

# Exampundit's Science Guidebook for SSC CGL, CHSL & Railways Exams

## BIOLOGY

- ❑ Father of Biology : Aristotle.
- ❑ Biology is a natural science concerned with the study of life and living organisms, including their structure, function, growth, origin, evolution, distribution, and taxonomy.
- ❑ The term 'Biology' is coined by a French naturalist Jean Lamarck.
- ❑ Fundamental axioms of modern biology:
  1. Cells are the basic unit of life
  2. New species and inherited traits are the product of evolution
  3. Genes are the basic unit of heredity
  4. An organism will regulate its internal environment to maintain a stable and constant condition
  5. Living organisms consume and transform energy.

### The CELL

- ❑ Cell is the smallest and fundamental unit of life.
- ❑ The smallest cell size is of a bacteria.
- ❑ The largest cell is of an ostrich egg.
- ❑ The largest human cell is the **ovum**. (.2mm)
- ❑ *Nerve cell(neuron) is the longest cell.*

### Father of Important Branches

Aristotle .....	Father of Nature's History/ Father of Biology
Alexander Fleming .....	Father of Antibiotics
Carolus Linnaeus .....	Father of Taxonomy
Edward Jenner .....	Father of Immunology
Louis Pasteur .....	Father of Microbiology
Rudolph Virchow .....	Father of Pathology
Robert Hook .....	Father of Sightology
Robert Koch .....	Father of Bacteriology
William Harvey .....	Father of Blood Circulation
W.M.Stanley .....	Father of Virology
Ivan Pavlov .....	Father of Conditioned Reflex
Ernst Von Baer .....	Father of Modern Embryology

- ❑ Human cells have 23 pairs (46number) of chromosomes.
- ❑ The cell with longest life span in our body is Nerve Cells
- ❑ The average size of the cell is 3-30 microns (1 micron = 1/1000 mm).
- 1. **Cell wall** - found only in plant cells. It consists of non-living substances.  
eg: lignin, pectin, cellulose etc.
- 2. **Cell membranes (plasmalemma)**  
It is the outer membrane of the cytoplasm found both in animals and plants. It is made of protein.
- ❑ In prokaryotes, there is no definite membrane bound nucleus Eg : Bacteria, Blue - green algae. In eukaryotes, there is a nucleus with definite double membrane.
- ❑ Plasma membranes are composed of phospholipids and protein.
- ❑ **Cytosol** - it is the soluble material in embryonic cell in which various organelles are embedded.
- 3. **Endoplasmic Reticulum (ER)**  
A network of tubes or channels of membrane in the cytoplasm which helps in protein synthesis and conduction of materials.

## DNA & RNA

- ▶ DNA (Deoxyribonucleic Acid) and RNA (Ribonucleic Acid) are two different nucleic acids found in the cells of every living organism. Both have significant roles to play in cell biology.
- ▶ DNA is found mainly in the nucleus of the cell, while RNA is found mainly in the cytoplasm of the cell.
- ▶ DNA contains the genetic codes to make RNA and the RNA in turn then contains the codes for the primary sequence of amino acids to make proteins.
- ▶ Within the cell structure, DNA is organized into structures called chromosomes, which are duplicated during cell division. These chromosomes would then release the genetic codes that will be transcribed and carried by the RNA to the ribosome. The ribosome will then synthesize new proteins that will help the body grow.

4. **Ribosomes:** Externally small, dense, granular, spherical bodies found in free state in the cytoplasm, composed of RNA and proteins. They help in synthesis of proteins.
  - ❑ Rough endoplasmic reticulum is the normal 'ER' with ribosomes attached to it.
  - ❑ Nucleus contains nucleoli and nucleoli are the centres of the synthesis of ribosomal RNA.
5. **Golgi bodies:** Bag like structures formed of membranes. Their functions include secretion of various substances.
6. **Vacuole:** A fluid filled sac within a cell. The watery fluid enclosed in the vacuole is called 'Cell Sap'. It is slightly acidic or neutral. Osmoregulation is the main function
7. **Mitochondria:** Rod like or spherical, semi solid structures containing DNA. They synthesise A.T.P (Adenosine Tri phosphate)
  - ❑ Mitochondria is the power house of the cell. It is also a double- membrane bound organelle. The inner membrane is thrown into folds called cristae to increase the surface area.
8. **Peroxisomes and glyoxysomes** are known as microbodies. They are enzyme bags.
9. **Lysosomes** are known as "suicide bags", as they contain hydrolysing enzymes. Occasionally they digest the whole cell or part of it.
10. **Plastids:** Small bodies found in the cells of higher plants. They are of many types.
  - ❑ **Chloroplasts** : are the centres of photosynthetic activity. It is found only in photosynthetic plant cell. Chloroplast is a green plastid.
  - ❑ Chloroplasts have double membrane, lamellae or thylakoids which absorb solar energy and pigments like chlorophylls and carotenoids.
    - i) **Leucoplasts:** Colourless starch storing particles
    - ii) **Chromoplasts:** Are coloured particles which give colour to fruits and flowers.
11. **Nucleus:** The nucleus controls all cell activities and enclose the nucleoplasm. Nucleus is responsible for transfer of heredity characteristics.
12. **Centrosome:** A rather dense area of protoplasm, lies close to nucleus.
  - ❑ Plant cell is different from animal cell as it contains cell wall surrounding plasma membrane and chloroplasts and devoid of centrioles which is seen only in animal cells.
  - Adenosine Triphosphate (ATP) provides energy for all kinds of activities of a cell.
  - *ATP is called the 'universal biological energy currency'.*
  - ATP synthesis takes place in mitochondrion.
  - Energy is stored in the mitochondria as ATP molecules.
  - The physical basis of life is 'protoplasm'.
  - Chromosome is made up of DNA & Proteins.
  - Chromosomes, other than the sex chromosomes, are called autosomes.
  - The ribosomes are chiefly concerned with the synthesis of protein.

### Types of cells

- ❑ **Prokaryotes:** Prokaryotes lack a nucleus (though they do have circular DNA) and other membrane-bound organelles (though they do contain ribosomes). Bacteria and Archaea are two domains of prokaryotes.
- ❑ **Eukaryotes:** Eukaryotes, on the other hand, have distinct nuclei bound by a nuclear

membrane and membrane-bound organelles (mitochondria, chloroplasts, lysosomes, rough and smooth endoplasmic reticulum, vacuoles). In addition, they possess organized chromosomes which store genetic material.

### Cell Division

- ❑ Cell division is the process by which a parent cell divides into two or more daughter cells. Cell division is usually a small segment of a larger cell cycle.
- ❑ Cell cycle is composed of three phases- interphase, mitosis, cytokinesis.
- ❑ Mitosis means the division of nucleus and cytokinesis means the cytoplasmic division.
- ❑ Two kinds of Cell Division : Mitosis and Meiosis.
- ❑ **Mitosis** occur in body cells, results in formation of two daughter cells with equal number of chromosomes.
- ❑ **Meiosis** Occurs in reproductive cells. It causes a reduction in number of chromosomes in the cell.

### Micro Organisms

- ❑ The study of microorganisms is called microbiology.
- ❑ Anton van Leeuwenhoek's discovered microorganisms in 1675, using a microscope of his own design.
- ❑ Microorganisms are very diverse; they include bacteria, fungi, archaea, and protists; microscopic plants (green algae); and animals such as plankton and the planarian.

### Diseases caused by Bacteria

Leprosy, Tetanus, Whooping Cough, Typhoid Fever, Paratyphoid Fever, Cholera, Plague, Tuberculosis, Meningitis, Bacterial Pneumonia, Diarrhoea, Diphtheria, Bacterial dysentery, Anthrax, Syphilis and Gonorrhoea.

### Fungal Diseases in Human

Ringworm  
Tinea  
Athlete's foot  
Madura foot  
Dhobie itch

- ❑ Microorganisms live in all parts of the biosphere where there is liquid water, including soil, hot springs, on the ocean floor, high in the atmosphere and deep inside rocks within the Earth's crust.
- ❑ Bacteria were first observed by Antonie van Leeuwenhoek in 1676.
- ❑ The name bacterium was introduced much later, by Christian Gottfried Ehrenberg in 1838.
- ❑ **Bacteria** are microscopic unicellular prokaryotic organism and lack of membrane bound nucleus and organelles.
- ❑ Bacteria are eventually placed in a **Kingdom Monera**.
- ❑ Reproduction in bacteria is largely asexual by **binary fission**.
- ❑ Respiration of bacteria are aerobic and anaerobic.
- ❑ Bacteria display a wide diversity of shapes and sizes, called morphologies.
- ❑ Bacteriophages are viruses eating (destroying) bacteria and were invented by d'Herelle.
- ❑ **Bacteriology** is the study of bacteria.
- ❑ **'Virus'** the term is coined by M.W. Beijerinck, a Dutch microbiologist.
- ❑ A virus is a small infectious agent that can replicate only inside the living cells of organisms.
- ❑ All viruses are nucleoprotein particles and contain either DNA or RNA. The genetic material inside the viruses is protected by a protein coat called 'capsid'.
- ❑ Viruses lack the cellular organisation of the living organism, but make use of the cellular machinery of the host cell to multiply themselves.
- ❑ A complete viral particle capable of infection is called a 'virion'.
- ❑ 'Viroids' are newly found group of pathogenic agents, much smaller than the viruses.
- ❑ The study of viruses is known as virology, a sub-speciality of microbiology.
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- L.S.D. (Lysergic acid diethyl-)

lamide) is obtained from a fungi, called *Ergot*.

- Smallest Cell - Pleuro Pneumonia Like Organism (PPLO). It is a mycoplasma.
- HIV is an RNA virus.
- Smallest living thing - Virus

## Kingdom Classification

- Five kingdom classification was developed by R.H. Whittaker.
- The five kingdoms are Monera, Protista, Fungi, Plants and Animals.

### Kingdom Monera

- Monera includes prokaryotic cells. Eg : True bacteria, Fungus-like bacteria i.e. 'Autonomecetes', Blue-green algae (cyanobacteria).
- Antibiotic drugs like streptomycin, erythromycin etc. are obtained from actinomycetes in Kingdom Monera.

### Kingdom Protista

- They are unicellular or colonial eukaryotes. Reproduction is both sexual and asexual. Motility is by Flagella, have diverse nutritional habits. Eg : Euglena, Dinoflagellates, diatoms etc.

### Kingdom Fungi

- Multi nucleate, non-photosynthetic, non-motile organisms. Reproduction is by both asexual and sexual means.
- Two divisions - myxomycota

**Photosynthesis** is vital for all aerobic life on Earth. Photosynthesis is a process that converts carbon dioxide into organic compounds, especially sugars, using the energy from sunlight. Photosynthesis occurs in plants, algae, and many species of bacteria. Photosynthesis uses carbon dioxide and water, releasing oxygen as a waste product.

phyta (slime molds) and Eumycophyta (True fungi)

- The true fungi is characterised by a definite cellular body composed of filaments called mycelium. The individual mycelium filaments are called hyphae.
- Water moulds, bread moulds, club fungi are examples.
- Ascospores or basidiospores are the products of sexual reproduction in Fungi.

### The Plant Kingdom

- Plants are the primary producers in nature.
- Flora is the plants of a particular region and Fauna is the animals of a particular region. Flora and Fauna together constitute the plants and animals of a region.
- The part of the earth and its atmosphere that is capable of supporting living things is the biosphere.
- Biosphere is divided into Lithosphere, Hydrosphere, Atmosphere etc.

Smallest seeds **Orchid seeds**  
 Largest leaf **Victoria regia**  
 India's national flower **Lotus**  
 Largest flower **Rafflesia**  
 Smallest flower **Wolffia**  
 Oldest living plant of the world

### Pinus

Study of trees - **dendrology**  
 Largest trees in plant world - **Conifers**

- Nitrogen Fixation means conversion of atmospheric nitrogen into useful compounds like nitrates with the help of bacteria and fungi.
- The biological nitrogen fixation is done by nitrogen fixing bacteria such as Rhizobium Nostoc and Azetobactor.
- Plants absorb the element nitrogen in the form of nitrates.
- Cyanobacteria is a blue green algae.
- The profuse amount of pollen grains liberated by pine forests at the time of pollination during the months of March-April is referred to as 'Sulphur Showers.'
- Araucaria embricate, a gymnosperm plant is commonly known as 'Monkey's Puzzle'
- Litmus is obtained from a lichen.
- Lichen is an association of fungus and algae.
- Turmeric is obtained from the stem of plant.
- Cloves are dried flower buds of plant syzygium aromaticum.
- Potato is a tuber crop.
- The native place of potato is America

**King of fruits - Mango**  
**Poorman's orange - Tomato**  
**Poorman's wood - bamboo**

## Subdisciplines of botany

- Agronomy:** Application of plant science to crop production
- Bryology:** Mosses, liverworts, and hornworts
- Economic botany:** Study of plants of economic use or value
- Ethnobotany:** Relationship between humans and plants
- Forestry:** Forest management and related studies
- Horticulture:** Cultivated plants
- Lichenology:** The study of lichens
- Paleobotany:** Fossil plants
- Palynology:** Pollen and spores
- Phycology:** Algae
- Phytochemistry:** Plant secondary chemistry and chemical processes
- Phytopathology:** Plant diseases
- Plant anatomy:** Cell and tissue structure
- Plant ecology:** Role of plants in the environment
- Plant genetics:** Genetic inheritance in plants
- Plant morphology:** Structure and life cycles
- Plant physiology:** Life functions of plants
- Plant systematics:** Classification and naming of plants

- ❑ Vanilla, a flavouring material, is extracted from the fruit of an orchid 'Vanilla Planifolia.'
- ❑ Rubber is obtained from the latex of *Hevea brasiliensis*.
- ❑ The milky juice that oozes from some trees like rubber is known as latex.
- ❑ Cotton, jute, silk, wool, etc are natural fibres and nylon is artificial fibre.
- ❑ Sugarcane is a type of grass.
- ❑ The fruit sugar is fructose.
- ❑ Tissue culture is the method of producing plants from minute plant fragments.
- ❑ The wall of the plant cell is made of cellulose. The cellulose cannot be digested by human alimentary canal.
- ❑ The largest flower in the world is *Rafflesia* and the smallest one is *Wolffia* (duck weed).
- ❑ The largest sperms among plants are found in gymnosperms.
- ❑ In plants gaseous exchange occur through stomata.
- ❑ The roots which do not grow from a main root (radicle) but directly from the stem are called adventitious roots.
- ❑ DNA (Deoxyribo Nucleic Acid) and RNA (Ribo Nucleic Acid) are the two kinds of nucleic acids.
- ❑ In a plant cell, DNA is found in chloroplast, mitochondria and nucleus.
- ❑ *Nepenthes*, sundew, *drosera*, etc. are some of the insectivorous plants.
- ❑ Insectivorous plants obtain nitrogen from animal bodies.
- ❑ Organisms which obtain their food from non living material

in their environment are called saprophytes

## Classification of Plant Kingdom

1. ***Rhodophyta*** (Red algae): Are mostly multicellular marine plants. Their reddish colour is due to a pigment, phycoerythrin.
2. ***Phaeophyta*** (Brown Algae): Are multicellular marine plants growing on rocks or attached to sea shores. Their brownish colour is due to xanthophyll pigment called fucoxanthin.
3. ***Chlorophyta*** (Green Algae): Are a group of bright green aquatic, unicellular plants.
4. ***Bryophyta***: Simple, non vascular small plants grow in moist places. Thallus like plant body is attached to the soil by rhizoids.  
eg: Liver worts, horn worts, mosses, etc.
5. ***Lycopodophyta*** (club mosses): Multicellular terrestrial plants with vascular tissues.
6. ***Arthropophyta*** (Horsetails): Are multicellular plants with vascular tissues. *Arthropophyta* are largely an extinct group represented by a single living genus, the *Equisetum*.
7. ***Pterophyta*** (Ferns): Are multicellular plants with vascular tissues; Here seeds are not produced.

## Gymnosperm

8. ***Cycadophyta***: Are multicellular terrestrial plants with vascular tissues. The stem is large and woody, leaves are large and fern like.  
eg: cycas, zamia (sago tree), etc.



9. **Conifers:** Are multicellular plants with well developed tissues. Leaves are simple, smaller and needle like.  
eg: Cedrus (deodar), Taxus (Yew), Pine
  10. **Angiosperms:** More advanced flowering plants with well developed vascular tissues. They make up more than half of all known species of plants.
- Flowering plants are divided into two classes – Dicotyledons (Dicots), Monocotyledons (monocots).

### Other Classifications

- ▶ **Terrestrial:** Plants which grow in soil.
- ▶ **Hydrophytes:** grow in water.
- ▶ **Epiphytes:** which perch on other plants but do not take nourishment from them.
- ▶ **Xerophytes:** Are adapted to grow in a dry habitat like deserts and can survive without moisture.  
eg: cacti
- ▶ **Mesophytes:** thrive under condition intermediate between very wet and very dry. The great variety of crops such as beans, tomatoes, pear, etc. belong to this category.
- ▶ **Parasitic:** which depend on other plants for their nourishment. They lack chlorophyll and thus cannot make their own food.  
eg: bacteria, fungi.
- ▶ **Carnivorous plants:** plants which trap insects and other small creatures on their sticky leaves.

### Plant Nutrition

- Plant nutrition is the study of the chemical elements that are

## Cultivations

**Sericulture** is rearing of silk worms.

**Horticulture** is the cultivation of flowers, fruits and ornamental plants.

**Pisciculture** is the art of rearing fishes.

**Silviculture** is forest planting.

**Apiculture** means honey making.

**Viticulture** is grape cultivation.

**Vermiculture** is breeding of worms useful to farmers.

**Floriculture** is cultivation of flowering plants.

**Arboriculture** means cultivation of tree and vegetables.

necessary for growth.

- There are 17 essential plant nutrients. Carbon and oxygen are absorbed from the air, while other nutrients including water are obtained from the soil.

### Macro Nutrients

- **Carbon:** Carbon forms the backbone of many plants biomolecules, including starches and cellulose. Carbon is fixed through photosynthesis from the carbon dioxide in the air and is a part of the carbohydrates that store energy in the plant.
- **Hydrogen:** Hydrogen also is necessary for building sugars and building the plant. It is obtained almost entirely from water.
- **Oxygen:** Oxygen is necessary for cellular respiration. Cellular respiration is the process of generating energy-rich adeno-

sine triphosphate (ATP).

- **Phosphorous** is important in plant bioenergetics.
- **Potassium** regulates the opening and closing of the stomata by a potassium ion pump.
- **Nitrogen** is an essential component of all proteins.
- **Sulphur** is a structural component of some amino acids and vitamins, and is essential in the manufacturing of chloroplasts.
- **Calcium** regulates transport of other nutrients into the plant and is also involved in the activation of certain plant enzymes. Calcium deficiency results in stunting.
- **Magnesium** is an important part of chlorophyll, a critical plant pigment important in photosynthesis.

### Micro nutrients

- **Iron** is necessary for photosynthesis and is present as an enzyme cofactor in plants. Iron deficiency can result in interveinal chlorosis and necrosis.
- **Molybdenum** is a cofactor to enzymes important in building amino acids.
- **Copper** is important for photosynthesis.
- **Manganese** is necessary for building the chloroplasts.
- **Zinc** is required in a large number of enzymes and plays an essential role in DNA transcription.
- In higher plants, **Nickel** is essential for activation of

urease, an enzyme involved with nitrogen metabolism that is required to process urea.

- ❑ **Chlorine** is necessary for osmosis and ionic balance; it also plays a role in photosynthesis.

### Tissues

1. **Parenchyma** : thin - walled, polyhedral cells with living protoplasm, metabolically most active.
2. **Collenchyma** : Cell wall is made up of thin and thick portions with thickening in the corners. Found below the epidermis (stem skin).
3. **Sclerenchyma**: highly thickened cell walls. So it is the primary strengthening tissue found in mature plants. No living protoplasm, some of these are highly elongated called fibres.

### Complex Tissues

- ▶ **Xylem** - primarily a conducting tissue meant for transport of water and mineral elements. Highly thickened walls.
- ▶ **Phloem** - meant for the transport of food material from the leaves where it is synthesized to the storage or consumption organs.
- ▶ **Epidermis** - outermost layer of the plant body and is primarily protective in nature.
- ▶ **Secretory Tissues** : Examples of secretions are resin, mucilage, essential oils, gums, nectar, etc.

### Morphology of the Plant

**Root:** Root develops from the 'radicle; forming tap root system or

from the base of the stem forming the fibrous root system.

**Stem:** Stem and leaves constitute the shoot system.

### Plant Movements

- ❑ Two types of movements are noted in plants.
  1. Growth movements (irreversible) (2) Turgor movements (reversible).
- ❑ Plants exhibit movements in response to external stimulus like touchings, light, gravitation, water etc.
  - Chemical stimulus induced growth is called **chemotropism**.
    - ▶ Bending of stem towards light is due to **phototropism**.
  - **Phototropism** means movements of plants towards light.
    - ▶ The movement of plant organs in response to the force of gravity is called as **geotropism**.
  - The movement of an organ induced by contact with a **foreign body** is called **haptotropism**.
  - Water stimulus induced growth movements are called **hydrotropism**.
  - The curvature movements of plant parts in response to the stimulus of **contact** are termed as **thigmotropism**.
  - Growth movements in response to the stimulus of **heat** or **cold** is called **thermotropism**.
  - **Alternation of day and night** causes movements of plants called **nyctinastic movements**.
  - **Seismonastic** movements are

in response to a **touch** or **shock stimulus**.

### Living medium of plants

- ❑ **Habitat:** The normal locality inhabited by a plant or animal, particularly in relation to the effect of its environmental factors.
- ❑ World habitat day - 1st Monday of October.
- ❑ The vegetation of deserts is called **xerophytes**. eg: Opuntia.
- ❑ A **hydrophyte** is an aquatic plant.
- ❑ Plants which grow in saline water are called **Halophytes**.
- ❑ Plants growing well in full sunlight are called **Helio-phytes**.
- ❑ Plants which grow luxuriantly in rainy season and shed all leaves in summer are called **Tropophytes**.
- ❑ **Oxylophytes** : plants growing on acidic soil.
- ❑ **Lithophytes**: plants growing on rocks.
- ❑ Plants growing in marsh are called **Helophytes**.
- ❑ **Hydroponics**: is a method of cultivating plants without using soil but by using nutrient solution.

