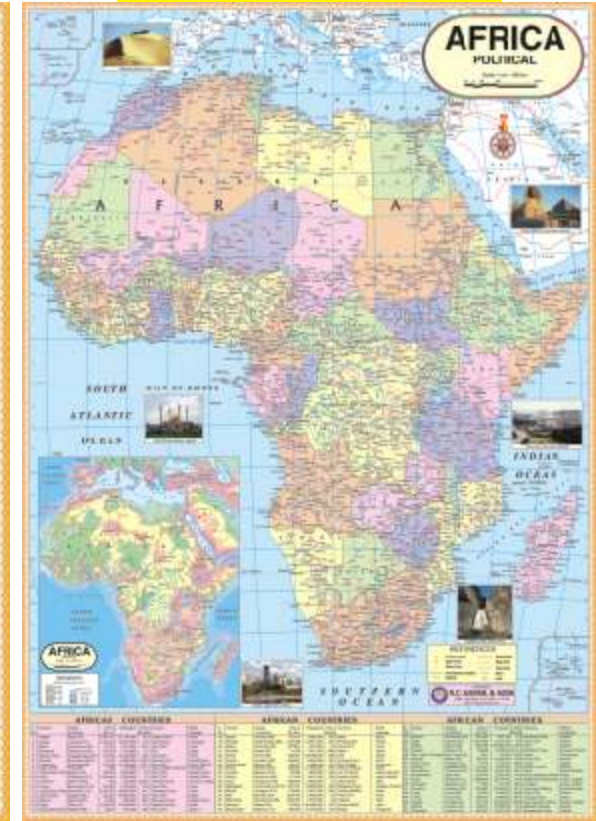
MWM01 : India Political



MWM02 : World Political



MWM04 : Africa Political



MWM03 : Asia Political



MWM05 : Australia Political



Laminated, Size 70 x100 cm (Available in English only and Hindi only)

# MAPS

MWM06 : Europe Political



MWM07 : North America Political



MWM08 : South America Political



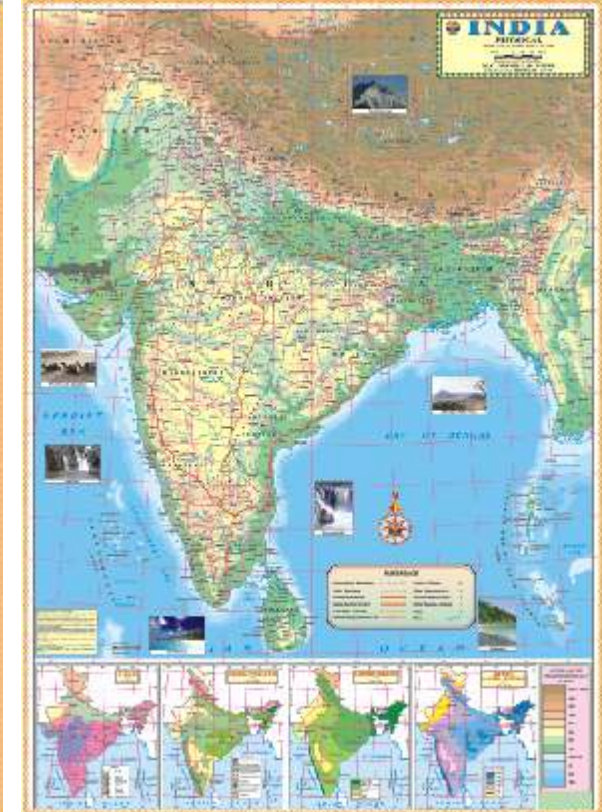
MWM26 : Sri Lanka Political



MWM27 : United States of America Political



MWM51 : India Physical





MWM52 : World Physical



MWM53 : Asia Physical



MWM54 : Africa Physical



MWM56 : Europe Physical



MWM58 : South America Physical



Laminated, Size 70 x100 cm (Available in English only and Hindi only)

# MAPS

# MAPS OF INDIAN STATES

Laminated, Size 70 x100 cm (Available in English only and Regional language only)