### Growth Regulators of Plants

- Certain chemical substances regulate the growth and differentiation of plants. These substances are called **plant growth regulators** or **phyto hormones**.
- The **auxins** induce cell elongation and root initiation.
- Indol - 3 Acetic Acid (IAA) is an important Auxin.

- Stem elongation and dormancy breaking are induced by **gibberillins**.
- Dormancy is the period in which seeds remains inactive.
- The hormone which helps in flowering of plants - **florigen**.
- **Cytokinins** help to induce cell division and cell elongation. (Cytokinins are largely present in coconut water.)
- The plant hormone that controls fruit ripening is **ethylene**.
- Unripe fruits can be made to ripe before proper time if they are kept in ethylene atmosphere.
- **Abscisic acid** cures ageing and abscission of leaves.
- It inhibits germination of seeds.
- Seed dormancy is due to abscisic acid.

## Plant Processes

- **PHOTOSYNTHESIS** is the process by which green plants manufacture food in the form of carbohydrates by using water,  $\text{CO}_2$  and sunlight. During Photosynthesis plants use carbon dioxide and give out oxygen.
- Oxygen balance in the atmosphere is maintained through the process of Photosynthesis.
- The percentage of light energy fixed in photosynthesis is generally around **1%**
- Photosynthesis takes place faster in **red light**
- Plant pigments do not absorb all the wavelengths of visible light. Out of the seven colours

of light, only blue, red and some violet light are absorbed.

- During day time plants **take in carbondioxide and give out oxygen**.
- **GUTTATION:** In some plants, water oozes through certain pores in the form of liquid, that pores remain permanently open and this phenomenon is called guttation.
- **OSMOSIS :** The process by which water diffuses through a semi-permeable membrane from a region of higher concentration of a solution to a region of lower concentration of a solution.
- **TRANSPIRATION:** The leaves excretes water through stomata by transpiration process.
- The required ingredient for photosynthesis in plant is **All the above**
- For the process of respiration in plants oxygen is necessary
- Xylem is responsible for the conduction of water in plants Plants get water through the roots because of **capillarity**
- Phloem carries prepared food from leaves to all parts of plant.

## Seed Dispersal and Pollination

- Pollination means transfer of pollen grains from the anther to the stigma of the same plant or a different plant.
- Pollination by water - Hydrophily
- Pollination by Bat - Chiropterophily

- Pollination between two flowers of one plant gytanogamy
- Pollination by insects is called **Entomophily**.
- Pollination by birds is called **Ornithophily**.
- Pollination by animals is called **Zoophily**.
- Pollination by wind is called **Anemophily**.
- The pollen grains in the plants are produced in **anther**.
- The chief pollinators of our agrihorticulture crops are **bees**.
- Wind borne pollen grains cause pollen allergy.
- In plants like castor and moringa seed dispersal takes place through wind.
- In Vallisnaria pollination occurs by water.
- Seed dispersal in coconut occurs through water.

## The Kingdom of Animals

- The animal with the longest life span on the land is elephant, while the animal having the longest life span, in general, is turtles and tortoises.
- **Blue Whale** is the biggest and the heaviest mammal.
- The smallest ape is **Gibbon**.
- **Chimpanzee** is the most intelligent ape.
- Elephant tusks are enlarged **incisors**.
- Fishes respire through **gills**.
- The vertebrate which has a two chambered heart is fish.



- **Coprophages** are the animals which derive their food from faecal matters.
- The organism which has the maximum number of ribs is the snake. The largest snake is the **anaconda** found in the Amazon region in South America.
- Kangaroo is a nocturnal herbivore.
- Zebras are jokingly called "the ponies in pygamas."
- ❑ The main chemical content of egg shell is calcium carbonate.
- **Hibernation** is the period of long sleep for animals in cold weather when there is no food available. During this period animals go underground and their metabolic activity becomes very low and hence they do not need to eat or drink during this period.
- ❑ The animal found in the advertisement board of forest department with the heading "I have no medicinal value" is **black ape**.
- ❑ Sanguivores are the animals

Largest ape ..... Gorilla  
 Tallest animal ..... Giraffe  
 Largest reptile ..... Crocodile  
 Lowest recorded temperature for a human being to survive ..... 20.3°C  
 Fastest Animal ..... Cheetah (speed 60-63 km/hr)  
 Smallest bird ..... Humming bird  
 Largest bird ..... North African Ostrich  
 Longest poisonous snake ..... King Cobra  
 Largest mammal (animal) ..... Blue Whale (wt. 209 tones)  
 Largest land animal ..... African Elephant (wt. 7 tones)  
 Largest teeth ..... Elephant tusks (upper incisors)

feeding on blood. Frugivores are the animals feeding on fruits.

- The **Kangaroo rat** never drinks water in its entire life.
- Ostrich, Rhea, Kiwi and Penguin—all are flightless birds.
- Dodo (a flightless pigeon) which appeared in Mauritius is now extinct.
- The smallest flightless bird is **kiwi**, while the smallest flying bird is the **Bee humming bird** of Cuba.
- Growth of tadpole into a frog

is called metamorphosis

- Cobra venom affects the nervous system and viper venom the blood circulatory system.
- A baby cockroach is called **nymph**.
- ▶ Organism is called the 'slipper animalcule' **paramecium**
- ❑ The organism which performs

### The animal classes that are vertebrates include

- ▶ Jawless fish
- ▶ Armored fish
- ▶ Cartilaginous fish
- ▶ Bony fish
- ▶ Amphibians
- ▶ Reptiles
- ▶ Birds
- ▶ Mammals

### Invertebrates include

- ▶ Sponges
- ▶ Jellyfish, hydras, sea anemones, corals
- ▶ Comb jellies
- ▶ Flatworms
- ▶ Molluscs
- ▶ Arthropods
- ▶ Segmented worms
- ▶ Echinoderms

## The Classification of animals

Animal Kingdom can be split up into main groups, vertebrates (with a backbone) and invertebrates (without a backbone). around 800,000 species have been identified in the Animal Kingdom — most of them in the Arthropod phylum.

Scientists classify each organism according to its: Kingdom, Phylum, Class, Order, Family, Genus and Species.

The science of classifying organisms is called taxonomy. Biologists classify living things into two kingdoms, the Plant Kingdom and the Animal Kingdom.

the sex transformation in crabs - Sacculina.

- ❑ The population of reptiles is maximum on earth.
- ❑ Saurology is the study of lizards.
- ❑ Ants go in a line by the secretion of trail pheromones.
- ❑ The tallest living bird is Ostrich.
- ❑ Silver fish is not a fish but a wingless insect.

## Six Basic Animal Groups

- ▶ **Amphibians** (Class Amphibia) are one of the six basic groups of animals.
- ▶ Amphibians include frogs, toads, caecilians, newts and salamanders.
- ▶ **Birds** (Class Aves). Birds, best known for their ability to fly, are unmatched in their command of the skies.
- ▶ **Invertebrates** are one of the six basic groups of animals. Katy-dids, spiders, sea squirts, octopuses, earthworms, starfish, beetles, hydras, dragonflies, sponges, corals, snails, and jellyfish are a handful of the invertebrates alive today.
- ▶ **Fish** are cold-blooded, aquatic animals that have scales, gills and fins.
- ▶ **Mammals** (Class Mammalia) are one of the six basic groups of animals.
- ▶ **Reptiles** (Class Reptilia) are cold-blooded vertebrates that diverged from ancestral amphibians about 340 million years ago.

## Physiology and Health

### I. Carbohydrates

Organic compounds containing carbon, hydrogen and oxygen which constitute sugars (Starch, cellulose, glucose etc) and supply calories for body activity.

- ❑ The general formula of carbohydrate molecule is  $C_n(H_2O)_n$ .
- ❑ The sources of carbohydrates are rice, wheat, honey, sugar, potato, carrot. Deficiency of carbohydrates causes weight loss and weakness.
- ❑ Polyhydroxy aldehyde or ketones are carbohydrates.
- ❑ Based on the number of sugar units they can be classified into, Monosaccharides, Oligosaccharides and Polysaccharides.

### II. Proteins

Proteins are highly complex nitrogenous compound found in all living organisms. Proteins are hydrolysed in the body to produce amino acids and are essential for growth and repair of the body tissues. They also provide energy when calories are deficient.

*Sources:* Milk, fish, meat, eggs, nuts, dal.

- ❑ Soyabean seeds possess highest percentage of proteins (30-35%).
- ❑ Prolonged protein deficiency cause severe under nourishment - a serious condition *Kwashiorker* is resulted mostly in children.

### III. Fats

Fats are insoluble in water but soluble in fat solvents. Major

sources are - butter, ghee, oils, ground nuts, almonds, etc.

- ❑ One gram of fat yields 9.3 calories of energy.

### IV. Vitamins

Vitamin A, D, E, K are fat soluble whereas vitamin B complex and C are water soluble.

- ❑ Rich sources of vitamin A are leafy vegetables, animal fat, carrot, spinach, milk etc.
- ❑ Severe deficiency of Vitamin A results in Xerophthalmia and Nightblindness.
- ❑ Rich sources of vitamin B are cereals, eggs, fruits, liver, pulses.
- ❑ Vitamin C is found in oranges, lemon, vegetables and milk.
- ❑ Milk, egg, liver etc are rich sources of vitamin E.
- ❑ Vitamin E is considered both as a vitamin and hormone.
- ❑ The source of vitamin K is green leafy vegetables and fishes, pea etc.
- ❑ Vitamin K is essential for blood coagulation.
- ❑ If milk is exposed to sunlight for a long time, vitamin  $B_2$  will be lost.
- ❑ Excessive intake of polished rice causes deficiency of  $B_1$  (Thiamine).
- ❑ Cow milk is a rich source of vitamin A.
- ❑ Vitamin D, can also be synthesised in our body with the help of sun light.
- ❑ Shark liver oil and cod liver oil are rich sources of vitamin D.
- ❑ Vitamin  $B_{12}$  (Cyanocobalamin) is a cobalt containing vitamin.
- ❑ Even though the amounts of vitamins required are small compared to other nutrients, it

## Source and Role of Principal Vitamins

Vitamin	Best Food Source	Function	Deficiency disease
<b>Retinal :</b> (Vitamin A) (Fat soluble)	Carrots, yellow and green vegetables. Other sources include butter, milk, fish-liver oil.	Synthesis of the visual purple of the retinal rods. Maintains general health and vigour of epithelial cells. Hence essential for good skin and hair.	<b>Xerophthalmia:</b> drying of cornea and ulceration. <b>Night blindness:</b> Inability to see in the dark. <b>Keratinization of epithelium:</b> Dry skin and hair.
<b>T h i a m i n e</b> (Vitamin B) (Water soluble)	Whole grains, yeast, liver, egg, pork, nuts.	Carbohydrate metabolism. Ensures normal functioning of the central nervous system.	<b>Beri-beri:</b> Partial paralysis of skeletal muscles and digestive disturbances.
<b>Riboflavin</b> (Vitamin B) (Water soluble)	Cereals, legumes, milk, egg, liver, kidney, yeast.	Essential carbohydrate and protein metabolism especially in the cells of the eye, skin, intestines, and blood.	Characterised by corneal ulceration and cracking of skin (especially around the lips).
<b>Niacin</b> (Water soluble)	Lean meat, liver, milk, eggs, nuts, whole grains.	Inhibits production of cholesterol and helps in the breakdown of fats, proteins and carbohydrates.	<b>Pellagra:</b> Characterised by dermatitis (skin inflammation), diarrhoea and dementia (loss of intellectual function).
<b>Pyridoxine</b> (Vitamin B <sub>6</sub> ) (Water soluble)	Salmon, yeast, yogurt, corn, spinach, cheese, cereals & legumes. Also synthesised by intestinal bacteria.	Essential for amino-acid metabolism. Assists production of antibodies.	<b>Epileptiform</b> seizures observed in children. Symptoms include dermatitis of eyes, nose and mouth; retarded growth.
<b>Folic Acid</b> (Water soluble)	Yeast, liver, green leafy vegetables. Synthesized by intestinal bacterial also.	Helps normal production of blood cells. Identified in chromosomes an important reproductive factor.	<b>Macrocytic anaemia:</b> Production of abnormally large red blood cells.
<b>Cyanocobalamin</b> (Vitamin B <sub>12</sub> ) (Water soluble)	Liver, kidney, meat, eggs, milk and cheese. (Note: Absent in vegetables, only vitamin containing cobalt.)	Necessary for red blood cells formation and normal functioning of nervous system.	<b>1. Pernicious anaemia.</b> <b>2. Neuro-psychiatric abnormalities:</b> Memory loss, mood and personality changes.
<b>Ascorbic acid</b> (Vitamin C) (Water soluble)	Citrus fruits, tomatoes, cabbage.	Influences permeability of capillary walls. Develops immunity against diseases. Forms collagen.	<b>Scurvy:</b> Swollen gums, teeth loss, bleeding gums.
<b>Calciferol</b> (Vitamin D) (Fat soluble)	Fish liver oils, egg yolk, milk, butter. Also synthesized in the human body by the skin under the influence of sunlight.	Controls calcium and phosphorus metabolism which contribute to formation of teeth and bones.	<b>Rickets</b> (in infants) Bones become soft (deformed). <b>Osteomalacia</b> (demineralization of bones)
<b>Tocopherol</b> (Vitamin E) (Fat soluble)	Wheat germ, fresh nuts, seed oils, green leafy vegetables.	<b>As anti-oxidant</b> which protects lipids of cells membranes against oxygen damage.	Deficiency not reported in humans Causes <b>sterility in rats.</b>
<b>Phylloquinones</b> (Vitamin K) (Fat soluble)	Liver, spinach, cauliflower, green tomatoes.	Assists in the production of prothrombin and other factors that ensure normal clotting of blood.	<b>Haemorrhage:</b> Subcutaneous and intramuscular bleedings due to delayed clotting time.

	Food Source
Vitamin A (Retinol)	Cod liver oil, carrots
Vitamin B1 (Thiamine)	Rice bran
Vitamin C (Ascorbic acid)	Citrus, most fresh foods
Vitamin D (Calciferol)	Cod liver oil
Vitamin B2 (Riboflavin)	Meat, eggs
Vitamin E (Tocopherol)	Wheat germ oil, unrefined veg.oils
Vitamin B12 (Cobalamins)	Liver, eggs, animal products
Vitamin K (Phylloquinone/ phytol naphthoquinone)	Leafy green vegetables
Vitamin B5 (Pantothenic acid)	Meats, whole grains, in many foods
Vitamin B7 (Biotin)	Meats, dairy products, eggs
Vitamin B6 (Pyridoxine)	Meat, dairy products.
Vitamin B3 (Niacin)	Meat, eggs, grains
Vitamin B9 (Folic acid)	Leafy green vegetables

is very necessary. Otherwise several deficiency diseases are caused in the body.

- ❑ The name 'vitamin' is coined by J.Funk (1912)
- ❑ Milk is a rich source of all vitamins except vitamin C.
- ❑ Vitamin D (in skin) and vitamin K (in liver) can be synthesized by our body.
- ❑ Deficiency of protein, carbohydrates and fats results in protein - energy - malnutrition.
- ❑ Protein deficiency causes Kwashiorkor- skin cracks and become scaly, abdomen swells, hair become reddish.
- ❑ Marasmus child show all above symptoms besides wasting of muscles.
- ❑ Diseases restricted to given region and arising from its specific environment condition are called endemic diseases. Eg : Goiter in sub - Himalayan region.
- ❑ Pellagra is common amongst people living on a maize diet, because maize interferes with the absorption of niacin in body.

- ❑ Overdose of water soluble vitamin does not cause any harm but accumulation of fat soluble vitamin can be toxic. It can lead to hypervitaminosis.
- ❑ Vitamin A accumulate in liver while vitamin D promotes high  $Ca^{+}$  absorption which damage the kidney where it is deposited.
- ❑ Vitamin A Deficiency causes Night Blindness and Keratomalacia.
- ❑ Deficiency of Vitamin B<sub>1</sub> (Thiamine) causes Beri Beri.
- ❑ Vitamin B<sub>3</sub> (Niacin) deficiency causes Pellagra.
- ❑ Vitamin B<sub>6</sub> Deficiency- Anemia.
- ❑ Vitamin B<sub>5</sub> deficiency - Paresthesia
- ❑ Vitamin C deficiency - Scurvy
- ❑ Vitamin D deficiency - Rickets

### Modes of Nutrition

- ✧ Autotrophic : Ability of organism to prepare its own food.
- ✧ Holophytic : Characteristic of plants where by they prepare complex food substances using simple raw materials.

- ✧ Heterotrophic : Organism is unable to prepare its own food.
- ✧ Holozoic : Mode of nutrition characteristic of animals whereby simple substances are obtained from complex food substances.
- ✧ Saprophytic : Absorbs nourishment from dead or decaying organic matter.
- ✧ Parasitic : Derives nutrition from living host without helping it in any way.
- ✧ Homodont dendition : Consists of only one type of teeth. They are used only for catching prey, as homodont does not chew their food. Eg : Snakes.
- ✧ Heterodont dendition : More than one type of teeth, differing in function, shape and function. Eg : Human

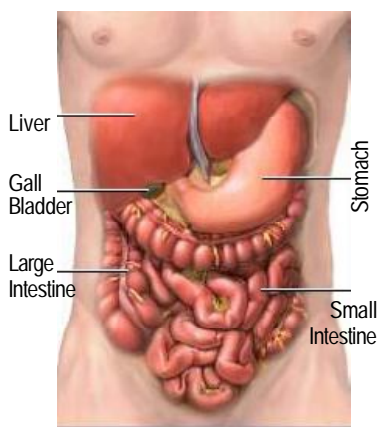
## Human Body

### Digestive System

- ❑ The process of converting food into energy giving substances is carried out by the digestive system.
- ❑ The digestive system consists of the alimentary canal (buccal cavity, oesophagus, stomach, small intestine, large intestine ending in the rectum and anus) and the associated glands.
- ❑ Alimentary canal is a long tube which is 6-9 metres long and starts from mouth and ends at anus.
- ❑ The parts of the alimentary canal are Mouth, Pharynx, Oesophagus, Stomach, Small intestine, Large intestine.
- ❑ The mouth leads into a funnel shaped pharynx, which is the

common passage for food and air.

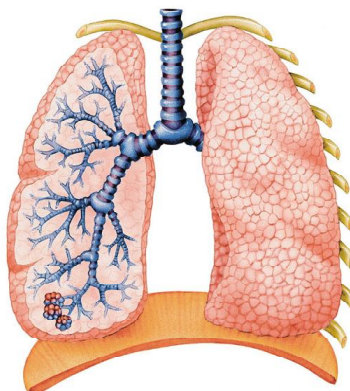
- ❑ Pharynx lead into oesophagus which is about 25cm long.
- ❑ The three divisions of large intestine are Caecum, Colon and Rectum.
- ❑ **Small intestine.** It is the largest and narrow tubular part of alimentary canal. It measures about 6 meters in length.
- ❑ Small intestine, the highly coiled portion has 3 divisions such as duodenum, jejunum and ileum.
- ⊛ Digestion is of two types
- ⊛ Intra cellular digestion : The digested products pass to the cytoplasm across the endocytotic inside membrane. Eg : Amoeba
- ⊛ Extra Cellular Digestion : Cell synthesizes one or more enzymes for digesting specific type of nutrient.
- ⊛ The liver is the largest gland of the body. It secretes bile, containing bile pigments and bile organic salt. If intestine contains no food, the bile flows to gall bladder, instead of duodenum ; which contract



and secrete bile later when food is present in intestine.

- ⊛ The large intestine secretes no enzyme and play only a minor role in the absorption of nutrients.

## Lungs



- ❑ The lung is the essential respiration organ in all air-breathing animals.
- ❑ Lungs are the respiratory organ in higher vertebrates (man).
- ❑ The main function of the lungs is the oxygenation of blood and to supply oxygen to it.
- ❑ The right lung is larger than the left lung.
- ❑ Right weight about - 620 g
- ❑ Left weight about - 570 g
- **Alveoli** are small air sacs of the lungs through the walls of which gaseous exchange takes place between blood and air.
- The organ without muscle is lungs
- **Pleura** protects lungs from harm.
- The CO content in the air that we exhale is about 8%.

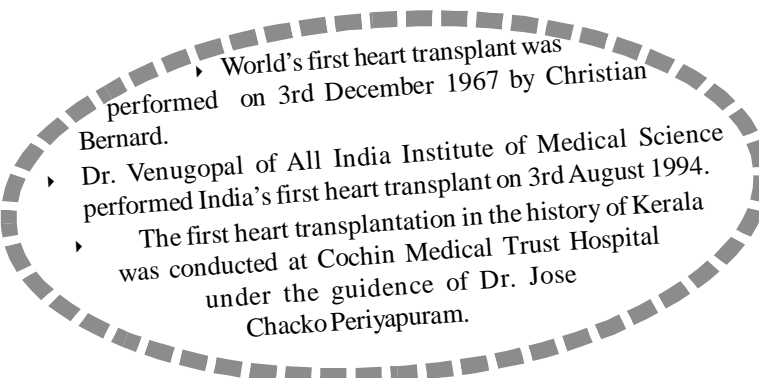
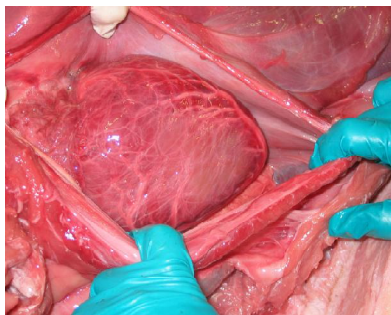
- The exchange of O<sub>2</sub> and CO<sub>2</sub> takes place in lungs at alveoli.
- ❑ The amount of air moving in and out of lungs during each breath is called **tidal volume**.
- ❑ The maximum volume of air that can be moved in or out of the lungs is referred to as the **vital capacity of the lungs**.
- ❑ **Eupnea** — Normal breathing
- ❑ **Dyspnea** —painful breathing
- ❑ **Anexia** — No O<sub>2</sub> in inspired air
- Pneumonia, pleurosis, bronchitis, silicosis and emphysema are diseases affecting respiratory tract.
- **SARS** (Severe Acute Respiratory Syndrome) a lung disease, is caused by Corona Virus.

## High altitude problems

1. Asphyxia - Oxygen starvation due to low atmospheric oxygen is called asphyxia.
  2. Hypoxia - refers to a general low level of oxygen availability. Physiologically it refers to a deficiency of oxygen at the tissue level.
- ❑ Tobacco smoke and exhaust fumes result in carbon monoxide poisoning.
  - ❑ The binding capacity of carbon monoxide is 200 times than that of carbondioxide with haemoglobin.
  - ❑ A leaf like cartilagenous flap, the epiglottis guards the opening of glottis.
  - ❑ Sleeping in a closed room with a burning kerosene lamp may lead to death due to lack of O<sub>2</sub>.
  - ❑ In mammals, the body cavity is partitioned into thoracic and abdominal parts by diaphragm.



## Heart



- The cardiovascular system comprises the heart, veins, arteries and capillaries.
- Heart is the pumping organ of blood vascular system.
- Heart length - 12 cm
- Heart width - 9 cm
- The normal heart beat is **70-72 per minute** in males and **78-82 per minute** in females.
- The heart beat of a child is more than that of an adult. ie 140/min
- The circulation of blood in the body is regulated by the heart.
- The human heart is on the left side beneath the left nipple.
- The **pericardium** protects heart from harm.
- The average weight of the heart is about 340 gm in men and 225 gm in women.
- The human heart has four chambers, a pair of auricles and a pair of ventricles.
- The human heart consists of four chambers and in fish the heart consists of two chambers. In those of amphibians there are 3 chambers. Heart of reptiles is incompletely divided into 4 chambers (Crocodile has 4 chambered heart). Mammals and birds also have four chambered hearts.
- The deoxygenated blood (impure blood) from the body coined by two large veins called Superior Venacava and Inferior Venacava is in the right auricle.
- The oxygenated blood from the lungs is received by the heart in left auricle.
- Aorta is the largest artery which carries oxygenated blood.
- The largest blood vessel in the body is Aorta.
- As blood passes through lungs, gases are exchanged through blood vessels called capillaries of alveoli. Heart beat rate in embryo (Foetus) 1 minute = 200. Heart beat rate in new born baby 1 minute = 140 times.
- Normal pulse rate of healthy adult human is 72 per minute.
- Normal BP is 120/80 mmHg.
- The science dealing with the study of the heart and its diseases is known as **cardiology**.
- **ECG (Electro Cardio Gram)** It is the photographic record of electric variations that occur during contraction of muscles of heart.
- ECG was invented by Wilhelm Einthoven.
- Arteries carry pure blood from the heart to the tissues.
- Pulmonary artery is the only artery carrying impure blood.
- Veins collect impure blood from the tissues and carry it to the heart.
- Pulmonary vein is the only vein carrying pure blood.
- The largest vein in human body is called inferior venacava.
- The length of our blood capillaries is about 1,00,000 cm.
- **Jarvik Heart** is the artificial pump to replace the human heart developed by Robert K. Jarvik.
- **John H. Gibbon (USA)** built the first successful heart-lung machine.
- A pacemaker is used to stimulate the heart muscles.
- Except heart all other organs of our body are found in pairs.
- The organ which is not affected by tumour is heart. Pain in heart muscles -- Angina pectoris.
- The circulation of blood in the body is regulated by the heart.
- The credit of discovering the circulatory system goes to William Harvey.

- The total length of our blood vessels is about one lakh kilometre.

### Heart disease

- **Coronary heart disease** refers to the failure of the coronary circulation to supply adequate circulation to cardiac muscle and surrounding tissue.
- **Coronary artery disease** is a disease of the artery caused by the accumulation of atheromatous plaques within the walls of the arteries that supply the myocardium. Angina pectoris (chest pain) and myocardial infarction (heart attack) are symptoms of and conditions caused by coronary heart disease.
- **Cardiomyopathy** is the deterioration of the function of the myocardium (i.e., the actual heart muscle) for any reason. People with cardiomyopathy are often at risk of arrhythmia and/or sudden cardiac death.
- **Cardiovascular disease** is any of a number of specific diseases that affect the heart itself and/or the blood vessel system, especially the veins and arteries leading to and from the heart.
- **Heart failure** also called *congestive heart failure* (or *CHF*), and congestive cardiac failure (CCF), is a condition that can result from any structural or functional cardiac disorder that impairs the ability of the heart to fill with or pump a sufficient amount of blood throughout the body.
- **Hypertensive heart disease** is heart disease caused by high

### Constituents of the human body

In a normal man weighing 60 kg

Constituent	Weight	Percent of atoms
Oxygen	38.8 kg	25.5 %
Carbon	10.9 kg	9.5 %
Hydrogen	6.0 kg	63 %
Nitrogen	1.9 kg	1.4 %
Calcium	1.2 kg	0.3 %
Phosphorus	0.6 kg	.2 %
Potassium	0.2 kg	0.06 %

blood pressure, especially localised high blood pressure.

- **Inflammatory heart disease** involves inflammation of the heart muscle and/or the tissue surrounding it.
- **Valvular heart disease** is disease process that affects one or more valves of the heart.

### Blood

- The blood serves to transport and distribute materials within the body.
- Distribution of enzymes is not a function of blood.
- Blood circulation was discovered by **William Harvey**.
- Since blood is found outside the cells it is called as extra cellular fluid (ECF).
- The pH value of human blood is nearly 7.5.
- The blood cholesterol level in 100ml of blood in a normal person varies between 150-250 mg
- The liquid part of the blood viz. the **plasma** constitutes 55% of the total blood volume.

- **Albumin, globulin and fibrinogen** are the plasma proteins.
- Fibrinogen is concerned with Coagulation of blood.
- The blood cells are of three types - Red blood cells (Erythrocytes), White blood cells (leucocytes) and the Platelets (Thrombocytes).
- Red Blood Corpuscles (RBC) contain haemoglobin which gives blood its red colour. Camel is the only mammal having nucleus in the RBC.
- The abnormal rise in total count of RBC is called polycythemia.
- ✧ Erythrocytes participate in transporting oxygen from lungs to tissues.
- ✧ CO<sub>2</sub> is carried in both plasma and RBC as bicarbonates.
- RBCs are produced in the **bone marrow**.
- Spleen & liver destroy the dead RBCs in human body. Spleen is known as graveyard of RBC.
- Spleen serves as a *Blood Bank* (Reservoir of blood) in the body.
- The life span of RBC is about **120 days**.
- Haemoglobin consists of iron containing pigment *haem* and a protein *globin*.
- Haemoglobin, the respiratory pigment gives red colour to RBC.
- Haemoglobin helps in transportation of oxygen.
- Normal adult human male has 14 grams of haemoglobin in 100 millilitre of blood.

### Blood pressure

Blood pressure (BP) is the pressure exerted by circulating blood upon the walls of blood vessels, and is one of the principal vital signs. During each heartbeat, BP varies between a maximum (systolic) and a minimum (diastolic) pressure.

- The condition when haemoglobin content of the blood falls below normal is termed anaemia.
- The disease resistant constituent of blood is W.B.C. which produces antibodies.
- Antigens are capable of stimulating the formation of antibodies.
- WBC-White Blood Corpuscles (Leucocytes) defend our body from disease causing microorganisms.
- ✧ The number of leukocytes per micro litre of blood is called the total count of WBC. It is normally 5000 in humans.
- Leukaemia, also called blood cancer, is caused by the over production of WBCs.
- Leucopenia is the disease caused due to decrease in the white blood cells count.
- The proportion of R.B.C. and W.B.C. in human body is 600 : 1.
- The life span of WBC is about 5 to 21 days.
- Platelets or thrombocytes are other blood cells. They perform an important role in blood clotting. They live only for a few hours.

### Functions of Blood

- Supply of oxygen to tissues (bound to hemoglobin, which is carried in red cells)
- Supply of nutrients such as glucose, amino acids, and fatty acids (dissolved in the blood or bound to plasma proteins (e.g., blood lipids))
- Removal of waste such as carbon dioxide, urea, and lactic acid
- Immunological functions, including circulation of white blood cells, and detection of foreign material by antibodies
- Coagulation, which is one part of the body's self-repair mechanism (the act of blood clotting when one gets cut to stop the bleeding)
- Messenger functions, including the transport of hormones and the signaling of tissue damage
- Regulation of body pH
- Regulation of core body temperature
- Hydraulic functions

- Clotting of blood in blood vessels is called **thrombosis**.
- The coagulation of blood in vessels is prevented during normal condition by heparin.
- **Haemophilia** is a hereditary bleeding disease due to inadequate clotting of the blood.
- Haemophilia sometimes referred to as bleeder's disease or '**christmas disease**.'
- A healthy person has 5-6 litres of blood in his body.
- At a time of blood donation only 300 ml of blood is used.
- The normal blood pressure of a healthy adult is 120/80 mm Hg.
- 120 mm Hg is known as systolic pressure and 80 mm Hg is known as diastolic pressure.
- High blood pressure (Hypertension) is known as the *silent killer*.
- ✧ Normal blood sugar level : 80-100mg/100ml of blood
- ✧ Normal cholesterol 50-180 mg /100ml of plasma.
- The largest leucocyte - Monocytes.
- The smallest leucocyte - lymphocytes.
- The leucocytes capable of producing antibodies are - lymphocytes.
- The leucocytes which are modified as scavenger cells are - Monocytes.
- The leucocytes that are able to produce the anticoagulant heparin are Basophils.

- Presence of blood in urine - Haematuria.
- Presence of haemoglobin in the urine - Haemoglobinuria.
- Presence of excess urea in the blood - Uremia
- Presence of excess proteins in urine - Proteinuria.

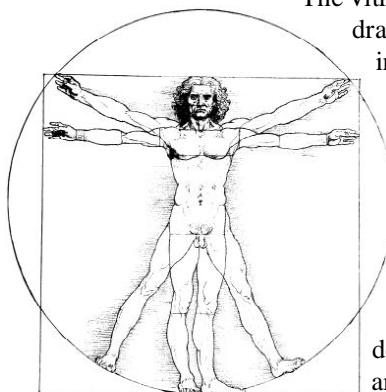
- **Plasma**  
About 55% of whole blood is blood plasma, a fluid that is the blood's liquid medium, which by itself is straw-yellow in color.
- Plasma functions in transport, body immunity, prevention of blood loss, retention of fluid in blood, maintenance of pH, uniform distribution of heat.

#### Hematological disorders

- **Anemia:** Insufficient red cell mass (anemia) can be the result of bleeding, blood disorders like thalassemia, or nutritional deficiencies.
- Abnormal increase in WBC count is known as leukemia or blood cancer.
- Leukemia is a group of cancers of the blood-forming tissues.
- Abnormal decrease in total count of WBC is known as leucopenia
- Non-cancerous overproduction of red cells (polycythemia vera) or platelets (essential thrombocytosis) may be pre-malignant.
- Hemophilia is a genetic illness that causes dysfunction in one of the blood's clotting mechanisms.
- Blood is an important vector of infection. HIV, the virus, which causes AIDS, is transmitted through contact with blood, semen or other body secretions of an infected person.
- Hepatitis B and C are transmitted primarily through blood contact.

Leonardo da Vinci's *Vitruvian Man* displays the proportions of a man.

The Vitruvian Man is a world-renowned drawing created by Leonardo da Vinci in the year 1487.



The drawing and text are sometimes called the *Canon of Proportions*.

It is stored in the Gallerie dell'Accademia in Venice, Italy. The drawing is based on the correlations of ideal human proportions with geometry described by the ancient Roman architect Vitruvius

- Bacterial infection of the blood is bacteremia or sepsis. Viral Infection is viremia. Malaria and trypanosomiasis are blood-borne parasitic infections.

#### Blood clotting

- Blood platelets breakdown in the vicinity of an injury and release an enzyme that causes formation of fibrin from fibrinogen. Fibrin forms a tangled mass of fibres which

shrink and form a hard clot to plug the opening of the blood vessel to stop bleeding. After clotting occurs, a straw coloured fluid called 'serum' is left. This portion of blood retains its liquid form indefinitely.

- Haemophilia is a hereditary bleeding disease due to inadequate clotting of the blood.

Recipient	Donor							
	O-	O+	A-	A+	B-	B+	AB-	AB+
O-	✓							
O+	✓	✓						
A-	✓		✓					
A+	✓	✓	✓	✓				
B-	✓				✓			
B+	✓	✓			✓	✓		
AB-	✓		✓		✓		✓	
AB+	✓	✓	✓	✓	✓	✓	✓	✓



## Blood Groups

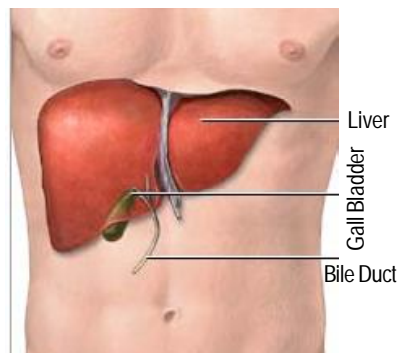
- ▶ A person having blood type B could safely donate blood to persons with blood type **B and AB**
- Blood groups A, B, AB and O were discovered by **Karl Landsteiner**.
- O blood group can be given to persons of any other group. Therefore O group is called **universal donor**.
- A person with group AB can receive any other group. So AB is called **universal recipient**.
- 'A' blood group is most common among the Europeans, while 'B' and 'O' are common among the Asians and the American Indians, respectively.
- Erythroblastosis foetalis — caused by the Rh blood group.
- Land Steiner and Weiner first found the Rh factor in Rhesus monkey.
- Normal count level RBC in Blood - 5 million/ccg Blood.
- Normal count level WBC in Blood - 5,000 to 9,000 ccg Blood.
- Normal count level platelets in Blood - 2,50,000 to 3 lakhs.
- Life span of RBC - 120 days
- Life span of WBC - 5 to 21 days
- Life span of platelets - 7 days
- ▶ The instrument used to measure the blood pressure in Human body - **Sphygmomanometer**
- ▶ The only one vein in human

body which carries pure blood is **pulmonary vein**

- ▶ Antigen is a substance which **stimulates formation of antibody**
- ▶ When the right ventricle in the human heart contracts, the blood moves to **pulmonary artery**

## Liver : The largest gland

- The liver is the largest gland in the body.



- **Largest blood cell in human body - Monocytes**
- **Smallest blood cell in human body - Lymphocytes**

## Major organ systems

**Cardiovascular system:** pumping and channeling blood to and from the body and lungs with heart, blood, and blood vessels.

**Digestive System:** digestion and processing food with salivary glands, esophagus, stomach, liver, gallbladder, pancreas, intestines, rectum, and anus.

**Endocannabinoid system:** neuromodulatory lipids and receptors involved in a variety of physiological processes including appetite, pain-sensation, mood, motor learning, synaptic plasticity, and memory.

**Endocrine system:** communication within the body using hormones made by endocrine glands such as the hypothalamus, pituitary or pituitary gland, pineal body or pineal gland, thyroid, parathyroids, and adrenals or adrenal glands

**Integumentary system:** skin, hair and nails

**Immune system:** the system that fights off disease; composed of leukocytes, tonsils, adenoids, thymus, and spleen.

**Lymphatic system:** structures involved in the transfer

of lymph between tissues and the blood stream, the lymph and the nodes and vessels that transport it.

**Musculoskeletal system:** muscles provide movement and a skeleton provides structural support and protection with bones, cartilage, ligaments, and tendons.

**Nervous system:** collecting, transferring and processing information with brain, spinal cord, peripheral nerves, and nerves

**Reproductive system:** the sex organs; in the female; ovaries, fallopian tubes, uterus, vagina, mammary glands, and in the male; testes, vas deferens, seminal vesicles, prostate, and penis.

**Respiratory system:** the organs used for breathing, the pharynx, larynx, trachea, bronchi, lungs, and diaphragm.

**Urinary system:** kidneys, ureters, bladder and urethra involved in fluid balance, electrolyte balance and excretion of urine.

**Vestibular system:** contributes to our balance and our sense of spatial orientation.



**Liver** plays a major role in metabolism and has a number of functions in the body, including glycogen storage, decomposition of red blood cells, plasma protein synthesis, hormone production, and detoxification. It lies below the diaphragm in the abdominal-pelvic region of the abdomen. It produces bile, an alkaline compound which aids in digestion, via the emulsification of lipids.

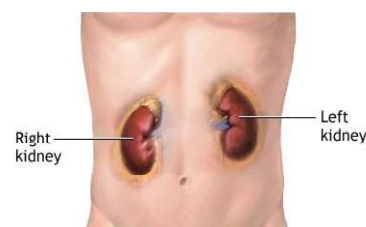
- It is the largest metabolic organ in human body.
- The liver is on the right side of the stomach.
- Liver is dark brown in colour.
- Sleeping on left side is useful because it gives maximum relaxation to the muscles of the right side and keeps the liver warm and relaxed and improves bile secretion.
- Glucose is stored in the liver and muscles in the form of *glycogen*.
- Liver is otherwise called HEPAR.
- Second largest gland in human body - Pancreas
- Exocrine and endocrine gland - Pancreas
- Heterocrine gland - Pancreas
- A Normal man secrete about 1 Litre of Pancreatic Juice per day.
- The main function of the liver is to produce **bile** which is an important agent in digestion of fat.
- There is no known digestive enzymes in the bile.
- Bile is stored in the gall bladder.

- *Bilirubin and biliverdin are bile pigments.*
- The disease which affects the liver is jaundice.
- Bleeding in liver is known as liver cirrhosis.
- Hepatitis is the viral disease of liver which influence functioning of liver.
- ▶ Excessive alcoholic consumption causes **cirrhosis**
- Excessive stimulus for alcohol consumption is called dipsomania.
- Manufacturing of urea takes place in liver.
- Excessive use of tobacco affects the nerves while the same of alcohol affects the liver.
- Stone in gall bladder called Cholecystostatis
- Urea is produced in the liver.
- Hepatitis is the viral disease of liver which influence functioning of liver.
- The weight of liver in man is about 1.5 kg.
- The disease that result due to any obstruction in the bile duct is Jaundice.
- Excessive alcoholic consumption causes cirrhosis.
- The high tendency to drink alcohol is termed as dipsomania.
- Liver has a great many important functions other than helping in digestion. They are:
  - 1) Regulation of carbohydrate, protein and lipid metabolism.
  - 2) Synthesis of urea for excretion.
  - 3) Removal of drugs and toxic materials. The liver has enzymes which can detoxify harmful materials.
  - 4) Storage of vitamins.
  - 5) Liver is the principal organ for the excretion of cholesterol, bile

pigments (bilirubin and biliverdin) and inactivated products of steroid hormones, some vitamins and many drugs.

- 6) Destruction of dead cells and bacteria by phagocytosis.
- 7) Synthesises heparin - an anticoagulant, prothrombin, fibrinogen and some factors necessary for blood coagulation.

## Kidneys and Dialysis



- The kidneys are the chief excretory organs of vertebrates.
- The main purpose of the kidney is to separate urea, mineral salts, toxins, and other waste products from the blood.
- Urea is removed from the blood by **kidneys**.
- The volume of urine produced in an adult human being for every 24 hours is 6.5 litres.
- The functional unit of kidneys is called nephron.
- Nephritis is the inflammation of the kidney caused by the infection of streptococci.
- Presence of urea in the blood is called **uremia**.
- Kidneys are responsible for the removal of excess water, salts and waste products from the blood in the form of urine.
- Increased flow of urine is called diuresis and substances that increase the flow of urine is called diuretics.

- **Anti Diuretic hormone (ADH)** or **Vasopressin** regulates the amount of water excreted in urine.
- Deficiency of ADH results in the disease **diabetes insipidus** characterised by a large amount of water being removed through urine.
- Increased flow of urine is called diuresis and substances that increase the flow of urine is called diuretics.
  - ▶ Dialysis is used in the case of a patient suffering from **kidney trouble**
- A dialysis unit is an artificial kidney which performs the functions of a normal kidney outside the body.
- Dysuria is called painful Urination.
- The right kidney sits just below the diaphragm and posterior to the liver, the left below the diaphragm and posterior to the spleen.
- Each adult kidney weighs between 125 and 170 grams in males and between 115 and 155 grams in females.
- The kidney has a bean-shaped structure, each kidney has concave and convex surfaces.
- Outer darker region of kidney is named as cortex.
- Inner pale region of each kidney is known as medulla.
- Urinary bladder and ureters are lined by transitional epithelium and hence are capable of being considerably stretched, when filled with urine.
- Normal urine is about 95% water and 5% dissolved solids.
- Presence of glucose in urine is referred to as glycosuria.
- The kidneys excrete a variety of waste products produced by metabolism. These include the nitrogenous wastes urea, from protein catabolism, and uric acid, from nucleic acid metabolism.
- The kidneys secrete a variety of hormones, including erythropoietin, calcitriol, and renin.
- At least one kidney must function properly for life to be maintained.
- Nephropathy refers to damage to or disease of the kidney. An older term for this is nephrosis.
- Diabetes is the most common cause of kidney failure, accounting for more than 40 percent of new cases. High blood pressure, or hypertension, is a major factor in the development of kidney problems in people with diabetes.

Some of the most common kidney diseases and conditions are: polycystic kidney disease, nephrosis, lupus nephritis, diabetic nephropathy, rhabdomyolysis, kidney stones, and renal tubular acidosis.

## Brain

- The brain is protected by cranial bone and meninges.
- The brain is marked into forebrain, mid brain and hind brain.
- The forebrain consists of cerebrum, the largest part of human brain.

*Cerebellum is known as 'Little brain' of the entire brain portions.*

- Cerebral cortex is outer layer of cerebrum. It is made of grey matter and contains many layer of nerve cells.
- Cerebral hemisphere is divided into frontal, parietal, temporal and occipital lobes.
- The surface of cerebral hemisphere shows many convolutions called Gyri separated by depressions called Sulci.
- The Gyri increases the surface area of cortex to accommodate more nerve cells.
- The general sensory or somesthetic area in parietal lobe perceive general sensation, viz pain, touch and temperature.
- The motor area in frontal lobe controls voluntary movement of muscles.
- The premotor area in frontal lobe is the highest centre of involuntary movements of muscles.
- The visual and auditory areas are in occipital lobe and are centres for visual and hearing sensation.
- Association area in the frontal lobe is responsible for association between various sensations and movements.
- Memory, intelligence, and judgement depends on coordinated and integrated activities of different cortical centres.
- Hypothalamus : contain higher nerve centres for temperature

regulation, hunger, thirst and emotional function. It secretes neurohormones which control secretions of anterior pituitary hormones. It synthesises the posterior pituitary hormones.