SM01 : Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland & Tripura



SM02 : Andhra Pradesh Political



SM03 : Bihar Political



SM04 : Chhattisgarh Political



SM05 : Delhi Road Guide



SM06 : Haryana Political



SM07 : Himachal Pradesh Political



SM08 : Karnataka Political



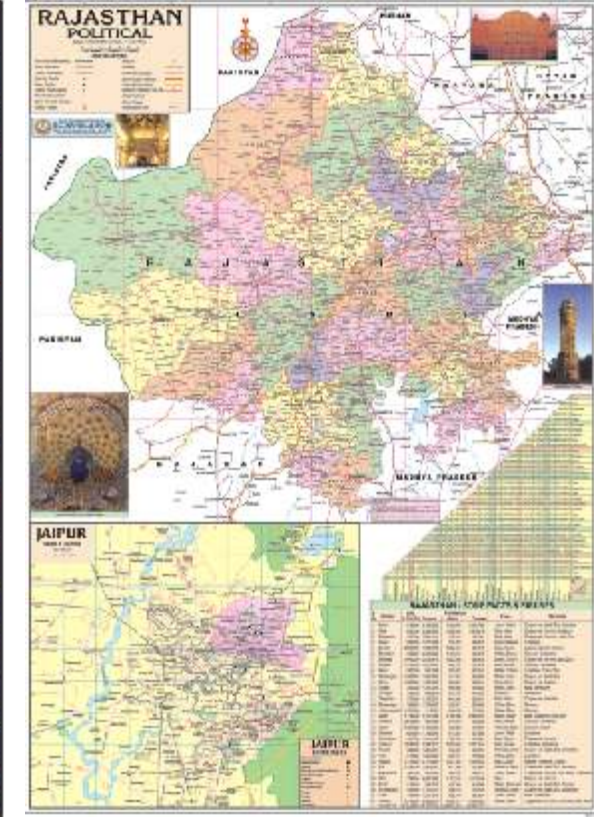
SM09 : Kerala Political



SM10 : Punjab Political



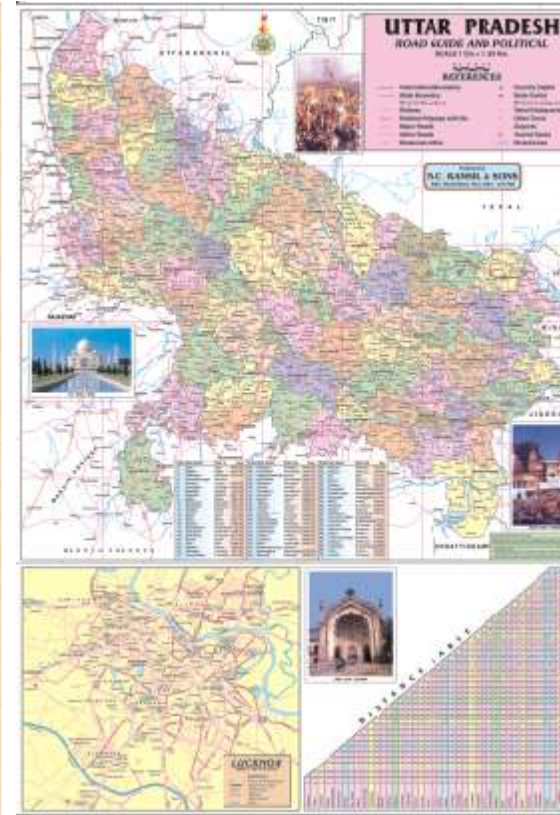
SM11 : Rajasthan Political



SM12 : Tamilnadu Political



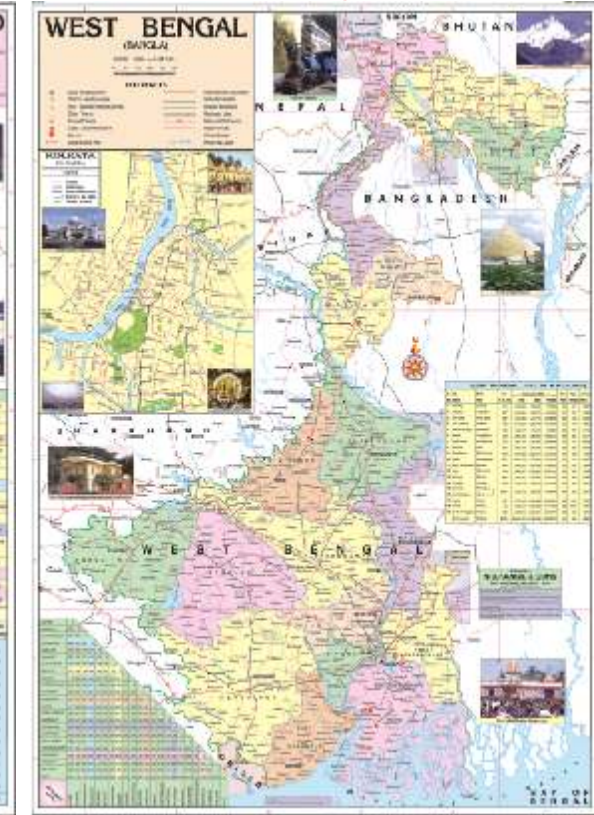
SM13 : Uttar Pradesh Political



SM14 : Uttarakhand Political



SM15 : West Bengal Political







# MAPS OF INDIAN STATES

Laminated, Size 70 x100 cm (Available in English only and Regional language only)