- ❑ The medulla oblongata controls the involuntary actions.
- ❑ The central control of respiratory activity in human body is exercised by medulla oblongata.
- ❑ Medulla oblongata has the centres, for regulating the working of the heart contraction of blood vessels and respiratory and digestive movements.
- ❑ The thermoregulatory centre of the human body is hypothalamus.
- ❑ E.E.G (Electro Encephalogram) is used to record changes in the electric potential in various areas of brain.
- ❑ Biological death of a patient means the death of tissues of the brain.
- ❑ Encephalitis is caused by virus.
- ❑ Disorder of brain affecting recognition of letters and words is Dyslexia.
- ❑ The final weight of the brain in an adult male is 1.4kg and 1.3 kg in case of a woman.
- ❑ Cerebellum is second largest portion of brain located at the base, under the cerebrum.
- ❑ Cerebellum contains centres for the maintenance of posture and equilibrium of body and for the muscle tone. It also modulates and moderate voluntary action initiated by the cerebral cortex.

- ❑ Brain stem consists of pons and medulla oblongata. It controls vegetative actions.

### Spinal Cord

- ❑ The spinal cord controls reflex actions in human beings.
- ❑ The length of the spinal cord is about 1 metre (3.3ft)
- ❑ The spinal cord is a series of 31 sections called segments. Each segment giving rise to a pair of spinal nerves.
- ❑ 10 pairs originate from the brain stem. It contain sensory, mixed and motor nerves.
- ❑ We lose consciousness if blood flow to the brain is cut off for more than five seconds.
- ❑ There are 12 pairs of cranial nerves and 31 pairs of spinal nerves in man.

## SENSE ORGANS

- ❑ The organs which receive the external and internal stimuli and convey the same to the central nervous system are called sense organs.

### Smell

- ❑ Receptors for smell occur in nasal mucosa and are made up of modified pseudo stratified epithelium. This epithelium is known as olfactory epithelium.
- ❑ Olfactory epithelium is more extensive in dogs with an acute olfactory sense.
- ❑ This epithelium is composed of three types of cells - olfactory receptor cells, supporting cells and basal cells.
- ❑ Olfactory receptor cells function as chemo receptors.
- ❑ In order for a substance to be

### Scientific classification of Human Being

Kingdom: ..... Animalia  
 Phylum: ..... Chordata  
 Class: ..... Mammalia  
 Order: ..... Primates  
 Family: ..... Hominidae  
 Subfamily: ..... Homininae  
 Tribe: ..... Hominini  
 Genus: ..... Homo  
 Species: ..... Homo Sapiens

smelled, the substance must be capable of entering to a gaseous state to reach nostrils and it must be water soluble to dissolve in the mucus to make contact with olfactory cells.

### Taste

- ❑ Taste buds are sense crayons for taste sensation.
- ❑ Taste buds are oval bodies found as some elevation in tongue called papillae.
- ❑ Human beings recognise four basic modalities or tastes- sweet, sour, salty and bitter.
- ❑ They are principally perceived at the tip, along lateral edges, on upper surface of front half and on the back of the tongue, respectively.
- ❑ Sour taste is evoked by H<sup>+</sup> ions, produced by ionisation of acids.
- ❑ Sweet taste is evoked by organic substances viz. sugar, dextrin, glycerol, chloroform, aspartame and saccharine.
- ❑ Bitter taste is evoked by quinine, morphine, caffeine, nicotine, urea and cation of many inorganic salts like Magnesium salts.
- ❑ Salty taste is evoked from cations of Na<sup>+</sup>.

- ❑ Aspartame & saccharine are widely used as artificial sweetening agents.
  - ❑ Loss of smell reduces the perception of taste also. That is why people suffering from cold (rhinitis) often complain that they cannot taste their food.
  - ❑ Taste of chillies, black pepper and hot sauces are not true sensation. It is mainly a sensation of pain receptors.
  - ❑ Many insects such as honey bee, flies, butterflies and moth possess chemoreceptors for taste sensation at their feet.
  - ❑ Some mammals like rhesus monkey, dogs, pig and cat possess taste sensation for water.
  - ❑ Man doesn't possess taste buds for tasting water.
- Skin - Touch**
- ❑ Skin : Touch corpuscle in the skin responds to physical sensations of pressure, heat, cold, contact and pain.
  - ❑ Skin is our tactile (sense of touch) sense organ.
  - ❑ It is the largest organ of the human body.
- ❑ In an adult man skin covers the muscles of about 1.9m<sup>2</sup> (20 sq.ft) and a woman has about 1.6m<sup>2</sup> (17sq.ft).
  - ❑ The outer layer of the skin is termed as epidermis, which has no nerves or blood vessels and is continuously renewed.
  - ❑ Inner layer, called dermis, is a thick layer below the epidermis which contain nerves, blood vessels, hair follicles, sebaceous gland and sweat glands.
  - ❑ Colour of the skin is due to the presence of the pigment, melanin, in epidermis.
  - ❑ The main function of human skin is excretion.
  - ❑ Sweat serves to regulate the body temperature.
  - ❑ Sweat glands seen in dermis layer help to eliminate excess heat from the body.
  - ❑ Dermatology is the branch of science that deals with the study of skin and its diseases.
- EYE - Vision**
- ❑ The eye (photoreceptor) is a globular ball like organ situated in a bony cavity, the orbit, of the skull.
  - ❑ The eyeball has a diameter of 2.5 cm.
  - ❑ The eyeball has 3 coatings
  - ❑ Outer most layer is an opaque, white, fibro elastic capsule called sclera. This is continuous with a transparent layer called Cornea (bulging white part of the eye)
  - ❑ The membrane that covers cornea is conjunctiva.
  - ❑ In case of eye transfer only cornea is used.
  - ❑ Middle layer is called choroid, is a highly vascular, pigmented layer.
  - ❑ Ciliary body is the thickest portion of vascular tissue, arising from a point just behind the junction of sclera and cornea. It consists of ciliary process and ciliary muscles.
  - ❑ A pigmented, muscular, opaque diaphragm called, Iris, extend from ciliary body in front of lens. It can be seen as a black screen through the cornea and has a small central aperture called 'Pupil'.
  - ❑ The iris has two sets of smooth muscles arranged circularly. The pupil is constricted and

## Facts about Human Body

Largest and Longest bone in a man .....	Femur (thigh bone)
Smallest muscle .....	Stapedius
Smallest bone .....	Stapes (middle-ear)
Total amount of blood in body .....	5.6 litres (1/15 of body weight)
Life span of RBC .....	120 days
Number of RBC's .....	in male 5000,000/cu.mm/in female 45,00,000/cu.mm
Number of WBC's .....	5000-10000/cu.mm
Life Span of WBC .....	2-5 days
Heart beats .....	72 per minute
Average amount of haemoglobin .....	14-15 mg/100 ml of blood
Thinnest skin .....	Conjunctiva (eyelid)
Largest endocrine gland .....	Thyroid gland
Longest cell in body .....	Nerve cell
Smallest cell in human body .....	Sperm cell
Largest cell in human body .....	Ovum

- dilated respectively by their construction, to reduce and increase the amount of light falling on the lens.
- ❑ In bright light the iris automatically shuts tighter, reducing the amount of light entering the pupil.
  - ❑ In front of the eye there is a convex lens. The lens is attached to the ciliary bodies by suspensory ligaments.
  - ❑ Retina is the inner most layer, sensitive and made up of many cells and fibres.
  - ❑ Retina acts like the film in camera. In order to form an image on the retina, light must pass through all the media of eye (cornea, aqueous humour, lens, vitreous humour) and it must be brought to focus on the retina to form an upside down image on it.
  - ❑ The interpretation takes place in the brain.
  - ❑ The image formed on the retina of the human eye is real and inverted.
  - ❑ Eye contain receptors called photoreceptors viz 'rods' and 'cone' cells, which convert the energy of specific wavelength into action potential of nerve fibre.
  - ❑ Nerve impulses are carried from rods and cones by bipolar nerve cells to the ganglion cells. The axon of the ganglion cells converge and leave the eye ball to form 'optic nerve.'
  - ❑ The spot at the back of eye, from where the optic nerve fibre leaves is covered by a zone of retina free from rods and cones. So this spot is devoid

of ability for vision and is called Blind Spot.

- ❑ Lateral to blind spot, there is a depressed area of retina, called Fovea, which contains only cones and no rods. Ability of vision is highest in fovea.
- ❑ The anterior compartment is filled with aqueous humour. It supplies nutrients to lens and cornea having no blood supply, maintain shape of cornea and support the lens.
- ❑ The posterior compartment is filled with transparent gelatinous material called vitreous humour, which supports the lens and retina.
- Colour blindness is a hereditary disease.
- Squint eye is another eye defect which can be corrected by an operation.
- ❑ The parts of eye involved in eye transplantation surgery are cornea, sclera and vitreous humour.
- ❑ The loss of vision during dim light is called night blindness.
- Twenty-twenty means perfect vision.

### SOME OF THE EYE DEFECTS

- » **Myopia:** Also known as near sightness or short sightness. Near object is clear. Far object is not clear. Eyeball become longer. Image is formed in front of Retina. Can be remedied by concave lens.
- » **Hypermetropia:** Also known as long sightness or far sightness. Far object is clear, near object is not clear. Eye ball become short. Image is formed behind the Retina. Can be remedied by convex lens.

- » **Astigmatism:** Curvature of cornea become irregular and image is not clearly formed. Remedied by cylindrical lens.
- » **Glaucoma:** It is due to increase intra ocular pressure in aqueous chamber. Operation is needed at early stage.
- » **Trachoma:** It is increased in Redness of eye and more secretion of watery fluid. It is due to infection of bacteria, chlamidia trachamastis. Due to this follicles may form in conjunctiva.
- » **Xerophthalmia:** It is due to deficiency of vitamin A. ( $A_2$ ). During this conjunctiva or cornea becomes Keratinized. It may lead to blindness.
- » **Strabismus:** In this type eyeball remain in somewhat bent position which is due to long ocular muscles formed during development of eye. Operation is needed at early stage. Also associated with squint.
- » **Presbiopia:** During this power of accommodation of lens decreases due to age factor and defected metabolism. Also known as age sightness. Can be removed by bifocal lens.
- » **Photophobia:** No clear image in bright light.
- » **Emmetropia - Normal vision**
- » **Cataract -** is the condition where lens became opaque which is due to defective protein metabolism leading to blindness. It may be due to disease or old age. It is remedied by replacing lens.
- » **Colour blindness:** It is known as daltonism. It is the inability



to distinguish between red and green colour. It is a sex linked (x-linked) genetic disorder.

- **Night Blindness:** During this Rhodopsin is not resynthesized while it is regenerated in dim light.

## Ear - Hearing

- The ears have two main functions
  - i) Detection and analysis of sound.
  - ii) Maintenance of balance of the body.
- Ear has three main regions - the outer ear, the middle ear and the inner ear.
- External ear consists of pinna and external auditory canal.
- Pinna is a funnel shaped cartilaginous flap. It collects and directs sound waves into ear canal.
- The external canal ends at a delicate membranous diaphragm, called eardrum or tympanic membrane.
- The middle ear is an air-filled chamber. It communicates with that of the pharynx through an air filled tube called, Eustachian tube.
- Eustachian tube helps to equalize air pressure on either side of ear drum and thus allows it to vibrate freely, when sound waves impinge on it.
- The vibrating eardrum transmits the vibration to the ear ossicles. Ear ossicles consists of the hammer (malleus), the anvil (incus) and the strip (stapes). The stapes is the smallest bone in the body.

- The ossicles transmit the vibration to the inner ear, where they cause waves in the fluid called perilymph.
- Perilymph is filled in the coiled, tube called cochlea, in the middle ear.
- Cochlea is a tube coiled, like a small snail shell, of  $2\frac{1}{2}$  turns.
- The sensory structures respond to different frequency, found on basilar membrane is the rods or corti.
- The internal ear is made up of bony labyrinth and membranous labyrinth. The bony labyrinth contains a fluid called perilymph.

## Endocrine Glands & Hormones

- Largest endocrine gland - Thyroid.
  - Thyroid gland is popularly known as Adam's Apple.
  - Hormones are chemical substances produced by endocrine glands (ductless glands).
  - Endocrine hormone molecules are secreted (released) directly into the bloodstream, whereas exocrine hormones (or ectohormones) are secreted directly into a duct, and, from the duct, they flow either into the bloodstream or from cell to cell by diffusion in a process known as paracrine signalling.
  - Glands are the organs of the human body which manufacture some liquid products which are secreted from the cells.
- Largest gland in our body is the liver.

Types of glands - There are two types of glands

i. Ducted glands - exocrine glands, ii. Ductless glands - endocrine glands.

- Deficiency of **Parathyroid hormone (PTH)** secreted by parathyroid gland causes tetany in which calcium level in blood decreases.
- **Adrenal glands** are situated over the kidneys.
- Adrenal gland has two parts, *Adrenal cortex* and *Adrenal medulla*.
- Blood pressure is controlled by **Adrenal gland**
- Adrenal medulla produces two hormones- **adrenalin** and **nor-adrenalin**.
- Adrenal gland prepares the animal to fight or flight.
- Adrenaline hormone raises the rate of heart beat and blood pressure.
- The hormone secreted when a man gets feared is adrenaline.
- Deficiency of insulin leads to excess sugar in the blood and this sugar is excreted in the urine. This disease is known as **diabetes mellitus** (hyper glycaemia)
- The main function of insulin is to control the level of sugar in the body.
- **Pituitary gland** is an endocrine gland attached to the base of the brain.
- The pituitary gland is called '**the master gland**' in the body because it controls all other endocrine glands present in the human body.
- Water balance in the body is

mainly controlled by the secretion of ADH (Anti Diuretic Hormone) by hypothalamus

### Endocrine and Exocrine System

The secretions which the endocrine glands produce, do not leave the gland through a duct but pass directly from the cells to the blood stream.

- ❑ The organ in the body which accumulates iodine is thyroid gland.
- ❑ Insufficient iodine in the diet results in the deficiency of the thyroid hormone, thyroxine.
- ❑ Thyroxine deficiency in body results in a disease called simple goitre.
- ❑ Pancreas is an endocrine gland that produces both an enzyme and a hormone.
- ❑ The pituitary gland is called 'the master gland' in the body because it controls all other endocrine glands present in the human body.
- ❑ Water balance in the body is mainly controlled by the secretion of ADH (Anti Diuretic Hormone) by hypothalamus.
- ❑ The normal value of blood sugar is 80 to 120mg 100 ml of blood.
- ❑ Insulin prepared outside the body is known as Huminsulin.
- ❑ Thymus is another endocrine gland situated in front of the trachea. Thymus secretes a juvenile hormone, Thymosin.
- ❑ Thymus gland becomes fully developed by about 7 years and degenerates and disappears after 14 years of age because of the activities of the sex glands.

### Sex chromosomes

In human beings sex chromosomes XX is present in females and sex chromosomes XY is present in males. When X of female joins X of male chromosomes the product will be a female baby (XX) and when X of female joins Y chromosome of a male, the product will be male baby (XY). That is the sex determination of a baby is dependent on sex chromosome of man.

- ❑ Pineal gland is another endocrine gland situated in brain. Pineal gland secretes the hormone melatonin and serotonin. Pineal gland is also known as 'Biological clock'.

### Exocrine Glands - Ducted Glands

- ❑ Exocrine glands secrete their product through well defined ducts.
- ❑ Liver is an exocrine gland, secretes bile in stomach.
- ❑ Lachrymal gland secrete tears in the eye.
- ❑ Salivary glands secrete saliva in the mouth.
- ❑ Sweat glands seen on skin, secrete sweat.
- ❑ Sweat is a mixture of sodium chloride and Urea.
- ❑ Spleen is the largest lymphatic gland in human body.

### Enzymes

- ❑ Enzymes are complex chemical substances consisting, wholly or in a large part, of proteins produced in the living cells.
- ❑ Enzymes are proteins that catalyze chemical reactions.
- ❑ Some enzymes are used commercially, for example, in the synthesis of antibiotics. Some household products use enzymes to speed up biochemical reactions

- ❑ Coenzymes are small organic molecules that transport chemical groups from one enzyme to another.

### Muscular Tissue

- ⊛ It is a contractile tissue consisting of very large cells. The unit of muscle tissue is muscle fibre, which is made of myofilaments.
- ⊛ Based on structural and functional differences three types of muscles are recognised. Unstriated muscles, Striated muscle and Cardiac muscle.

### Reproduction

- Reproduction is a process by which an organism produces new individuals or offsprings of its own species.
- Sexual reproduction requires **one individual of each sex**.
- ❑ Testis is the sperm producing organ of man.
- The average period of **human pregnancy is 36-38 weeks** - approximately 280 days
- Mother's milk contain 7% of lactose.
- ❑ The part of the body that comes out first during delivery - head
- Identical twins are formed, when the ovum after fertilization splits into two parts.

- ❑ Vasectomy - Sterilization process in male.
- ❑ Tubectomy - Sterilization process in female.
- ❑ Five principal methods of asexual reproduction are: binary fission, multiple fission, fragmentation, budding and sporulation.

### Human Reproductive System

- ❑ In the human reproductive process, two kinds of sex cells, or gametes, are involved. The male gamete, or sperm, and the female gamete, the egg or ovum, meet in the female's reproductive system to create a new individual. Both the male and female reproductive systems are essential for reproduction.
- ❑ The organs which perform important functions in reproduction but neither produce gametes nor secrete sex hormones are called secondary sex organs.
- ❑ Secondary sex organs include the prostate, seminal vesicles, vas deferens and penis, in males. In females, secondary sex organs include fallopian tubes, uterus, vagina and mammary glands.
- ❑ Extra-abdominal testes are the testes of human males.
- ❑ Testes is the male reproductive organ. The sperms are produced by spermatogonia.
- ❑ The male sex hormone, testosterone, is produced by Leydig cells.
- ❑ The copulatory organ in male is the Penis.
- ❑ Female reproductive system consists of a pair of ovaries, a pair of oviducts, the uterus, the

vagina, accessory genital glands and the mammary glands.

- ❑ Graffian follicle produce a hormone estrogen.
- ❑ The external genital organs of females are collectively called vulva. Clitoris is the vestigial penis in female.
- ❑ Important sexual hormones of females include estrogen and progesterone.
- ❑ An important sexual hormone of males is androgen, and particularly testosterone.
- ❑ When the male ejaculates during intercourse, semen is deposited into the female's vagina. From the vagina the sperm make their way up through the cervix and move through the uterus with help from uterine contractions. If a mature egg is in one of the female's fallopian tubes, a single sperm may penetrate it, and fertilization, or conception, occurs.

### Bones

- ❑ Human skeleton is made of bones and cartilages.
- Largest and longest bone is **femur** (thigh bone).
- ❑ The shortest bone in the human body is stapes or stirrup bone in the middle ear.
- Human bones are made up of Calcium phosphate and Calcium carbonate.
- The total number of bones in human skull is 29.
- The total number of bones in an adult human body is 206.
- A new born baby has 300 bones, but 94 bones fuse together as it grows.

- There are 24 ribs in human body.
- The total number of ear bones are six.
- In an adult human being, the number of vertebrae is 26. Neck region of human has 7 bones.
- The face of a man is made up of 14 bones.
- Phosphate of lime forms 51% of bone.
- The bones contain calcium phosphates upto 85%
- The smallest bone in the human body is the stapes (stirrup) found in the middle ear.
- Bone marrow contains the parent cells that give rise to blood cells.
- '**Funny Bone**' is a nerve at the back of the elbow.
- Cranium is the Brain box that encloses brain
- Ethmoid is the bone of Nasal chamber
- ❑ The total number of bones in the skull is 29.

### Disorders of Bone

- ❑ The bones of aged persons are more fragile than the bones of young persons.
- ❑ The breaking of a bone is known as fracture.
- ❑ When the person feels acute pain at the joints, particularly while moving the joints, is referred to as arthritis.
- ❑ Osteoarthritis is commonly known as "wear and tear" arthritis.
- ❑ Osteoporosis is another bone disorder common in woman over 50 years, and is characterised by decreased bone mass and increased susceptibility to fractures.

## Teeth

- There are 20 milk teeth in human body.
- A full set of permanent teeth consists of 32 teeth.
- The hardest material found in human body is **enamel**.
- Milk teeth appear by the age of 7 months, adult teeth appear from 6th year onwards and wisdom teeth appear between the ages of 17-30 years.
- **Fluorides** are the compounds that prevent tooth decay.
- One of the ingredients of tooth paste is **calcium fluoride**.
- **Enamel** is the hardest substance in the body.

## Skin

- Skin is the largest organ in human body.
- Colour of the skin is due to the presence of **melanin**.
- The main function of human skin is protection and excretion.
- Perspiration is an usual way

## Important Vaccines

<i>Vaccine</i>	<i>Name of the Scientist</i>
Small pox	Edward Jenner (1786)
Cholera	Louis Pasteur (1880)
Diphtheria and tetanus	Emil Adolf Von Belming and Shiba saburo kita sato.
TB Vaccine	Leon Calmatte and Camille Guerin.
Polio Vaccine	Jonas E. Salk
Measles Vaccine	John F. Enders

## National Research Institutes in India

Central Drug Research Institute	Lucknow (U.P)
Cattle Breeding Research Institute	Hissar (Haryana)
National Dairy Research Institute	Karnal (Haryana)
Forest Research Institute	Dehradun (U.P)
Centre for Cellular and Molecular biology	Hyderabad
Indian Cancer Research Centre	Mumbai
Central Marine Research Institute	Chennai
Central Public Health Engineering Research Institute	Nagpur
National Institute of Communicable Diseases	Delhi

of the body to maintain the body temperature. Sweat glands help to eliminate excess heat from body.

- **Dermatology** is the branch of science that deals with the study of skin and its diseases.

## Genetics

- **Genetic engineering** is the branch of Science.
- **Genetics** is the science of genes, heredity, and variation in living organisms.
- A **gene** is the fundamental biological unit which is transmitted from one generation to the next. It is the unit of heredity. It remains at a definite position on a chromosome. In man about 1,00,000 genes are known to be found in 23 pairs of chromosomes.
- **Genetics** deals with heredity and the laws that govern it. **Rev. Gregor Mendel is the 'Father of Modern Genetics.'**
- **Mutation** is the process of sudden heritable change undergone in a gene due to change in its composition.
  - ▶ Mutation is **a change that is inherited**
- DNA (Deoxyribo nucleic acid) is the principal genetic material of all living beings.
- The structure of DNA molecule was discovered by **Watson and Crick** in 1953.
- Recombinant DNA involves transplanting a piece of DNA of one organism to the DNA of another, which finds application in the production of Interferon and Insulin.
- DNA has a double helical structure of nucleotide chains consisting of deoxyribose sugar and nitrogen bases- Adenine, Guanine, Thymine and Cytosine. It stores and transfers hereditary information and creates its own replica.