SM62 : Uttarakhand Physical



SM64 : Tamilnadu Physical



## NEW SCIENCE TEACHING KITS



TK4003  
Wake Me Robot



TK7094  
Vision



TK7086  
My Senses



TK7076  
Go Electronic



TK7074  
Go Weather



TK7072  
Go Circuit



TK8200  
Physics



TK8360  
Super Chem 150



TK8405  
Solar Power



TK8650  
Ecology



TK8740  
Hydrolab



TK8950  
Energy



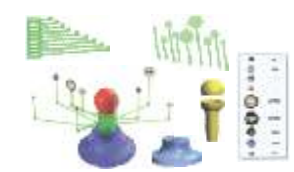
EL315  
6 in 1 Solar Kit



CS015  
STUDENT BALANCE KIT



CS020  
MINI SOLAR SYSTEM





South Africa



Eastern Cape



Gauteng



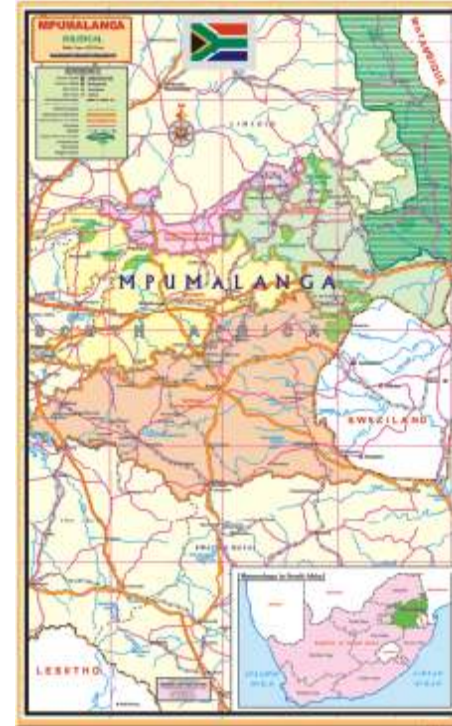
Kwazulu-natal



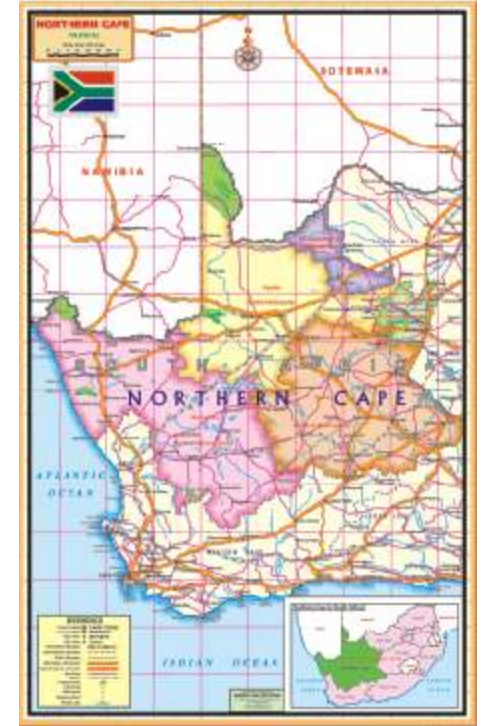
Free State



North West



Mpumalanga



North Cape