### Father of Modern Genetics

Rev. Gregor Mendel was the Augustinian priest and scientist. The theories of heredity attributed to Gregor Mendel, based on his work with pea plants.

**Experiments with Plant Hybrids**, in which Mendel described how traits were inherited, has become one of the most enduring and influential publications in the history of science.

Mendel's study showed that one in four pea plants had purebred recessive alleles, two out of four were hybrid and one out of four were purebred dominant. His experiments brought forth two generalizations, the Law of Segregation and the Law of Independent Assortment, which later became known as Mendel's Laws of Inheritance.



- The nitrogen base Thymine in DNA is replaced by Uracil in RNA.
- RNA has sub-species m-RNA and t-RNA, which carries the stored information of the DNA for translation into various proteins.
- In protein synthesis, the genetic code is carried from the DNA of the nucleus to the ribosomes of the cytoplasm by m-RNA.
- DNA fingerprinting has helped to solve many mysteries and crimes.
- The number of chromosomes in a human cell is 46.
- Presence of an extra chromosome in the foetus - **mongolism**.
- The Bacteria which receives genes from another species is called Transgenic bacteria.
- The genes transfer from one species to another species through **Plasmids**.
- The gene with Bt.Toxin is isolated from Bacillus Thuringiensis's Bacteria.
- Bt. Cotton is the cotton plant with Bt.Toxin gene.

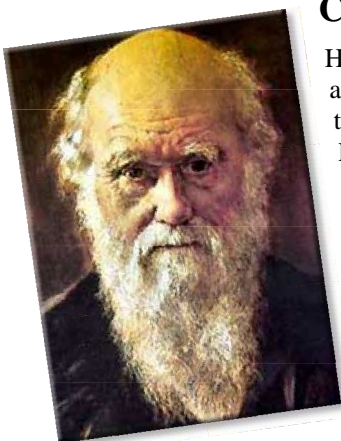
### DNA testing

DNA testing is used for identification of individuals on the basis of their respective DNA profiles. It is also used for parental testing and rape investigation. Although 99.9% of human DNA sequences are the same in every person, enough of the DNA is different to distinguish one individual from another. The DNA testing technique was first reported in 1984 by Sir Alec Jeffreys in England. Jeffrey's technique of **DNA fingerprinting** is now used to identify criminals in forensic laboratories. It is also used to determine paternity or maternity, that is who the true biological father or mother of a child.



## ECOLOGY

- ❑ Ecology is the scientific study of the relation of plants and living organisms to each other and their surroundings.
- ❑ Ecology is closely related to the disciplines of physiology, evolution, genetics and behavior.
- ❑ Biodiversity describes all varieties of life from genes to ecosystems and spans every level of biological organization.
- ❑ An ecosystem is the largest functional unit in ecology because it includes both living (biotic) and non-living (abiotic) environments.
- ❑ June 5 is considered as World Environment Day.
- ❑ Ecomark is given to environment friendly products of BIS (Bureau of Indian Standards)
- ❑ Ecological friendly tourism is termed ecotourism.
- ❑ Prof. R. Mishra is called as 'Father of Ecology in India'.
- ❑ The rich source of energy which never causes atmospheric pollution is solar energy.
- ❑ The conditions under which an organism lives constitute its environment. A few physical factors that greatly influence the environment are Light, Temperature, water and gases.
- ❑ A biome is a unit resulting from the interaction of a regional climate, animal and plant life and substrate. The types of biome are grasslands, deserts, coniferous forests, deciduous forests, tropical forests, tundra, fresh water and marine environment.



## Charles Darwin

He discovered a hypothesis for the origin and continuation of life on Earth. His theory is also called the Theory of Evolution. Charles Darwin became famous when he hypothesized that all life evolved from common ancestors through evolutionary processes of natural selection. Darwin is the first of the evolutionary biologists, the originator of the concept of natural selection – Theory of Natural Selection.

Charles Darwin collected a large number of specimens and concluded that the Species arose as a result of natural selection. He published his theory in his book *On the Origin of Species (1859)*. "*The Voyage of the Beagle*" - another important book. "In the struggle for survival, the fittest win out at the expense of their rivals because they succeed in adapting themselves best to their environment" - Charles Darwin.

- ❑ There are six major air pollutants: carbon monoxide, sulphur oxides, nitrogen oxides, particulates, hydrocarbons and photochemical oxidants.
- The mode of transfer of energy of food synthesised in plants through a series of organisms of an ecosystem with repeated eating and being eaten is known as **food chain**.
- The rich source of energy which never causes atmospheric pollution is **solar energy**.
- The interlocking of many food chains is called 'food web'.
  - ▶ A simple sequence in which the grass grows, a cow eats the grass, a human eats the cow or drinks its milk, is an example of **food chain**
- B.O.D means Biological Oxygen Demand. The estimation of B.O.D gives an idea of the amount of pollution in water.
- B.O.D is measured as the weight (in mg) of oxygen that is consumed in 1 litre of water stored for 5 days in darkness at a constant temperature of 20°C.
- Water pollution is caused by sewage, sullage and industrial effluents.
- ❑ The mass death of living organisms including man in one night at Bhopal (1984), was due to the leakage of methyl isocyanate (toxic gas) into the air from an insecticide plant managed by Union Carbide.
- Environmental planning organisation is NEERI. NEERI is National Environment Engineering Research Institute. It is in Nagpur.
- First Earth Summit (1992) at Rio

de Janerio (Brazil) was related to conservation of genetic resources of plants and animals.

- Second Earth Summit (2002) at Johannesburg (South Africa).
- Petroleum, coal, fossil fuel etc are non-renewable sources.
- Domestic wastes contain biodegradable pollutants.
- Most hazardous metal pollutant of the automobile exhaust is lead. Unleaded petrol is free of lead.
- Biomass is a renewable source of energy.
- Ultra Violet rays are non-ionising radiations damaging to DNA.
- Nuclear radiations may cause **cataract**, an eye disease.
- Strontium-90 ( $Sr^{90}$ ) causes leukaemia (blood cancer).
- Radiation causes leukaemia.
- CSE – Centre for Science and Environment

## Origin & Evolution

- ✱ Life was present on the earth about 3.9 billion years ago. Theories :-
- (i) Special creation : This idea embodies that life on Earth is divine creation.
- (ii) Spontaneous generation : According to this theory, life originates spontaneously from lifeless matter i.e. abiogenesis. However this idea has been put to rest when Louis Pasteur

## Global warming

Global Warming is the increase of the average temperature on Earth. As the Earth is getting hotter, disasters like hurricanes, droughts and floods are getting more frequent. It happens when greenhouse gases (carbon dioxide, water vapor, nitrous oxide, and methane) trap heat and light from the sun in the earth's atmosphere, which increases the temperature. Over the last 100 years, the average air temperature near the Earth's surface has risen by a little less than 1 degree Celsius or 1.3 degrees Fahrenheit.

Increase of one degree Celsius makes the earth warmer now than it has been for at least a thousand years. The top 11 warmest years on record have all been in the last 13 years, said NASA in 2007, and the first half of 2010 has already gone down in history as the hottest ever recorded.

Projections from the UN climate change body the Intergovernmental Panel on Climate Change (IPCC) say that global surface temperature will probably rise a further 1.1 to 6.4 degrees Celsius (2.0 to 11.5 degrees Fahrenheit) during the 21st century.



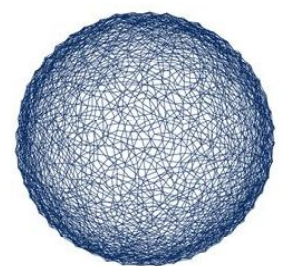
provided proof that micro-organisms come only from other micro-organism.

- (iii) Cosmic origin : This notion advocates that life could have originated once or several times in various part of galaxy in universe.
- (iv) Terrestrial or Biogenic origin : This idea holds that life arose by series of sequential chemical reactions. This is modern concept.

## Greenhouse Effect

Greenhouse gases heat up our planet. They are part of Earth's atmosphere and trap warmth emitted by the sun, thus heating Earth. It is this process – the greenhouse effect – that makes life on the planet possible. Natural greenhouse gases like carbon dioxide, methane, and nitrous oxide have always been in the atmosphere. Without them, the world's average surface temperature would be a chilly -18 degrees Celsius. However, we enjoy an average temperature of 14 degrees.

Tall grass grasslands of North America .....	Prairie
Short grass grass lands .....	Plains
Plants of deserts .....	Xerophytes
Coniferous forests .....	Boreal forests (Taiga)
Trees those shed their leaves .....	Deciduous
Tropical forests .....	Evergreen Rain forests.
Tundra .....	Treeless



**COP15  
COPENHAGEN**  
UN CLIMATE CHANGE CONFERENCE 2009

## Kopenhagen Summit

The 2009 United Nations Climate Change Conference, commonly known as the Copenhagen Summit, was held at the Bella Center in Copenhagen, Denmark. This was the 15th Conference of the Parties (COP 15) to the United Nations Framework Convention on Climate Change and the 5th Meeting of the Parties (MOP 5) to the Kyoto Protocol. The Copenhagen Accord is a significant first step in engaging the world's largest emitters in the global effort to slash carbon emissions.

The Copenhagen Accord was drafted by the US, China, India, Brazil and South Africa. Accord is not legally binding and does not commit countries to agree to a binding successor to the Kyoto Protocol, whose present round ends in 2012.

### Kyoto protocol

The Kyoto Protocol is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC or FCCC), aimed at fighting global warming. The UNFCCC is an international environmental treaty. The Protocol was initially adopted on 11 December 1997 in Kyoto, Japan. The target agreed upon was an average reduction of 5.2% from 1990 levels by the year 2012.

### Radiation Pollution

Nuclear fuel cycle, combustion of coal, accidents in nuclear power plants, medical therapy and diagnosis, scientific research, detonation of nuclear weapons in testing and war, television sets are sources of radiation. Foetuses are more sensitive to radiation. Cancer may be increased by ionising radiation.

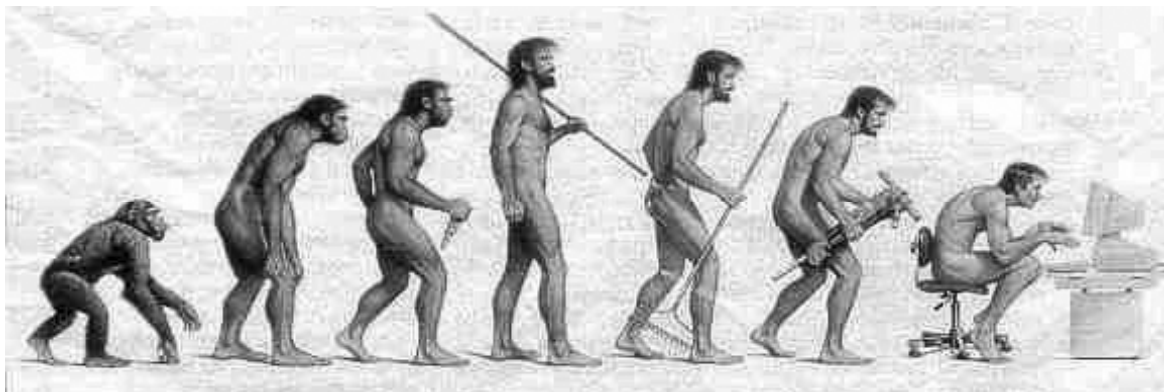
- ✳ Ozone layer filters out solar ultraviolet radiation which is harmful to most animal and plant life. 90% of ozone resides in stratosphere.
- ✳ One chlorine atom can destroy about 1,00,000 ozone molecules.
- ✳ Tetraethyl lead and tetramethyl lead are used in automobiles as anti-knocking agent.
- ✳ Lead,  $\text{SO}_2$ ,  $\text{NO}_2$  and CO impedes oxygen transport by

combining with Hb.

- ✳ The effect of particulate matter depends on the size and fate of particles on our body.
- ✳ The effect of gaseous pollutant depends on their solubility in water.
- ✳  $\text{NO}_2$  at high concentrations impairs functioning of lungs by accumulating water in air spaces.
- ✳ Polluted air cause respiratory disorders such as bronchitis, emphysema and lung cancer especially in children.
- ✳ Fluorides destroy leaf tissues.
- ✳ Oxides of Nitrogen and fluoride reduce crop yields.
- ✳ Hydrocarbon such as ethylene causes premature falling of leaf, flower bud and curling of petals.
- ✳ Smaller particles are separated from harmless gases by cyclone collector or electrostatic precipitator.

- ✳ The most important method of conversion of pollutant is oxidation in air.
- ✳ Sewage waste are always rich in bacteria and organic substrate.
- ✳ In organic nitrates and phosphates stimulate excessive plant growth in lake.
- ✳ The organochlorides in pesticides are highly persistent and pass through food chain. They accumulate in fatty tissue and affect the nervous system.
- ✳ Change in colour is a very common effect produced by dyes, inorganic substances like chromium and iron compound.
- ✳ Noise is physical form of pollution.
- ✳ Kyoto protocol - To reduce the emissions of Green House Gases (GHGs)
- ✳ Montreal Protocol - To keep ozone layer intact (To reduce CFCs)
- ✳ Cartagena Protocol - To preserve bio diversity & Biosafety protocols
- ✳ Stockholm convention - To reduce the use of POPs (Persistent Organic Pollutants) or Dirty Dozen

## Evolution of Man



- ✧ Apes are represented by gibbons, orangutans, chimpanzees, and gorillas.
- ✧ 'Homo sapiens' appeared in either Africa or Asia 5,00,000 years back and spread out. Today no other species is as widely distributed as animals.
- ✧ Neanderthal specimen of man is excavated from Neander Valley of Germany. The Neanderthals lived 100,000 to 30,000 years ago. They were the typical cave humans, short with heavy brows, retreating foreheads, large jaws, a lumbering gait and stooped posture. They wore clothing and were good hunters.
- ✧ 'Cro - magnon' man bears the closest resemblance to modern man. He was completely erect, and 6 feet tall. He belonged to Stone Age. He is the most recent pre-historic man.
- ✧ Dryopithecus, Ramapithecus, Australopithecus, and Homo erectus are prehuman types, ranging from 20 million years to 12 million years back.
- ✧ The fossil record of humans and other primates is incomplete.
- ✧ Modern man and apes are recent products of evolution and both are thought to have descended from a common extinct ancestral form. The view that humans evolved from apes has been invalidated.
- ✧ Primates are members of the order of mammals that includes monkeys, apes and human (together called anthropoids) as well as lemurs, lorises and tarsiers, (together called prosimians)
- ✧ Generally they have forward directed eyes, gripping hands and feet opposable thumbs and big toes. They tend to have nails rather than claws with gripping pads on the ends of the digits, all adaptations to the climbing mode of life.
- ✧ Ramapithecus : Extreme reduction of canines, modification of the chewing teeth, to be much stronger. Development of bipedalism :- walking on two feet, and than an erect posture and free hands. Terrestrial living and balance of head on the spinal column. Terrestrial gathering economy.
- ✧ Australopithecus :- Walked erect with a curved back Larger size of brain barrel like trunk with robust build. Meat eaters and gathers, but still not hunters but scavenger.
- ✧ Homo erectus : More rounded head, 5 feet in height and had strong bones. Made stone tools, started hunting 'Domesticated' fire.
- ✧ Homo Sapiens : More strengthened chewing muscles more developed brain (all lobes developed). Humans, known taxonomically as Homo sapiens.
- Anatomically modern humans originated in Africa about 200,000 years ago, reaching full behavioral modernity around 50,000 years ago.
- The study of human evolution encompasses many scientific disciplines, including physical anthropology, primatology, archaeology, linguistics and genetics.



## Medical Science

### Pharmacy

- **Small pox** was the disease that led to the discovery of first antiviral vaccine.
- Small pox is the only disease totally eradicated in 1980 throughout the world by vaccination.
- **Tetracyclins** (antibiotics) helps to cure trachoma, an eye disease.
- Antibiotics are the drugs which are produced by bacteria and which act against other strains of bacteria.  
*e.g. penicillin, streptomycin, chloromycin.*
- **Antihistamines** are the substances that relieve the symptoms of asthma, hay fever and other allergies.
- Antipyretics are the drugs used medically to lower body temperature.
- Leprosy is also known as **Hansen's disease**.
- The vaccine, **triple antigen** is given to children to immunise them against **Diphtheria, Pertussis (whooping cough)** and **Tetanus**.
- **Quinine** is an alkaloid that cures malaria.
- Quinine is extracted from the tree '*Cinchona officinalis*.'
- Azidothymidine (AZT) is a drug used to combat AIDS.
- To prevent polio, two vaccines Sabin (oral) and Salk (injectable) vaccine are offered.
- A drug that prevents infection and decay is called an anti-septic.
- LSD (lysergic acid diethyla-

mide) is a hallucinogenic drug.

- Eldepyl is a new wonder drug to treat Parkinson's disease (a neurodegenerative disease).
- Aspirin (i.e., *Acetyl Salicylic Acid*) is commonly used as a pain reliever.
- The chief ingredient of the mosquito repellent cream is derived from neem plant.
- B.C.G. (*Bacillus Calmette Guérine*) Vaccine is administered to prevent **tuberculosis**.
- **Tranquillizers** are drugs to calm the nervous system and prevent tension and worry while sedatives are drugs used to induce sleep.
- **Shanvac-B** is India's first indigenous genetically engineered Hepatitis - B vaccine
- **Viagra** is a tablet for stimulating sex potential.
- Morphine works as an analgesic drug and is classified as narcotics.
- An antibiotic is a substance produced by a living organism, especially a bacterium or a fungus.
- Penicillin is produced from fungus known as *Penicillium notatum*.
- CP-20-961 is a malarial vaccine.

### Diseases and Treatments

- Avian influenza virus is responsible for contagious disease "Avian flu" affecting birds.
- Avian flu is due to the mutated genes of  $H_5N_1$  virus.
- SARS is severe Acute Respiratory Syndrome.

■ *Euthanasia means mercy killing*. It was first introduced legally in **Netherlands** and in **Belgium** second time.

- Computer Axial Tomograph (CAT) scan is used for photographing a selected plain of the human body using X-rays for diagnosing the cause of a disease.
- CAT Scan is also known as CT Scan.
- CAT scanner was invented by Godfrey Hounsfield.
- MRI-Scan means Magnetic Resonance Imaging Scan.
- PET Scan is Positron Emission Tomography scan. It is used for studying brain.
- Otoloscope is an instrument used for examining the outer ear and ear drum.
- Physiotherapy is the treatment of diseases or disabilities by massaging and exercise.

### Cancer

- Uncontrolled growth of cell, which can be caused by Oncogenes are cancers.
- A biopsy is done in order to detect the presence of cancer.
- Biopsy means examination of tissue cut from living body.
- Lithotripter is the machine used to break up kidney stones by ultra sound waves.
- Oral Rehydration Therapy (ORT) is useful in combating cholera, dysentery and gastroenteritis.
- In medicine, radioactive isotopes are used as tracers for diagnostic purposes.



## Diseases and Affected Organs

Osteomyelitis .....	Vertebral column
Polio .....	Central nervous system
Malaria .....	RBC
Meningitis .....	brain and spinal cord
Typhoid .....	Intestine, whole body
Diphtheria .....	throat
Bright's disease .....	kidney
Eczema .....	skin
Hepatitis .....	liver
Jaundice .....	liver
Tuberculosis .....	lungs
Pneumonia .....	lungs
Gingivitis, pyorrhoea .....	gums
Goitre .....	thyroid
Trachoma .....	eyes
Arthritis .....	joints

- Arsenic - 74 is used to detect tumours.
- Sodium - 24 is incorporated into salt (NaCl) and used to detect the presence of blood clots in the circulatory system.
- Cobalt-60 is used in treatment of cancer.
- China is famous for the mode of medical treatment called Acupuncture.
- Anaemia is the shortage of haemoglobin in blood.
- The number one killer diseases in the world are tuberculosis and cardiovascular disease respectively.
- Pneumonia, gonorrhoea, tuberculosis, tetanus (or lock-jaw), botulism, syphilis, typhoid, cholera, leprosy, plague, whooping cough *etc* are **bacterial diseases**.
- Chickenpox, rubeola (German measles), measles, mumps, influenza, common cold, AIDS, hepatitis, polio and rabies are **viral diseases**.
- **Protozoans** cause amoebic dysentery, malaria, African sleeping sickness, Kala-azar etc..
- Fungi causes athlete's foot and ringworm.
- Haemophilia, sickle cell anaemia and Huntington's disease (It is a hereditary disease resulting in the involuntary movement of body parts.) are congenital diseases (ie, present at birth).
- Diphtheria is a disease of throat.
- **D.P.T. Vaccine (Triple Vaccine)** is used to prevent diphtheria, pertussis or whooping cough and tetanus.
- Rubeola is the medical name of the disease measles.
- Elephantiasis is caused by the nematode 'Wuchereria bancrofti'.
- The vector of the disease filariasis (elephantiasis) is culex mosquito.
- **Contagious diseases** are diseases which spread from one person to another by physical contact.
- **Infectious diseases** are diseases caused by a specific organism and spread through air, water, food, etc.
- The loss of elasticity of muscles results in a disease called Parkinson's disease. It was invented by an English surgeon namely James Parkinson.
- **Malaria** is caused by Plasmodium vivax.
- **Malaria** is spread by female anopheles mosquitoes and it affects the RBC.
- **Plague** is spread by rat fleas.
- **Dengue fever** is spread by Aedes aegypti mosquitoes.
- **Tuberculosis, Smallpox and Influenza** are diseases that spread through air.
- Tuberculosis is known as 'White Plague.'
- Tetanus can cause lock jaw.
- Cholera, typhoid, dysentery and diarrhoea are water borne diseases.
- Exophthalmic goitre is known as grave's disease.
- Disease causing microorganisms are called **pathogens**.
- The virus which attack bacteria is called bacteriophage.
- Arthritis and rheumatism affect the joints.
- Hydrophobia is a disease caused by the bite of a mad dog. It is commonly known as rabies. It can be prevented by injections discovered by Louis

- Pasteur. Injections are known as ARV (Anti-Rabies Venom).
- Rabies is caused by a virus, and it affects the nerve cells of the brain.
  - **Alzheimer's disease** Amyloid beta ( $A\beta$ ) deposits are the fundamental cause of this disease.
  - Trypanosomiasis is transmitted from animal to man by the tse-tse fly and causes the dreaded disease sleeping sickness. Kala-azar (Leishmaniasis) is transmitted by sandflies.
  - Hypothermia is the loss of body heat (below  $31.7^{\circ}\text{C}$ ).
  - People living in hilly areas suffer from goitre because of the lack of iodine in diet and drinking water.
  - Minamata disease resulting from mercury poisoning causes brain damage, birth defects and death.
  - Virus is responsible for common cold, the disease which affects largest number of people in the world.

### Miscellaneous

- Antigen is a substance which

### Common Drugs

<i>Anaesthetics</i>	Drugs that block sensory nerves and make a patient fully unconscious to prevent him from feeling pain.
<i>Analgesics</i>	Drugs used to prevent or relieve pain like aspirin.
<i>Antibiotics</i>	Drugs used to prevent growth of bacteria or other germs.
<i>Antihistamines</i>	These drugs are used to relieve symptoms of asthma, hay fever and other allergies.
<i>Antipyretics</i>	Drugs used to lower body temperature.
<i>Hormones</i>	Drugs used to combat hormone deficiency that cause diseases.
<i>Narcotics</i>	Drugs that deaden the nervous system and prevent a person from feeling pain.
<i>Sedatives</i>	Drugs used to induce sleep, like barbiturates and bromides.
<i>Tranquillizers</i>	Drugs that calm nervous system and prevent worry, tension etc.
<i>Vaccines</i>	Drugs that are injected to help the body to develop resistance to disease or immunization of the body.

- stimulates the formation of antibodies.
- A colour-blind person has difficulty in distinguishing between green and red colour. This disease mainly affects males.
- Hookworm enters the intestine by penetrating through the skin.
- Amnesia is related to the loss of memory.
- UV radiation also give us a suntan. But an excess is harmful and can cause skin cancer and damage to retina.
- Test tube baby refers to the phenomenon, where the fertilization is external and development is internal.
- World's first test tube baby Louise Brown was born on 25th July 1978.
- World health day is observed on April 7th.

### Important Digestive Enzymes

Amylase, (ptyalin)	Salivary glands in mouth	Starch to maltose
Pepsin	Gastric glands in stomach	Proteins to peptones
Trypsin	Pancreas in abdomen	Proteins to peptones
Amylase	Pancreas	Carbohydrate to maltose
Lipase	Pancreas	Fats to fatty acid and glycerol.
Erepsin	Intestinal glands in small intestine	Peptides to amino acids
Maltase	Intestinal glands	maltose to glucose
Lactase	Intestinal glands	lactose to glucose
Sucrase	Intestinal glands	sucrose to glucose.

## Agriculture

- The chemical contained in tobacco is nicotine in root.
- Quinine, Tannin and Cinnamon are obtained from the bark of the tree.
- Tea leaves contain 18% tannin.
- T x D and D x T are high yielding hybrid varieties of coconut.
- **Hybrid** is an animal or plant that has been bred from two different types of animals or plants.
- HYV means High Yielding Varieties.
- Foot and Mouth disease occurs in cattle, sheep and pigs.
- Cocoon stage of silkworm produces silk.
- Silk worms are reared on mulberry.
- The most important stimulant in coffee leaves is **caffeine**.
- Opium is extracted from the immature fruits of the plant poppy (**Papaver somniferum**).
- Paper is chemically cellulose.
- Sunflower oil has the maximum polyunsaturated fatty acids.
- Mint is propagated through *rhizomes*.
- For safe storage, the moisture contents of foodgrains should be less than 14%.
- The acid present in the soil and substances formed by the decomposition of decayed green matter is '**humic acid**.'

## Famous Botanical Gardens in India

Agri Horticultural Society of India, Alipore, Kolkata  
 Indian Botanical Gardens, Shibpur, Kolkata  
 Lalbagh, Bangalore, Karnataka  
 Government Botanical Gardens, Udagamandalam, Tamil Nadu  
 Jhansi Botanical Garden, Jhansi, Uttar Pradesh  
 Saharanpur Botanical Garden, Saharanpur, Uttar Pradesh  
 Lloyd's Botanical Garden, Darjeeling, West Bengal  
 Garden of Medicinal Plants, North Bengal University, West Bengal  
 Tropical Botanic Garden and Research Institute Palode Kerala

## Fertilizers

- Azolla acts as biofertilizer in association with the blue-green algae. It is used in the cultivation of rice.
- N.P.K. mixtures are fertilizers with the mixtures of nitrogen, phosphorus and potassium.
- **Nitrogen** helps in greening of plants and their rapid growth.
- **Phosphorous** helps in flowering of plants.
- **Potassium** helps in the fruit forming stage in plants.
- Salinity of soil can be neutralized by using pyrite and gypsum.
- Iron is an essential micro-nutrient required for the development of plants.
- Blue-Green algae works as a bio-fertilizer.
- Biologically and rapidly degraded in nature.
- Biological control of insects means control of insect population in exploitation of natural prey-predator relationship.
- D.D.T. (an insecticide) has a tendency to remain stable in environment for long periods.
- Bordeaux mixture is a fungicide.
- BHC is Benzene Hexa Chloride.
- Loss of agricultural productivity due to pests and diseases is about 30%.
- **Sporeine** is a bio insecticide. Sporeine was the first bio insecticide to be developed on a commercial scale.
- Natural insecticide 'azadirachtin' is obtained from Neem.
- The pesticide used in foundations of buildings for preventing, termite attack is 'Aldrin.'

## Pesticides

- Pesticides include insecticides, fungicides, nematocides, rodenticides and herbicides.
- D.D.T and Parathion pesticides are banned in most of the developed countries. Major drawback of D.D.T as a pesticide is that it is not eas-

## Forestry

- Turpentine oil is obtained from pinus tree.
- Sweet potato is a modification of adventitious roots.
- Plants and animals living in a given area form a **community**.

## Numbers in Human Body

Number of bones .....	206
Number of muscles .....	639
Number of ribs .....	24
Number of bones in skull .....	22
Number of bones in neck .....	7
Number of bones in face .....	14
Number of cranial nerves .....	12 pairs
Number of spinal nerves .....	31 pairs
Number of heart beat .....	70-72 times/minute
Respiratory rate .....	16-20 times/minute

- Rain forests occur in Western Ghat and Eastern Himalayas.
- **Herbarium** is a collection of 'preserved plants.'
- The 'Great Banyan Tree' is in Indian Botanical Garden Sibpur, Kolkata.
- Wild Life Protection Act was enacted in India in 1972.
- The threat of extinction of tigers forced the India government to initiate the 'Project Tiger' on April 1, 1973.
- In India, paper is mainly manufactured from Bamboos.
- Mango, Papaya, Banana, Guava, Pineapple, Mangosteens etc are included in tropical fruits.
- Silent valley is a conserved forest.
- Tropical rain forest is seen in Assam.
- Nicotine is a poisonous alkaloid present in Tobacco.
- Brazil is the native place of cashewnut.
- Rainforests occur in Western Ghat and Eastern Himalayas.
- 'Vanamahotsav' started in 1950.
- Chipko movement is connected with plant conservation.
- Botanical survey of India

Rate of blood pressure .....	120/80 mm. Hg.
Number of RBC's .....	in male - 5,000,000/Cu. m.m. in female - 45,000,000/Cu. m.m.
Life span of RBC .....	120 days
Life span of WBC .....	2-15 days
Amount of blood .....	5-6 litres
Average amount of haemoglobin ..	14-15 mg/100 ml blood
Weight of brain .....	1.4 kg.

### Test and Diseases

<i>Byopsi</i> .....	<i>Cancer</i>
<i>Lepromin Test</i> .....	<i>Leprosy</i>
<i>Eliza Test</i> .....	<i>Aids</i>
<i>Western Blot</i> .....	<i>Aids</i>
<i>Shik Test</i> .....	<i>Diphtheria</i>
<i>Tuberculin Test</i> .....	<i>Tuberculosis</i>
<i>Papsmear</i> .....	<i>Uterus Cancer</i>
<i>Glycocolated Haemoglobin</i> .....	<i>Diabetics</i>
<i>EEG</i> .....	<i>Brain Diseases</i>
<i>E.C.G</i> .....	<i>Heart Diseases</i>
<i>Mamography</i> .....	<i>Breast Cancer</i>
<i>Widal Test</i> .....	<i>Typhoid</i>
<i>Vasarman Test</i> .....	<i>Syphilis</i>

(BSI) with its head office in Kolkata came into existence in 1890.

- National Botanical Garden (National Botanical Research Institute, NBRI) is situated in Lucknow.

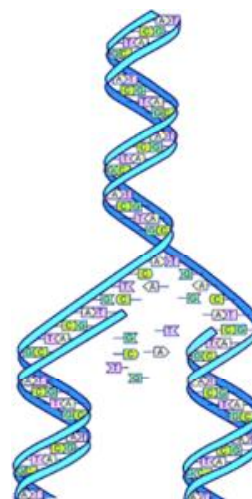
## Human Genome Project (HGP)

HGP was launched in 1988, with the Nobel laureate Dr. James D. Watson as the director and the project envisaged.

The Human Genome Project originally aimed to map the nucleotides contained in a human haploid reference genome (more than three billion).

Objective of the Human Genome Project is to understand the genetic makeup of the human species, the project has also focused on several other nonhuman organisms such as E. coli, the fruit fly, and the laboratory mouse.

Project identified and map the approximately 20,000–25,000 genes of the human genome from both a physical and functional standpoint.



## The Ramsar Convention

The Ramsar Convention is an international treaty for the conservation and sustainable utilisation of wetlands. Ramsar Convention (1971) was drafted at Ramsar, Iran. The headquarters is located in Gland, Switzerland.

**World Wetlands Day occurs on 2 February each year.**

<b>Tallest Animal</b> .....	<b>Giraffe</b>
<b>Largest Bird</b> .....	<b>Ostrich</b>
<b>Smallest Bird</b> .....	<b>Humming Bird</b>
<b>Largest snake</b> .....	<b>Anakonda</b>
<b>Largest Mammal</b> .....	<b>Blue Whales</b>
<b>Largest animal in land</b> .....	<b>African Elephant</b>
<b>Longest flying bird</b> .....	<b>Articturn</b>
<b>Largest Reptile</b> .....	<b>Crocodile</b>
<b>Fastest animal</b> .....	<b>Chetta</b>

## The Scientific Names

Indian elephant .....	<i>Elephas maxims</i>
Frog .....	<i>Rana hexadactyla</i>
Man .....	<i>Homo sapiens</i>
Cat .....	<i>Felix domesticus</i>
Hornbill .....	<i>Buseros bywrnis</i>
Peacock .....	<i>Pavo cristatus</i>
Tiger .....	<i>Panthera tigris</i>
Cockroach .....	<i>Periplaneta americana</i>
Earthworm .....	<i>Pheretima Posthuma</i>
Crow .....	<i>Corvus Splendens</i>
Parrot .....	<i>Psittacula krameri</i>
Penguin .....	<i>Aptenodytes forsteri</i>
Sparrow .....	<i>Passer domesticus</i>
Whale .....	<i>Balaenoptera indica</i>
Cow .....	<i>Bos indica</i>
Pig .....	<i>Sus scrofa</i>
Camel .....	<i>Camelus dromedarius</i>
Horse .....	<i>Equus caballus</i>
Donkey .....	<i>Equus asinus</i>
Rabbit .....	<i>Oryctolagus cuniculas</i>
Squirrel .....	<i>Funambulus pennanti</i>

## Cloning

- ❑ Cloning is the process of producing many identical organisms or clones (clone means exact carbon copy or copies of a single parent).
- ❑ It is the production of one individual organism from a nucleus, cell or asexual offshot or another.
- ❑ Ian Wilmut and his colleagues at the Roslin Research Institute in Scotland cloned the first sheep Dolly.
- ❑ The young one of Dolly, named Polly, was born in 1998.
- ❑ **Ian Wilmut** is considered as



the father of cloning.

- ❑ Carbon copy is the first cloned cat, in 2001, at Texas A and M university.
- ❑ Cell cloning is based on the property of totipotency ( in plant) or pluripotency ( in animals).
- ❑ Totipotency is a potential ability of plant cell to grow into complete plant. Pluripotency is the potential ability of an animal cell to develop into any type of cell in the animal body.

### Species cloned

Tadpole, Carp, Mice, Sheep, Rhesus Monkey, Gaur, Cattle, Cat, Dog, Rat, Mule, Horse, Water Buffalo and Camel.



# PHYSICS

**Physics is the study of the properties of matter and energy.**

## MOTION

- ▶ The length of the path between two points is the **distance** between them.
- ▶ Physical quantities that have only magnitude and no direction are called **scalar quantities**.

Eg: Distance, speed, time, work, mass, density, temperature etc.

- ▶ Physical quantities that have both magnitude and direction are called **vector quantities**.

Eg: Displacement, weight, velocity, acceleration etc.

- ▶ **Speed** is the distance travelled by a body in unit time. It is a scalar quantity. Its unit is m/s.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

- ▶ **Velocity** is the displacement per unit time. It is a vector quantity and its unit is m/s.

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$$

- ▶ **Acceleration** is the rate of change of velocity. It is a vector

quantity and its unit is  $\text{m/s}^2$ .

- ▶ A decrease in the velocity with time is called deceleration or retardation. It is otherwise known as negative acceleration.

- If the acceleration remains constant, i.e., it does not change with time it is said to be uniform acceleration.

- The earth attracts every-body towards its centre. The acceleration with which freely falling bodies are attracted towards the earth is called the acceleration due to gravity. It is same for all bodies and its value is  $9.81 \text{ m/s}^2$ .

- ▶ **Inertia** is the tendency of a body to continue in its state of rest or the state of uniform motion along a straight line.

- ▶ **Galileo** discovered law of inertia.

- ▶ An athlete runs some distance before taking a long jump, by running the athlete gives himself larger *inertia* of motion.

- ▶ As the train starts moving, a man sitting inside leans backwards because of inertia of rest.

- ▶ The branch of science which deals with the study of relative movement of interacting surfaces is called **tribology**.

- ▶ In order to increase stability, a person climbing a hill bends forward.

- ▶ The flying of birds is a consequence of Newton's third law of motion.

## Equations of Motion

- ▶ There exists some relation between velocity, acceleration and the time intervals during which we study the motion of a body. These relations are called equations of motion.

They are:

$$V = u + at$$

$$S = ut + \frac{1}{2} at^2$$

$$2as = v^2 - u^2$$

where  $v$  - final velocity

$u$  - initial velocity

$t$  - time interval

$a$  - uniform acceleration

$s$  - displacement

- ▶ The force required to stop a moving body depends on its mass and also on its velocity.
- ▶ Momentum ( $P$ ) is defined as the product of mass and velocity of a body i.e.,  $P = mv$

- ▶ Momentum is a vector quantity
- ▶ Unit of momentum is Kg m/s.

## FORCE

- ▶ Force is any influence that tends to change the state of rest or the uniform motion in a straight line of a body.
- ▶ Unit of force is **Newton**
- ▶ The force of attraction between like molecules is called cohesion.
- ▶ The force of attraction between *unlike* molecules is

called **adhesion**.

- ▶ Weight can be defined as the force with which earth attracts a body.

$$\text{Weight, } w = m \times g$$

- ▶ *Mass* remains constant while *weight* varies from place to place.
- ▶ **Friction** is a force that resists the movement of one surface over another.
- ▶ The force required by a revolving body is called centrip-

etal force.

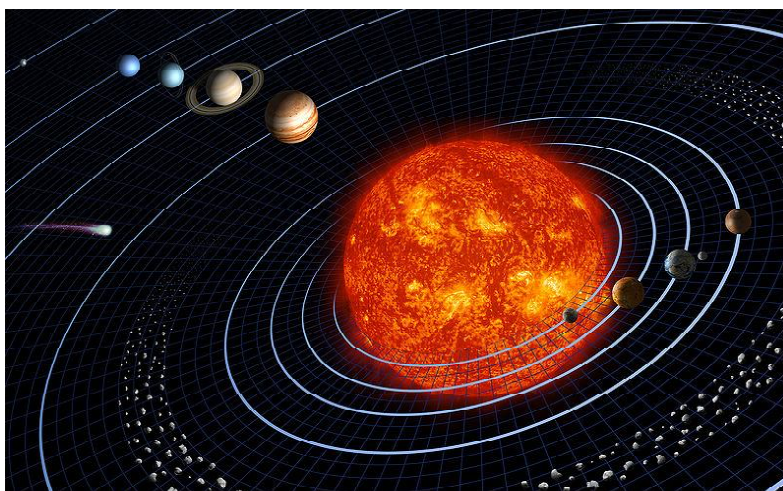
- ▶ Friction can be reduced by changing over from **sliding to rolling**
- ▶ When a man circles round the earth in a spacecraft, his **mass remains constant but weight becomes zero**
- ▶ Two object losing the same weight when immersed in water must have the same **density**
- ▶ **Centrifugal force** helps to separate cream from milk.

## GRAVITATION

- ▶ The attractive force of earth, or other celestial body, on an object is called gravity.
- ▶ The earth attracts everybody towards its centre. The acceleration with which the freely falling bodies are attracted towards the earth is called the acceleration due to gravity (g).

$$\text{Value of } g = 9.8 \text{ m/s}^2$$

- ▶ The value of g at the centre of earth is zero.
- ▶ The value of g is very high at polar region.
- ▶ The value of g is very small at equatorial region.
- ▶ The weight of a substance is zero at the centre of earth. As the mass of the substances increases the gravitational force between them also increases.
- ▶ The weight of a body in earth is very high in the polar



**Gravitation keeps the planets in orbit around the Sun.**

region and low in the equatorial region.

- ▶ The weight of a body on the moon will be less than its weight on the earth. This is so because the mass of the moon is  $\frac{1}{81}$  of the mass of the earth its radius is  $\frac{1}{3.66}$  of the radius

of the earth. Therefore, the acceleration due to gravity experienced on the moon will be less than the acceleration due to gravity experienced on the

earth. This will be about  $\frac{1}{6} g$ .

- ▶ On the moon an astronaut cannot drink lemonade with the help of a straw because - There is no atmosphere on the moon.

- ▶ The mass of a body which determines the gravitational force of attraction due to earth is called **gravitational mass**.
- ▶ **Escape velocity** is the minimum speed which a spacecraft must have to escape from the earth's gravitational force. It is 7 miles/s. (or 11.2 km/s)
- ▶ The escape velocity of a body is different and different celestial bodies.
- ▶ In the absence of an effective force of gravity, bodies become weightless in artificial satellites.
- ▶ Gravitational field is the space around a massive body in which gravitational force of attraction is felt.
- ▶ Planets move slower along their orbits when they are farthest from the sun (at apogee) and they move faster along their orbits when they are nearest to the sun (at perigee)
- ▶ Gravitation is responsible for keeping the Earth and the other planets in their orbits around the Sun; for keeping the Moon in its orbit around the Earth; for the formation of tides; for natural convection, by which fluid flow occurs under the influence of a density gradient and gravity; for heating the interiors of forming stars and planets to very high temperatures; and for various other phenomena observed on Earth.

- ▶ The line on earth's surface passing through the places having zero dip is called the magnetic equator. It passes through Thumba.

## VISCOSITY AND SURFACE TENSION

- ▶ Capillary action is responsible for the absorbance of water by the plants and oils by the wick of lamps.
- ▶ Fluids flow with zero viscosity is called *superfluids (anti-gravity property)*.
- ▶ The force within the liquid which opposes the relative motion of one layer over the other is called **viscosity**.
- ▶ Venturimeter is used for measuring the rate of flow of liquids.
- ▶ Viscosity is the internal fluid friction.
- ▶ Surface tension is the property possessed by a liquid surface whereby they appear to be covered by a thin elastic membrane.
- ▶ Surface tensions is caused by unbalanced molecular cohesive force.  
Unit of surface tension is N/m.
- ▶ When the temperature of fluids increases viscosity decreases.
- ▶ The surface tension decreases with rise of temperature.
- ▶ Surface tension is a property of a liquid by which the free surface of a liquid behaves like a stretched elastic membrane, having contractive tendency.
- ▶ The larger the surface, the more energy there is. To minimize energy, most fluids assume the shape with the

smallest surface area.

- ▶ The spherical shape of rain drops and mist drops are due to surface tension. The spherical shape is attained to maintain equilibrium.
- ▶ Soap bubbles also tend to form themselves into shapes with minimal surface area.
- ▶ Soap is added to water to reduce the surface tension, so clothes (or whatever else) get much cleaner.
- ▶ Water has a fairly low viscosity; things like shampoo or syrup have higher viscosities.
- ▶ Viscosity also depends on temperature : engine oil, for instance, is much less viscous at high temperatures than it is in a cold engine in the middle of winter.

## ELASTICITY

- ▶ **Elasticity** is the ability of a body to return to its original shape and size on the removal of the deforming force.
- ▶ Glass is more elastic than steel and steel is more elastic than rubber.
- ▶ If a body does not regain its original size and shape after the removal of deforming force, it is called a plastic body and this property is called **plasticity**.  
Eg: Clay, Plasticine etc.

## DENSITY & PRESSURE

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\text{Relative density} = \frac{\text{Density of a body}}{\text{Density of water}}$$

## Eye Opener

When a bird sits on a very high voltage cable without having any insulation cover on it, its feathers tend to spread out due to electrostatic repulsive force. i.e; feathers on either side of the bird become charged of like nature. (either both become positively charged or both become negatively charged). Hence repulsion takes place.

- ▶ The amount of water vapour in the air is termed as humidity.
- ▶ When a piece of ice floating on the surface of water in a bucket melts completely, the water level will remain the same.
- ▶ An iron nail floats on mercury but sinks in water because the specific density of iron is lower than that of mercury and higher than that of water.
- ▶ A petrol fire cannot be extinguished by throwing water on it since the density of water is more than the density of petrol, water sinks below the petrol when it is poured over a petrol fire.
- ▶ The density of sea water is higher than the density of river water, therefore it is easier to swim in the sea than in river. This is why a ship entering from river mouth to sea rises up a little.
- ▶ Ice floats on water because its weight is less than the weight of an equal volume of water.
- ▶ Ice floats on water but sinks in alcohol because the density of alcohol is lower than that of water.
- ▶ **The density of water is maximum at 4°C**
- ▶ The pressure at a point on a surface is the thrust acting normally per unit area around that point.

$$\text{Pressure} = \frac{\text{Thrust}}{\text{Area}} \text{ N/m}^2 \text{ or Pascal}$$

- ▶ The total normal force exerted by a fluid on a surface is called thrust. Its unit is Newton (N).
- ▶ Pressure increases with depth
- ▶ The pressure inside a barometer remains high under a calm climate.
- ▶ Mercury is used as the liquid in thermometers as it does not wet glass.
- ▶ **Pascal's law** states that pressure in a fluid in equilibrium is the same everywhere.
- ▶ Water distribution in cities, flush tank, hydraulic brake, hydraulic lift, hydraulic press etc are working based on Pascal's law.
- ▶ The lactometer used to test the purity of milk is based on the principle that the greater density of a liquid, the lesser will be the immersion of an object.