Limpopo



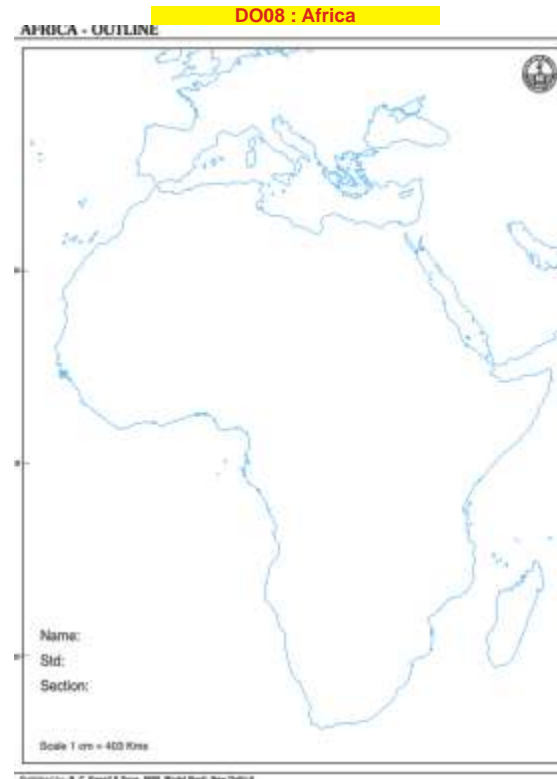
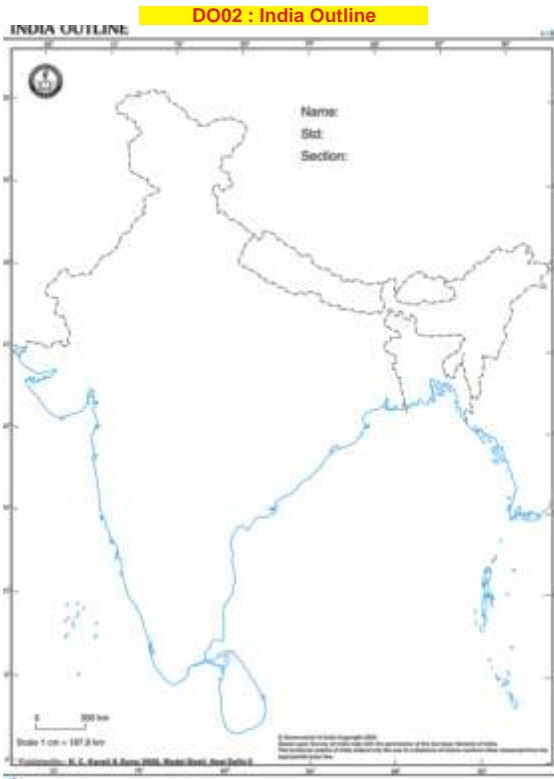
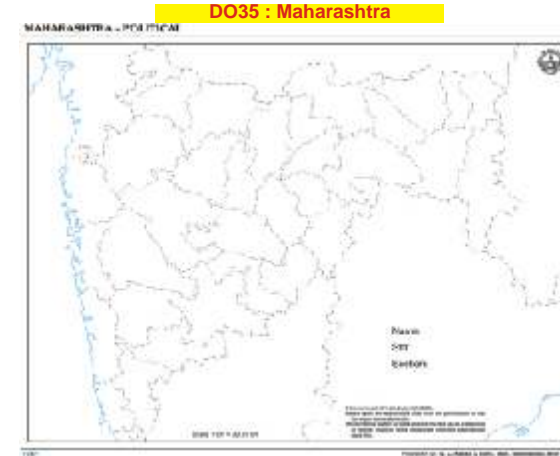
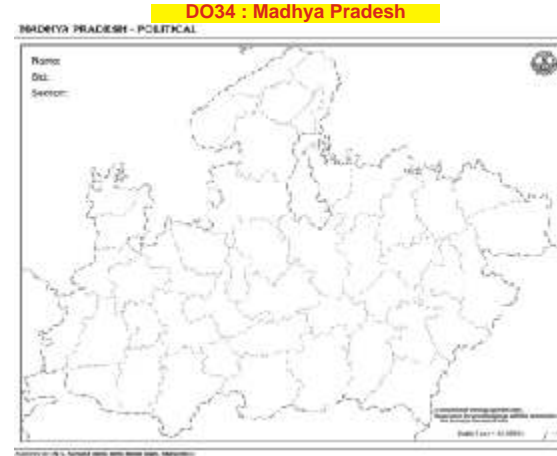
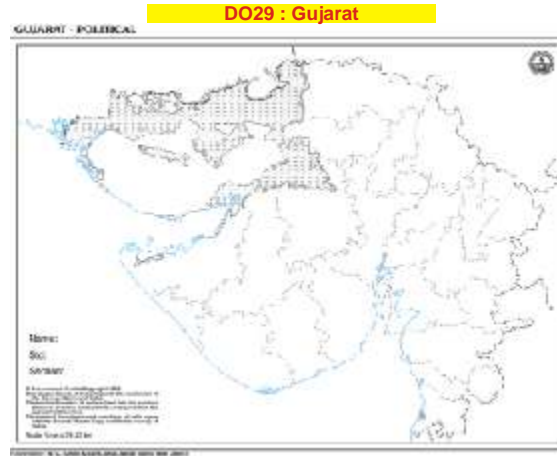
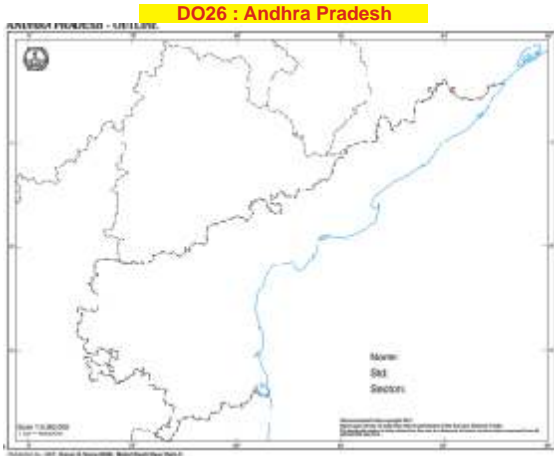
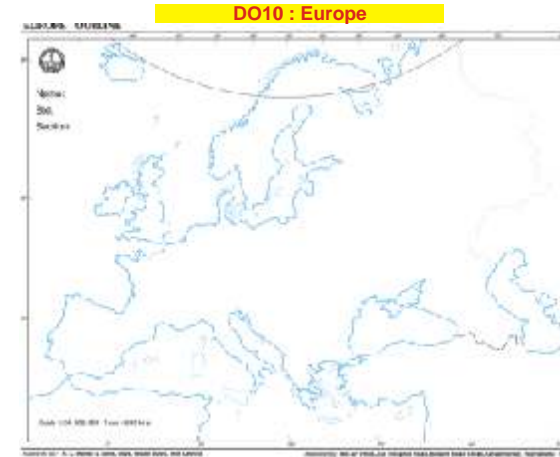
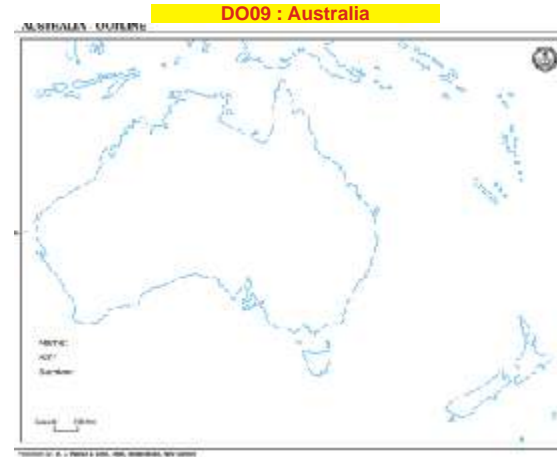
Western Cape