## WORK, ENERGY AND POWER

- ▶ Work refers to an activity involving a force and movement in the direction of the force. A force of 20 newtons pushing an object 5 meters in the direction of the force does 100 joules of work.
- ▶ Energy is the capacity for doing work. You must have energy



**Rock climbers do a lot of work at a slow rate; their power is small.**

to accomplish work - it is like the "currency" for performing work. To do 100 joules of work, you must expend 100 joules of energy.

- ▶ Power is the rate of doing work or the rate of using energy, which are numerically the same. If you do 100 joules of work in one second (using 100 joules of energy), the power is 100 watts.
- ▶ **Unit of energy is joule.**
- ▶ The energy possessed by a body due to its position in a field of force or configuration is called **potential energy**.

$$P.E = mgh$$

m = mass      g = gravity  
h = height (distance between the body and the surface)

- ▶ Energy of a body due to its motion is called **kinetic energy**.

$$\text{Kinetic energy} = \frac{1}{2}mv^2$$

(m = mass, v = velocity)

- ▶ The change in the kinetic energy of an object is equal to the net work done on the object.
- ▶ Mechanical energy can be either kinetic energy (energy of motion) or potential energy (stored energy of position). Objects have mechanical



energy if they are in motion and/or if they are at some position relative to a zero potential energy position

- ▶ Rate of doing work is called power. Its unit is watt

$$Power = \frac{work}{time}$$

- ▶ Escape velocity is the velocity with which a projectile must be projected in order that it may escape the earth's gravitational pull.
- ▶ The escape velocity from the surface of the earth is 11.2 kms
- ▶ The escape velocity from the planet, Jupiter is 61 km/second. For Mercury it is 42 km/second.
- ▶ According to **law of conservation of energy of Albert Einstein**, energy can neither be created nor be destroyed but it may be transformed from one form to another.
- ▶ The energy possessed by the water collected in the reservoir of a dam is **potential energy**
- ▶ When a force acts upon an object causes a displacement then, it is said that work was done upon that object.
- ▶ There are three key ingredients to work - force, displacement, and cause.
- ▶ The work done by a force on a body is defined as the product of the magnitude of the force and the distance moved in the direction of force.
- ▶ Work done = force  $\times$  distance
- ▶ A boy, swinging a stone, tied to a string, with a uniform

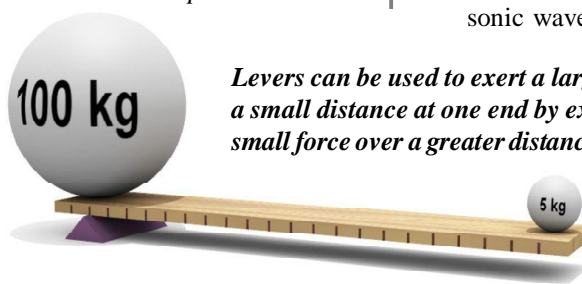
speed in a circle in a horizontal plane over his head, does no work.

- ▶ Unit of work is Newton metre (Nm).

## LEVERS

- ▶ A lever is a simple machine consisting of a rigid rod pivoted at a fixed point called the fulcrum. It is used for shifting or raising a heavy load or applying force in a similar way.
- ▶ A body in which a force is felt is called resistance (R) and the force applied here is called effort (E).
- ▶ If the fulcrum comes in between resistance and effort such levers are called I<sup>st</sup> order levers.  $\overbrace{R \quad F \quad E}$   
Eg: balance, nail puller see-saw, a pair of scissors etc.
- ▶ If resistance comes in between effort and fulcrum then such levers are called II<sup>nd</sup> order levers.  $\overbrace{E \quad R \quad F}$   
Eg: Wheel barrow, nut cracker etc.
- ▶ If effort is between resistance and fulcrum such levers are called III<sup>rd</sup> order levers.  $\overbrace{R \quad E \quad F}$   
Eg: Pincers, Ictongs etc.
- ▶ Efficiency of a machine

$$= \frac{Power\ output}{Power\ input}$$



*Levers can be used to exert a large force over a small distance at one end by exerting only a small force over a greater distance at the other.*

- ▶ Mechanical advantage of a

$$machine = \frac{load}{effort}$$

## WAVES

- ▶ Electromagnetic waves are coupled periodic electrical and magnetic disturbances created by oscillating electric charges.
- ▶ All waves of the electro magnetic spectrum travel at the same velocity, a quantity known as the speed of light. The speed of light is approximately  $3 \times 10^8$  m/s (about 186,000 miles per second).
- ▶ Electromagnetic waves can travel through vacuum.
- ▶ Transverse wave is a type of energy wave in which motion of the particles is perpendicular to the motion of the wave.
- ▶ Wave on a rope and waves on the surface of water are transverse.
- ▶ If the motion of the particles is along the direction of motion of waves, it is called a longitudinal wave.
- ▶ Sound waves in a medium (solid, liquid or gas) are longitudinal.
- ▶ Transverse waves travel in the form of crests and troughs while longitudinal wave travels in the form of compressions and rarefactions.
- ▶ Earthquake waves are infrasonic waves.



- ▶ The property which distinguishes transverse waves from longitudinal waves is polarization.
- ▶ Diffraction is the property in waves of turning round the edges of an obstacle.
- ▶ Sound can be heard around a corner due to diffraction.
- ▶ When a wave strikes a surface of separation of two different media, some of it is thrown back into the original medium. This property of bouncing of the waves is called reflection.
- ▶ The property of sound reflection is used by bats (which cannot see in the dark) for flying during night.
- ▶ Visible light is electromagnetic wave in the range of frequencies  $4.3 \times 10^{14}$  to  $7 \times 10^{14}$  Hz. Electromagnetic waves do not require any material medium for their propagation, they can travel in vacuum.
- ▶ RADAR is the abbreviation of Radio detection and ranging.

## SOUND

- ▶ Sound is a travelling wave.
- ▶ Sound requires medium to travel.
- ▶ Sound cannot travel through vacuum.
- ▶ Study of sound is known as **Acoustics**.
- ▶ Echo and reverberation are due to the reflection of sound. For the production of echo there should be a minimum distance of 17m between us and the reflecting surface.
- ▶ Bats can fly in the dark because they can generate ultrasonic sound and if there is any hindrance in their way

the sound waves get reflected and they can change their direction. They use this method to catch insects also.

- ▶ Since sound waves need a medium to travel they cannot be transmitted through vacuum.
- ▶ The audible frequency of human ear is between 20 hertz and 20,000 hertz (20 KHz).
- ▶ A speed greater than the speed of sound is referred to as supersonic.
- ▶ Velocity of sound in the air is 340 m/s.
- ▶ Sound consists of waves of alternate compression and rarefaction that transmit kinetic energy through a medium.
- ▶ Frequency of a sound wave is the number of wavelengths (vibrations) that are completed in a given period of time.
- ▶ Doppler effect is the change in a sound wave's frequency (and wavelength) that is caused when the hearer and sound source move relative to each other.
- ▶ Sounds are distinguished from each other by pitch (frequency), loudness (intensity) and quality.
- ▶ We can recognise our friends from their voices due to the quality of sound.
- ▶ Phonogram is a machine to reproduce sound.
- ▶ The speed of sound depends on the medium the waves pass through.
- ▶ Sounds with frequencies lower than the lowest limit of human hearing (about 20

Hz) are called **infrasonic waves**.

- ▶ Sounds of frequency higher than 20,000 Hz are known as ultrasonic and are inaudible.
- ▶ **SONAR** stands for Sound Navigation And Ranging. It uses **ultrasonic waves**.
- ▶ Sound travels faster through solids, especially, through metals.
- ▶ The intensity of sound is measured in decibel.
- ▶ The intensity of polite conversation is 40 db-30 db.
- ▶ During night the allowed intensity of sound in a hospital area is 40 db.
- ▶ The reverberation of sound in a hall results due to continued **reflection**
- ▶ Sound travels faster in **steel**
- ▶ Sound can travel only through a medium. It cannot travel through vacuum. It travels through solids, liquids and gases.
- ▶ Equipment for generating or using sound includes musical instruments, hearing aids, sonar systems and sound reproduction and broadcasting equipment. Many of these use electro-acoustic transducers such as microphones and loud speakers.

## How do bats fly at night?

Bats can fly in the dark because ultrasonic waves produced by them during flying are reflected back to them from the obstacles in their way and hence they can fly with out difficulty.

## LIGHT

- ▶ **'The corpuscular theory'** related to light was proposed by **Issac Newton** in 1675.
- ▶ Study of light is known as *optics*.
- ▶ Light an electromagnetic radiation.
- ▶ Through vacuum electro magnetic waves travels with a speed of  $2.9979 \times 10^8$  m/s.
- ▶ Paper, cardboard and stone are examples for **opaque substances** (substance which do not passess light).
- ▶ Substances which allow the light to pass through are called **transparent substances**.  
Eg: glass
- ▶ The particle which is supposed to travel faster than light is **tachyon**
- ▶ Tachyons were discovered by E.C.G. Sudarshan.
- ▶ On a rainy afternoon a rainbow is seen in the east
- ▶ A rainbow is always seen in the opposite direction of the sun.
- ▶ Rainbow is caused by reflection, refraction and dispersion of light by the water particles present in the atmosphere.
- ▶ **LASER** is **Light Amplification by Stimulated Emission of Radiation**.
- ▶ Laser is the surface intense radiation.

### Eye Openes:

If two bulbs of power 40w and 100w are joined in series and connected to the domestic electric supply terminals, the 40w bulb glows much more brighter than the 100w bulb.

- ▶ LASER is a source of intense monochromatic light in the ultraviolet, visible or infrared region of the spectrum.
- ▶ LASER beams are used in the medical field to perform minute operations.
- ▶ LASER was discovered by Theodore Maiman in 1960.
- ▶ **Visible spectrum** is the band of colours obtained when a ray of light passes through a prism.
- ▶ Spectrum consists of seven colours viz Violet, Indigo, Blue, Green, Yellow, Orange and Red (VIBGYOR).
- ▶ Violet light is scattered most, blue somewhat less, and green, yellow and orange still less, in that order.
- ▶ Red light is scattered least.
- ▶ The beautiful colour of the soap foam and oilspread water is due to **interference of light**.
- ▶ Red, green and blue are the primary colours.
- ▶ Green objects placed in red light will appear black.
- ▶ In the spectrum violet light has short wave length and high frequency. While red light has the highest wave length and the least frequency.
- ▶ A diamond sparkles due to total internal reflection because it has a high refractive index.
- ▶ Scattering of light is responsible for sky being seen as blue. This is because blue and violet colour have short wave length and hence scatter more.
- ▶ **MASER** is Microwave Amplification by Stimulated Emission of Radiation. It was discovered by Charles H. Towns.
- ▶ **Refraction** is the sudden

- ▶ **James Clark Maxwell** founded that **lights are electromagnetic waves**.
- ▶ **Wave theory** of light was discovered by **Christian Huygens**.
- ▶ Microwave Amplification by Stimulated Emission of Radiation was discovered by Charles H. Towns.

change of direction of light when passing from one transparent substance to another. When we put a stick in water it seems to be bended. It is due to refraction.

- ▶ Diffraction is the spreading out of waves of light as it passes through a narrow aperture. The spreading of light rays towards the screen from a projector in film theatre is due to diffraction.
- ▶ Dispersion is the splitting up of light ray into different colours. Rainbow is formed due to dispersion. The seven colours of light has different wavelength. Hence when light passes through a prism each colour gets refracted at different angles.
- ▶ A bubble of water shines because of total internal reflection.
- ▶ Refraction of light through air having very large temperature gradients causes a mirage.
- ▶ A periscope is a device which works by the principle of reflection and refraction.
- ▶ When there is thunder we see the lightning first and hear the thunder later because the velocity of light is greater than the velocity of sound.

- ▶ The term light year is a unit employed in measuring Distance.
- ▶ The rays which appear to originate outside the earth - **The cosmic rays**
- ▶ In a Doctor's stethoscope the sound is intensified because of **reflection of sound**
- ▶ Light from the sun reaches the earth in 8 minutes.
- ▶ Light travels fastest through vacuum. Through vacuum light travels with a speed of  $3 \times 10^8 \text{ m/s}$ .
- ▶ The shortest distance for clear vision is 25 cm.
- ▶ **Myopia** or *short sightedness* is such a type of defect in which one can see nearby objects clearly but is difficult to see objects at long distances. Here image of the substance falls in front of the retina.
- ▶ *Myopia can be corrected by using a concave lens.*
- ▶ **Hypermetropia** or *long sightedness* is such a type of defect in which one can see distant objects clearly whereas nearby objects look blurred. Here the image of the substance falls behind the retina.
- ▶ *Hypermetropia can be corrected by using a convex lens of appropriate focal length.*
- ▶ *Persons suffering from both myopia and hypermetropia use bifocal lenses to withstand the condition.*
- ▶ **Astigmatism:** This defect is due to the cornea not being spherical. This defect can be corrected by using a cylindrical

cal lens, instead of a spherical lens.

- ▶ As the age advances, the elasticity of eye becomes very much reduced. As a result the near point of eye recedes gradually resulting in presbyopia. It can be corrected by convex glasses.
- ▶ When we observe distant objects, the focal length of the eye lens increases and if we observe the objects near by, the focal length of eye lens decreases.
- ▶ Twenty - Twenty means perfect vision.
- ▶ The image formed on the retina of the human eye is **real and inverted**.
- ▶ The lens in the human eye is convex.
- ▶ **Pigments** are substances used to colour paints, filters, plastics and other materials.
- ▶ The sky generally looks blue because the blue colour of short wave length is scattered more than the longer waves of red light.
- ▶ *It is true that the violet waves are dispersed, even more than the blue. However, the sky does not appear violet because the sunlight is relatively weak in violet light.*
- ▶ Red colour has the longest wavelength and shortest frequency whereas violet colour has the highest frequency and shortest wave length.
- ▶ The formation of brilliant colours in soap film is a conse-

quence of the phenomenon of **multiple refraction and interference**

- ▶ An astronaut on an earth satellite will observe the sky as **Black**.
- ▶ The shortest height of a plane mirror required to show the full size image of a person of height 'L' cm is  $\frac{L}{2} \text{ cm}$ .
- ▶ Dioptre is the unit of power of lenses.
- ▶ Concave mirror is used as a burning glass.
- ▶ For the rear view, motorists use convex mirror.
- ▶ To concentrate light on the teeth, the dentists use concave mirrors.
- ▶ Film is a part of the camera which is analogous to the retina in the human eye.

## HEAT AND THERMODYNAMICS

- ▶ **Absolute zero** is the lowest possible temperature which is equal to 0K or  $-273.16^\circ\text{C}$  or  $-459.69^\circ\text{F}$ .
- ▶ **Temperature** is the degree of hotness and **heat** is a form of energy which increases the temperature of a body.
- ▶ **Specific heat capacity** of a substance is the amount of heat required to raise the temperature of the substance through  $1^\circ\text{C}$
- ▶ As we go up in the atmosphere, the temperature decreases.
- ▶ Plasma is the fourth state of matter. Solid, liquid and gas are other three states of matter.

- ▶ A black surface absorbs heat more than other colours.
- ▶ **Cryogenics** is concerned with the production, control and application of extremely low temperatures.
- ▶ At ultra high temperature matter exist in plasma form 99% of matter in the Universe is in plasma form.
- ▶ One **calorie** is the amount of heat needed to raise the temperature of 1gm of water by 1°C.
- ▶ Steam causes more severe burns than water of the same temperature because steam possess more heat energy due to latent heat than water.
- ▶ Transmission of heat from one point to another without heating the medium is called radiation.
- ▶ **Cotton** dresses are safe for wearing while cooking.
- ▶ **Conduction** is the process of net energy transfer through a substance without the movement of the substance itself, but by molecular collisions.
- ▶ Very poor conductor, such as glass are called Insulators. Air is a good insulator.
- ▶ Mica is a good conductor of heat, but a bad conductor of electricity.
- ▶ Perspiration is maximum, when temperature is high and air is humid.
- ▶ Evaporation takes place at all temperatures and is accompanied by cooling.
- ▶ Melting point of ice can be raised by the decrease of pressure.

### Eclipse

Lunar eclipse occurs when the earth comes between the sun and the moon. While solar eclipse occurs when the moon comes between the sun and the earth.

- ▶ Water has maximum density at 4°C. Water expands when it freezes. Water occupies maximum volume at 0°C.
- ▶ The Clinical Thermometer is specially designed to measure human body temperature. Normal human body temperature is 36.9°C (or 98.4°F)
- ▶ Melting point of mercury is -39°C and that of alcohol is -115°C.
- ▶ The main source of energy in the biosphere is solar energy which reach earth by means of radiation.
- ▶ Water expands on freezing. Due to this reason when water is filled in a bottle and is allowed to freeze the bottle breaks, and during winter water pipes break in cold regions.

### MAGNETISM

- ▶ **'Lodestones'**, are natural magnets.
- ▶ Magnetic lines of force cannot penetrate certain materials as easily as they can penetrate air or vacuum. Such materials are called **"diamagnetic."**
- ▶ Diamagnetic materials have negative susceptibility.
- ▶ Bismuth, antimony, zinc, silver, copper, gold, lead, water, alcohol, hydrogen and the inert gases are diamagnetic.

- ▶ The law of magnetic poles states that like poles repel, unlike poles attract.
- ▶ A freely suspended magnet stands vertical at magnetic south pole
- ▶ **"Ferromagnetic"** substances are those which can be magnetised to a great extent.
- ▶ Iron steel, nickel, cobalt, alloys of these substances, and gadolinium are ferromagnetic substances.
- ▶ **Paramagnetic** materials have feeble magnetic properties. Platinum, solutions of salts of iron, oxygen, manganese, palladium, osmium etc are examples of paramagnetic substances.
- ▶ Inside a magnet, direction of magnetic lines of force is from south to north.
- ▶ **Tesla is the unit of strength of magnetic field.**
- ▶ The instruments which are dependent of magnetic power of electricity are fan, telephone receiver, Dynamo etc.

### ELECTRICITY

- ▶ Laws of electrolysis were formulated by **Michael Faraday (Father of electricity)**.
- ▶ Electric fittings are *earthed* because in case of a short circuit, the current passes to the earth to overcome the damages.
- ▶ Filtered water at normal temperature is better conductor of electricity than filtered hot water and distilled water.
- ▶ **Conductors** are substances that allow electric charges to flow through it.

- ▶ Metals and graphite are good conductors of electricity.
- ▶ Silver is the metal having lowest resistance.
- ▶ The best conductor of electricity is **silver**.
- ▶ Free electrons constitute current in a conductor.
- ▶ **Insulators** do not allow current to flow through it.
- ▶ Current through a conductor is the flow of electrons through it.
- ▶ Rubber, plastic, paper, glass, mica etc are insulators.
- ▶ Elements such as silicon and germanium allow feeble currents to pass through them and they are known as **semi-conductors**.
- ▶ Air without moisture (dry air) is an insulator.
- ▶ The unit of electric charge is Coloumb. It is equal to the charge of  $6.25 \times 10^{18}$  electrons.
- ▶ 
$$\text{Current} = \frac{\text{Charge}}{\text{Time}}$$
- ▶ A high current is produced in a low resistance circuit when two wires of main comes in contact with each other. This is called **short circuiting**.
- ▶ Electric bulbs are filled with gases like **argon, neon, nitrogen** etc.
- ▶ When an isolated conducting sphere is given a positive charge, its mass decreases. This is because, 'giving positive charge' means 'taking electrons out of it'.
- ▶ The principle on which quartz crystal in watch works is **piezo electricity**. Piezo electricity is the property of some crystals to develop an electromotive

force or voltage **across opposite forces** when subjected to a mechanical strain and conversely, to expand or contract in size when subjected to an electromotive force.

- ▶ 220-230 volt is the voltage at which the alternate current (a.c) is supplied for house hold use in India.
- ▶ The frequency of household a.c in India is 50 hertz.
- ▶ An inductor is a device which passes dc but blocks ac.
- ▶ Alternating current is used more widely than Direct Current.
- ▶ ac (alternating current) is more dangerous than dc (direct current).
- ▶ Usually the air inside an electric bulb is removed because when the filament (tungsten) is heated in the presence of air, it forms oxide by combining with oxygen present in the air and readily gets fused.
- ▶ **Nichrome** is used as a heating element in many appliance because it has high resistivity and it resists oxidation in air when red hot.
- ▶ An electric bulb makes a bang when it is broken because there is a vacuum inside the electric bulb. When the bulb is broken air rushes in at a great speed from all sides to fill the vacuum and this produces the sound.
- ▶ To avoid overloading, a device called a '**fuse**' is inserted in **series** with the circuit.
- ▶ The fuse is a piece of wire made of financial Lead.
- ▶ The fuse offers a great deal of

Conductors	Insulators
silver	glass
copper	rubber
gold	oil
aluminum	asphalt
iron	fibre glass
steel	porcelain
brass	ceramic
bronze	quartz
mercury	(dry) cotton
graphite	(dry) paper
dirty water	(dry) wood
concrete	plastic, air, diamond, pure water

resistance to the electric current and melts at a fairly low temperature. The fuse wire must have a low melting point.

- ▶ A fuse wire is used to prevent an unduly high electric current to pass through a circuit.
- ▶ Capacitor is a device used to store electrical energy but it is not a device to store electric charge.
- ▶ The emf or potential difference measured in volt is called **voltage**.
- ▶ A convenient unit to measure electric power is the **kilowatt hour (kwh)**. This is often simply called a **unit**.
- ▶ **1 kwh = 1000 watt x 3600 seconds**
- ▶ In our houses, electric wiring is done in parallel connection so that all instruments in the house could get equal supply of electricity.
- ▶ when two cells of e.m.f 'V' volts each are connected in series the effective emf is  $V+V=2V$  volts



- ▶ When one cell is reversed ,the effective emf is  $V-V=0$  volts, ie, zero volts.
- ▶ In parallel connection of equal emf cells,whatever be the number of cells used the effective emf will be equal to the emf of a single cell.
- ▶ When we want a stronger current for a longer time parallel connection is used.
- ▶ A source of emf containing two or more cells is called a **battery**.
- ▶ In a dry cell the negative electrode(cathode) is zinc and positive electrode(anode) is carbon rod.
- ▶ The emf of a voltaic cell is 1volt.
- ▶ The emf of a dry cell is 1.5 volts.
- ▶ Colour of the light of sodium vapour lamp is yellow.
- ▶ Colour of the light of chlorine vapour lamp is green.
- ▶ Light of nitrogen vapour lamp is red.
- ▶ Light of mercury vapour lamp is white.
- ▶ Light of neon vapour lamp is orange red.
- ▶ Light of hydrogen vapour lamp is blue.
- ▶ In our houses we get 220V ac.The value 220 represents **effective voltage**
- ▶ The advantage of ac over dc is that **it can be transmitted over long distances with minimum power loss**
- ▶ Resistance of carbon decreases with increase of temperature.
- ▶ In an electrical circuit a fuse

is connected **in the live wire**  
Along with fluorescent tubes are fitted with a choke. Here the choke coil steps up the line voltage.

- ▶ An electrical appliance is earthed to **prevent shock**
- ▶ One should not connect a number of electrical appliances to the same power socket because **this can damage the domestic wiring due to over heating**
- ▶ A capacitor (condenser) is used to **store electric charge**
- ▶ "Hydro Power" is the term used for electricity produced through **water**
- ▶ Electricity for domestic purpose is measured in **kWh**
- ▶ The power of ordinary torch cell is 1.5 volt.
- ▶ In the rechargeable batteries used in touch light, electric-shavers etc. nickel and cadmium are used as electrodes.

## ELECTRONICS

- ▶ Electronics is the study of nature, control and application of electrons.
- ▶ Modem is *Modulator Demodulator*.
- ▶ **Rectifiers** are used to convert Alternating Current (AC) to Direct Current (DC).
- ▶ An electronic oscillator is a device which converts DC energy into AC energy.
- ▶ Silicon is used in solar cells.
- ▶ Materials whose resistivity lies in between conductors and insulators are called **semi conductors**.

- ▶ Germanium, silicon, carbon etc are semi conductors.
- ▶ A **transistor** transfers a signal from a low resistance to high resistance .
- ▶ The word **transistor** came from the process of **transfer and the resistor**.
- ▶ **ELINT** is electronic intelligence.
- ▶ Triode was invented by Lee De Forest.
- ▶ IC chip is a circuit which performs the functions of transistors, diodes, resistors, condensers etc altogether.
- ▶ The largest IC chip manufacturing company in the world is INTEL.
- ▶ Electrons are carriers of current in a npn transistor. Holes are the carriers of current in a pnp transistor.
- ▶ The frequencies transmitted by a TV station is called channel.
- ▶ Soft X-rays are X-rays having high wavelength and low energy. As these are absorbed by body tissues they are not used in taking photographs of internal organs.
- ▶ X-rays having short wavelength but high energy are called hard X-rays. These are used in the photography of internal organs.
- ▶ In order to study internal atomic structure of crystals, we use **X-rays**
- ▶ "IC" chips for computers are usually made of **Silicon**
- ▶ The process which makes the current to pass in the same direction is called **rectification**

## TELECOMMUNICATION

- ▶ A revolution in wireless telecommunications began in the first decade of the 20th century, with Guglielmo Marconi winning the Nobel Prize in Physics in 1909 for his pioneering developments in wireless radio communications.
- ▶ The first commercial electrical telegraph was constructed by Sir Charles Wheatstone and Sir William Fothergill Cooke, and its use began on 1839.



*In 1901, Guglielmo Marconi established wireless communication between St. John's, Newfoundland and Poldhu, Cornwall (England), earning him the Nobel Prize in Physics for 1909*

### The Nobel Prize in Physics 2010

The Nobel Prize in Physics 2010 was awarded jointly to Russian born scientists, Andre Geim and Konstantin Novoselov "for ground breaking experiments regarding the two dimensional material graphene", a super-thin and strong form of carbon with high conductivity that can be used for touch screens and light panels.

- ▶ **Alexander Graham Bell** invented the telephone.
- ▶ The first commercial telephone services were set up in 1878 and 1879 on both sides of the Atlantic.
- ▶ Telex means Teleprinter Exchange.
- ▶ INTELSAT (International Telecommunication Satellite Organisation), with its headquarters in Washington DC, was established on February 12, 1973. It operates space equipment and earth stations owned by telecommunication entities in each country. INTELSAT'S 13 satellite system provides about two-thirds of the world's international telecommunication services to more than 140 countries including India.
- ▶ Father of cybernetics - **Norbert Weiner**
- ▶ RADAR is Radio Detection and Ranging.
- ▶ RADAR is a device that uses radio waves to detect the position of objects such as aeroplanes, missiles etc.
- ▶ Radar was invented by Albert H. Taylor and Leo C. Young.
- ▶ The first telecommunications device was the **telegraph**.
- ▶ A television camera takes 25 or 30 electronic photographs (called frames) of a scene every second.
- ▶ Hybrid computers are a combination of the analog and digital computers.



Optical fibre provides cheaper bandwidth for long distance communication

### Samuel Morse

Samuel Finley Breese Morse was an American contributor to the invention of a single-wire telegraph system based on European telegraphs, co-inventor of the Morse code.

## NUCLEAR PHYSICS

- ▶ A **Geiger Counter** or Geiger-Muller Counter is used for detecting and measuring radiation.
- ▶ **Radio-Carbon Dating** or **Carbon dating**, widely employed to determine the age of fossils of animals or plants. The radio-isotope carbon-14 is used in Carbon dating process.
- ▶ **Chain reaction** is a self sustaining series of nuclear fissions, each one started by

## Nuclear Fusion and Fission

The process of formation of a heavily weighed nucleus by the fusion of two or more low weighed nucleus is called **nuclear fusion**. On earth, the most likely fusion reaction is Deuterium–Tritium reaction. Deuterium and Tritium are both isotopes of hydrogen. The splitting of nucleus of an atom into two pieces having equal weight is called **nuclear fission**. **Otto Hahn** in 1939 discovered nuclear fission. Nuclear fission is the splitting of a massive nucleus into photons in the form of gamma rays, free neutrons, and other subatomic particles. The main difference between these two processes is that fission is the splitting of an atom into two or more smaller ones while fusion is the

neutrons emitted in a previous fission.

- ▶ Proton was discovered by Rutherford.
- ▶ Electron was discovered by J.J.Thomson.
- ▶ James Chadwick discovers the neutron.
- ▶ Out of the three radiations - alpha, beta, and gamma, **gamma radiation** is most penetrating.
- ▶ **Enriched uranium** is uranium with more of the isotope of **Uranium - 235**.
- ▶ The age of rocks may be calculated through **radioactive dating** using uranium isotopes.

- ▶ Alpha particles ( $\alpha$ ) are positively charged. Basically  $\alpha$  – rays are Helium nuclei.
- ▶ Gamma rays are electromagnetic radiation emitted by the nuclei of radioactive elements.
- ▶ A **tracer** is minute amount of a radioisotope, added to a large amount of non-radioactive isotopes of elements.
- ▶ **Half-life** is the time taken for half of any amount of a radioactive isotope to decay.
- ▶ Radiocarbon '*carbon - 14*' has a half-life of 5,730 years.
- ▶ Isotopes used in dating rocks include Uranium-235 which becomes lead-207; thorium-

### Power Plant

Narora Atomic Power Station  
Rajasthan Atomic Power Station  
Tarapur Atomic Power Station  
Kakrapar Atomic Power Station  
Kudankulam Nuclear Power Plant  
Madras Atomic Power Station  
Kaiga Nuclear Power Plant

### Location

Narora  
Rawatbhata  
Tarapur  
Kakrapar  
Kudankulam  
Kalpakkam  
Kaiga

### State

Uttar Pradesh  
Rajasthan  
Maharashtra  
Gujarat  
Tamilnadu  
Tamilnadu  
Karnataka

232 which becomes lead-208; rubidium-87 which changes into strontium-87; and potassium-40 which changes into argon-40.

Nuclear fusion is also known as thermo-nuclear reaction because it demands extremely high temperatures.

A breeder reactor is that which produces more fissionable material than it burns.

- ▶ The enormous energy released in an atomic explosion is due to the conversion of mass into energy.
- ▶ **Neutron** is used to trigger-off the nuclear fission reaction.
- ▶ *Atom bomb* is an example of nuclear fission reaction, while *Hydrogen bomb* is that of nuclear fusion reaction.
- ▶ More energy is produced in a fusion reaction than fission reaction.
- ▶ The monozite found abundantly in coastal areas of Kerala contains thorium.
- ▶ The temperature required for the maintenance of fusion is about 350000000°C.

## ATOMIC REACTORS

- ▶ Nuclear power is the fourth-largest source of electricity in India after thermal, hydro and renewable sources of electricity.
- ▶ In 2010, India has 19 nuclear power plants in operation generating 4,560 MW while 4 other are under construction.
- ▶ The first atomic reactor in India is 'Apsara' in Trombay (Maharashtra)

## NPCIL

Nuclear Power Corporation of India Limited is a Public Sector Enterprise under the administrative control of the Department of Atomic Energy (DAE), Government of India. The main objective of NPCI is operating the atomic power stations and implementing the atomic power projects for generation of electricity

- ▶ India's first breeder reactor is set up at the place known as Kalpakkam in Tamil Nadu.
- ▶ The early reactors were known as Atomic Piles.
- ▶ Heavy water, graphite and neutrons are used as **moderator** in nuclear reactors.
- ▶ Coolant is a fluid used in nuclear reactors to remove the heat produced in the core.
- ▶ The coolant used in fast breeder reactors is generally liquid sodium.
- ▶ Heavy water is used as a *coolant* as well as a *moderator* for nuclear reactors.
- ▶ The moderator in a nuclear reactor slows down the fast moving neutrons.
- ▶ The commonly used moderators are graphite, heavy water and berilium.
- ▶ The main source of solar energy is nuclear fusion.
- ▶ The **fast breeder reactor** gets its name from the fact that it utilizes excess free neutrons to breed new fissionable material.

- ▶ The original fuel in the fast breeder reactor is plutonium and uranium oxides or carbides.
- ▶ Cadmium rod is used in a reactor to absorb neutrons.
- ▶ **Willers Frank Liby** discovered carbon dating.
- ▶ **Coal** is the most important raw material for thermal power plant.
- ▶ **Flyash** is a waste product of thermal power plants.
- ▶ Cobalt-60 is commonly used in radio therapy because it emits beta rays which has more energy than the X-rays.

## SPACE PHYSICS

- ▶ Space exploration began with the launching of Russia's Sputnik-1 into space on October 4, 1957.
- ▶ Sputnik-2 carried a dog 'Laika' to space.
- ▶ The U.S.A. entered the space arena on January 31, 1958 with the launching of the Explorer-1. This satellite is credited with making the important discovery of the Van Allen radiation belts around the earth, where electrons and protons from the sun are trapped by earth's magnetic field.
- ▶ The extremely large distances between the various heavenly bodies like the stars and planets can be expressed in terms of two units namely light year and parsec.
- ▶ One light year is the distance

travelled by light in one year through space.

- ▶ 1 light year =  $9.46 \times 10^{12}$  Kilometres
- ▶ 1 Parsec = 3.26 light years
- ▶ A galaxy is a vast collection of billions of stars, dust and hydrogen gas isolated in space from similar systems.
- ▶ Galaxies are the building blocks of the universe.
- ▶ The sun and the eight planets belong to the milky way galaxy, whose Indian name is Akash-Ganga.
- ▶ Milky way is a spiral shaped galaxy. There are nearly  $10^{11}$  stars in the galaxy.
- ▶ Among numerous dim stars in the sky, there are some groups of bright stars. These groups of stars forms certain shapes or patterns and are called constellations. The constellations were given the name of the figures they resembled.
- ▶ There are 89 constellations. The largest of these is Hydra, which contains at least 68 stars visible to the naked eye.
- ▶ A satellite is a heavenly body that rotates around a planet.
- ▶ Venus is the brightest object in the night sky, leaving out the moon. It is visible either in the early morning in the eastern sky or in the early evening in the western sky and is called "morning star" and "evening star".
- ▶ Sun is our nearest star. It is a hot sphere of gas - 74% hydrogen, 25% helium and 1% other elements.
- ▶ The sun is at a distance of 8



- light minutes from the earth. i.e, it takes about 8 minutes for light to travel from the sun to the earth.
- ▶ An asteroid is an irregular, rocky hunk, small both in size and in mass compared to a planet.
  - ▶ In the belt which lies between Mars and Jupiter there are thousands of minor planets or asteroids.
  - ▶ Ceres is the largest known asteroid.
  - ▶ Meteor is the streak of light observed in the sky. They are formed when a particle of matter enters the earth's atmosphere and become incandescent as a result of friction with atmospheric atoms and molecules. Meteor are also called shooting stars.
  - ▶ Stars twinkle because of refraction of light.
  - ▶ The tail of a comet points away from the sun. This is due to radiation pressure.
  - ▶ The colour of a star is an indication of its temperature.
  - ▶ The planet that has got a well developed set of rings is saturn.
  - ▶ India's satellite launching station is situated at Sriharikota.
  - ▶ When a person is orbiting in a satellite, his weight becomes zero.
  - ▶ The ink of the pen leaks out in an aeroplane because pressure of ink inside is more than the ambient pressure.
  - ▶ The Space Application Centre for training in Satellite

Communication Technology is located at Ahmedabad.

- ▶ The credit for starting space science research in India goes to Vikram Sarabhai.
- ▶ Moon has no atmosphere because its gravity is not sufficient for any atmosphere to hold on to it.
- ▶ All stars have identical chemical composition but they differ in surface temperatures. This is the reason for the difference in spectra of stars.
- ▶ The outward stream of protons and electrons on the surface the sun during solar flares and sun-spot activity constitute the solar wind.

## UNITS AND MEASUREMENTS

- ▶ The purest form of gold is 24 carats. Ornaments are usually made of 22 carat gold. One metric carat is equal to 200 milligram.
- ▶ **The weight of precious gems are also measured in carat.**
- ▶ One gallon is equal to 4.546 litres.
- ▶ One horse power is equal to 746 watts.
- ▶ Light year is a unit of distance used in astronomy.
- ▶ Light year is the distance that
- ▶ **Astronomical Unit** is another unit of distance in space. It is the mean distance between earth and Sun. One light year contains nearly 63282 Astronomical Units.
- ▶ Par sec (Parallactic second) is yet another unit of distance in space. One par second is equal to  $3.08 \times 10^{16}$  m.
- ▶ **Lambert** is the unit of intensity of light.
- ▶ **Pascal** is the unit of pressure.
- ▶ **Angstrom** is the unit of the wave length of light.
- ▶ **Poise** is the unit of viscosity of fluid.
- ▶ **Curie and Rutherford** are unit of radio activity.
- ▶ Unit of Plane angle is radian
- ▶ Unit of solid angle is steradian
- ▶ Newton is the unit of force
- ▶ Joule is the unit of energy and work
- ▶ Unit of power is watt
- ▶ Hertz is the unit of frequency
- ▶ Coulomb is the unit of electric charge
- ▶ Unit of electric capacitance is farad
- ▶ Ohm is the unit of electric resistance
- ▶ Becquerel is the unit of radio activity
- ▶ Henry is the unit of inductance

Several systems of unit have been in use for describing measurement. The common systems are the C.G.S. system (centimeter, gram, second); the F.P.S. system (foot, pound, second) which is the British system, the MKS system (meter, kilogram & second) and now internationally accepted is the System International Units, abbreviated as S.I. units.



Quantity	Unit
Length .....	Metre (m)
Mass .....	Kilogram (kg)
Time .....	Second (s)
Electric Charge .....	Ampere (A)
Temperature .....	Kelvin (K)
Frequency .....	Hertz (Hz)
Force, Weight .....	Newton (N)
Work, Heat .....	Joule
Power, Radiant flux .....	Watt (W)
Pressure, Stress .....	Pascal (Pa)
Electric charge or flux .....	Coulomb (C)
Electrical potential difference, Electromotive force (emf) .....	Volt (V)
Electric resistance, .....	Ohm
Electric capacitance .....	Farad (F)
Magnetic flux .....	Weber (Wb)
Magnetic flux density, magnetic induction .....	Tesla (T)
Inductance .....	Henry (H)
Electrical conductance .....	Siemens
Radioactivity .....	Becquerel (Bq)
Catalytic activity .....	Katal
Thermodynamic temperature .....	Degree Celsius
<b>Derived Units</b>	
Area .....	square metre (m <sup>2</sup> )
Volume .....	cubic metre
Speed, velocity .....	metre per second (m·s <sup>-1</sup> )
Acceleration .....	metre per second squared (m/s <sup>2</sup> )
Jerk .....	metre per second cubed (m·s <sup>-3</sup> )
Angular velocity .....	radian per second
Momentum .....	Newton second (N·s)
Torque, moment of force .....	Newton metre
Wavenumber .....	Reciprocal metre
density, mass density .....	kilogram per cubic metre (kg·m <sup>-3</sup> )
specific volume .....	cubic metre per kilogram
entropy .....	joule per kelvin (J·K <sup>-1</sup> )
electric field strength .....	volt per metre
magnetic field strength .....	ampere per metre
molar energy .....	joule per mole
specific energy .....	joule per kilogram
energy density .....	joule per cubic metre
surface tension .....	newton per metre
thermal conductivity .....	watt per metre kelvin
dynamic viscosity .....	pascal second
electric charge density .....	coulomb per cubic metre
electric current density .....	ampere per square metre
radian .....	rad
steradian .....	rad <sup>2</sup>

- ▶ Weber is the unit of magnetic flux
- ▶ Lumen is the unit of luminous flux
- ▶ Lux is the unit of illuminance
- ▶ Unit of electric conductance is Siemens
- ▶ **Joule** is the unit of work.
- ▶ **Dyne** is the unit of force.
- ▶ Newton is yet another unit of force.
- ▶ One newton = 10<sup>5</sup> dynes
- ▶ **Centigrade, Fahrenheit** are the units of temperature.
- ▶ Degree is the unit of angle.
- ▶ **Mho** is the unit of conductance.
- ▶ **Fathom** is the unit of depth of the sea. One *fathom* is equal to 6 feet.
- ▶ In India, National Physical Laboratory of New Delhi is responsible for the maintenance and improvement of physical standards of length and time.
- ▶ Solar day is the period between noons of two consecutive days.

## BRANCHES OF SCIENCE

### Actinology

A branch of science which deals with the chemical effects of electromagnetic radiation.

### Aerodynamics

The study of the motion and control of solid bodies (eg. air craft, rockets, missiles etc) in air.

### Aeronautics

A branch of science which deals with flight through air.

### Astro physics

The branch of physics con-

cerned with the physical properties of celestial bodies and the interaction between matter and energy with them.	forces which change their motion.	which deals with effect of motion without reference to mass or force.
<b>Astronautics</b> The scientific study of travel outside the Earth's atmosphere.	<b>Electronics</b> A branch of science dealing with the study and development of circuit involving thermionic valves, semi conductors and other electrical components like resistance, capacitors, inductances etc.	<b>Optics</b> It is the branch of physics dealing with the study of light.
<b>Audiology</b> The science of hearing	<b>Electrostatics</b> The study of the effects associated with electric charge at rest.	<b>Rheology</b> The study of the deformation and flow of matter.
<b>Ballistics</b> The study of path (motion) of projectiles.	<b>Fluidics</b> The study and use of fluid flow through pipes in an analogous way to the flow of electric current through circuits.	<b>Solid state Physics</b> The branch of physics which deals with the nature and properties of matter in the solid state.
<b>Cosmology</b> The science of the nature, origin and history of the universe.	<b>Holography</b> Science of recording three dimensional image of an object.	<b>Statistical Mechanics</b> The study of the mechanical properties of large assemblies of particles or components in terms of statistics.
<b>Crystallography</b> The study of structure of crystals.	<b>Kinematics</b> The branch of mechanics	<b>Tribogy</b> The study of friction and lubrication.
<b>Dynamics</b> The study of the behaviour of bodies under the action of		

### Famous scientists and invention

GalileoGalilei .....	Discovered the phases of Venus, the four satellites of Jupiter Io, Europa, Callisto, and Ganymede	Alessandro Volta .....	Battery (Electric)
Christiaan Huygens .....	Wave theory	Kirkpatrick Macmillan .....	Bicycle
Sir Isaac Newton .....	Newton's Laws of Motion, Universal gravitation, Calculus	Tennant .....	Bleaching Powder
Benjamin Franklin .....	Discovered the two electric charges, 'positive' and 'negative'.	Edwin T. Holmes .....	Burglar Alarm
James Watt .....	Modern condenser steam engine	John Harrison .....	Chronometer
Michael Faraday .....	Electro magnetic induction	Nicolas & Jean Lumiere .....	Cinema
Sir Chandrasekhara Raman .....	Scattering of light and found the Raman effect	Wilmot .....	Cloning, (Mammal)
Nikola Tesla .....	Alternating current	Rudolf Diesel .....	Diesel Engine
Daniel Gabriel Fahrenheit .....	Determined the temperature scale called Fahrenheit scale	Thomas Alva Edison .....	Electric Lamp
Christian Doppler .....	Doppler effect	Henry W. Seely .....	Electric Iron
James Chadwick .....	neutron	J.J.Thomson. ....	Electron
J. Robert Oppenheimer .....	Atom Bomb	Lewis E. Waterman .....	Fountain Pen
Dalton .....	Atomic Theory	Thomas Alva Edison .....	Gramophone
Carrier .....	Air Conditioning	Denis Gason .....	Holograph
Evangelista Torricelli .....	Barometer	Edward Teller .....	Hydrogen Bomb
		Sir Frank Whittle .....	Jet Engine
		Theodore Maiman .....	Laser
		Elisha G. Otis .....	Lift (Mechanical)
		Benjamin Franklin .....	Lighting Conductor
		John Logie Baird .....	Mechanical Television
		Rutherford .....	Proton-