Laminated, Size 58 X90 cm (Available in English only)

# DESK OUTLINE MAPS

Pad of 100 sheets

Printed on superfine white paper, Size 27 x 22 cm (Available in English only)







**ZX-1202 Human Skull Model Dx.**



**ZX-1201 Human Fetal Skull**



**ZX-1603 Kidney Microstructure**



**ZX-1604 Skin Model**



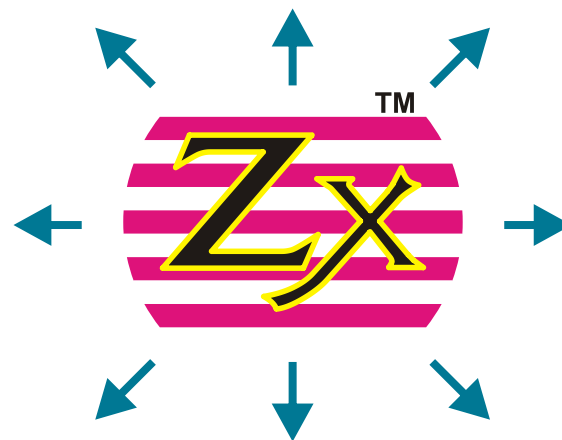
**ZX-GP6611 Cervical Lesion Model**



**ZX-1601 Bone Microstructure**



**ZX-NS 6503 Teeth Model in Oral Cavity**



**ZX-1401 Human Skin**



**ZX-1402 Human Stomach, Pancreas & Duodenum**



**ZX-1301A Human Digestive System**



**ZX-1307 Human Nervous System**



**ZX-1302 Human Circulatory System**



**ZX-1303 Human Excretory System**



**ZX-1304 Human Reproductive System Male**



**ZX-1305 Human Reproductive System Female**

**NEWLY INTRODUCED ZX SERIES MODELS ANATOMY MODELS**

**NEWLY INTRODUCED ZX SERIES MODELS  
MEDICAL MODELS**



**ZX-NS6002 Multifunctional Nursing Simulator (unisex) with Interchangeable Breast Cancer Plate**



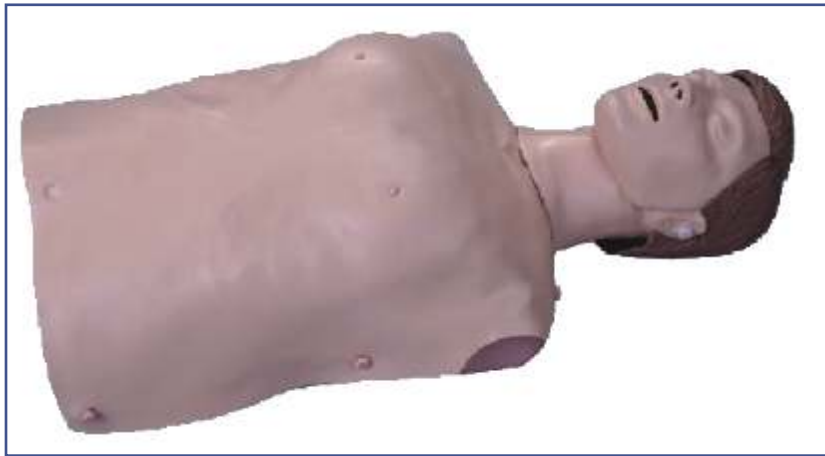
**ZX-NS6028 Buttock Inter Muscular Injection Training Model**



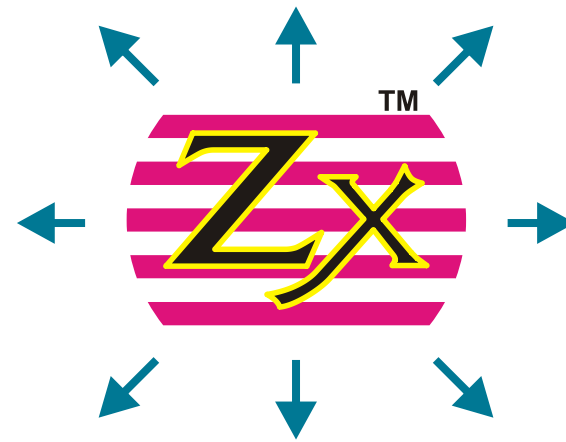
**ZX-GP6620 Breast Inspection Model**



**ZX-FA5050 Advanced Endotracheal Intubation Training Model**



**ZX-CPR1900 Half Body CPR Training Manikin without Light**



**ZX-GP6621 Breast Inspection & Diagnosis Training Model**



**ZX-NS6005 Multifunctional Intravenous Injection Arm Model**



**ZX-CPR1950 Advanced Half Body CPR Training Manikin with Light**



**ZX-CPR2300 Advanced CPR Training Manikin with Monitor**



**ZX-CPR1600 Advanced Infant CPR Training Manikin**

# About Us

N. C. Kansil & Sons was established in 1932 by Late Shri N.C. Kansil, an engineer by profession and an educationist at heart, at Lahore (Undivided India). The firm shifted to the present place of its registered office in 1947. Since then we have engaged ourselves in the field of Teaching Learning Materials like maps, charts, globes and models. As the next generations continued to join the family business, from a small publisher of educational maps and charts, it has now grown into a very big establishment as a highly effective distribution center for schools and medical institutions.

Our products have always helped parents and teachers to foster creativity, instill a learning attitude, a positive behaviour and a spirit of enthusiasm in our young generation. We constantly strive to improve our product range in all aspects i.e practically and at the performance level so that our learning aids benefit the child. We constantly innovate new ideas, product techniques in order to offer the best services to our customers in this highly competitive global market.

Our product range consists of Educational Maps of world, continents and countries, Globes, Charts for Students, Human Anatomy & Physiology, Geography, Environment, Science & Technology, Maths, Life Sciences, Languages, Health & Hygiene, Genetics, First Aid, Yogasan & Diseases and Food & Nutrition. Models on Geography, Human Anatomy, Medical, Nursing, Maths etc. Our products are used in Maths Lab, Social Studies Lab, Science Lab and Language Learning Lab in schools.

The rich experience of 84 years have enabled the company to scale ever new heights. We have developed into one of the foremost designers and producers of maps and charts for educational purposes. The products we supply are highly applauded not only in India but overseas also, in terms of their content, presentation, effectiveness and cost. We have performed excellently in the past and do not want to sit on our laurels. We wish to enhance our range of products and publications through application of new and genuine ideas.

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## MATHS



Abacus



Drawing Models



Palm Clock



Sextant Model



Bucket Balance



Jr. Pythagoras Theorem



Geometry Box



Potraits



Charts

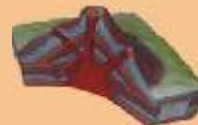
## SOCIAL STUDIES



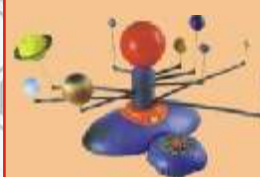
Globe



Delta Model



Volcano Model



Solar System



GPS



Dumpy Level



OHP

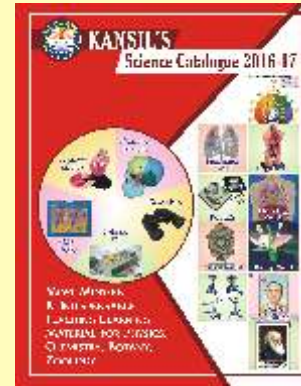


Maps



Charts

## SCIENCE



Human Torso



DNA Model



Anatomy Models



Skeleton Models



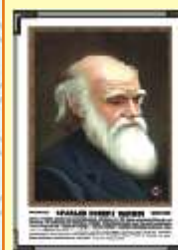
Botany Models



Chemistry Lab Kit



Zoology Models



Portraits



Dissection Kit



Charts

## MEDICAL



Skeleton model



Human Torso



Human Female Pelvis



Multi Functional Nursing Manikins



Brain Model



Eye Model



Charts



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