(1) NATURE & SCOPE OF BLOLOGY

Science : The word 'science' is derived from a Latin word 'scientia' , meaning , 'to know'. Science is a process that is used to answer the questions about nature.

✪ Science is a body of knowledge derived from observations and experiments, which are directed to determine the principles underlying what is being studied.

Steps of scientific method :

1. Observation
2. Formulation of Hypothesis
3. Testing of Hypothesis
4. Developing theory

1. Observation

It is simply the ability to notice something, keeping records and finding out answer for question framed by the observer.

A scientific investigator must have a clear idea about what is to be observed and what is to be ignored. A scientist needs to direct the observations that raise question, like 'what', 'why', 'how'. Measuring everything is neither wise nor possible. It is also very important to find out the proper method of measurement and keeping record of data. All data should be preserved because any one of them might be useful in answering any present or future question.

2. Formulation of Hypothesis

The next requirement is to develop a number of potential explanations or hypothesis based on the observation. Suppose, suddenly you realize that a room is dark. As an explanation for this perception, you may formulate several hypothesis , such as the switches are turned off or the bulbs are burnt out or, perhaps, you are going blind. Actually, a hypothesis is a logical explanation that accounts for the observation. This step involves guessing or predicting the plausible answers to a question. A good hypothesis should be as simple as possible. A hypothetical proposition might stand true or false. Hence, the data that emerge from a set of observations must be analysed which may help to make some kind of coherent generalization.

3. Testing of Hypothesis

You need to test the hypothesis. For this, you must devise ways of testing. Generally, the scientists carry out an experiment for testing one or more hypothesis. Based on the result of experiment they eliminate or confirm one or more of the hypothesis. This process helps to reject the most unlikely hypothesis and select the most likely one. Considering the hypothesis made earlier for explaining the causes of darkness in the room, first, as an experiment, you may try to switch on the light. If the room is still dark the first hypothesis is untrue and hence it is to be rejected. The shortcoming of this experiment is that it does not prove the other two hypothesis are true or false.

A standard type of experiment is called **control experiment.** Usually a scientist performs two sets of parallel experiments that are identical in all respects except in one variable.

For example, to test the specific type of nutrient that affects the growth of plant, you may take five pots, each containing the same type of plant. Then add different nutrients to four of them and no nutrient to the fifth pot. This pot will serve as a control for your experiment. In the next step, expose all the five plants to sunlight and water them uniformly. Observe the differences in growth of all the plants, record your data and formulate the appropriate hypothesis.

4. Developing theory

If the repeated experiments to test a hypothesis of the prediction give the same result again and again the hypothesis gains validity. A hypothesis that survives repeated tests over a long period of time and that has central importance to an area of science, may be considered a **theory.**

✪ **Robert Hooke** observed the presence of **cellulae** (in Latin, small rooms and hence cells) as early as 1665, whereas the actual living cells were observed a few years later (1670) by **Anton van Leeuwenhoek.** Actually, Hooke's concept of cell received the proper recognition in 1838, when a botanist, **Matthias Schleiden,** carefully studied plant tissues and developed the first statement on Cell Theory. Following this **Theodor Schwann** reported animal tissues in 1839. An important extension of Cell Theory – all living cells arise from preexisting cells. It came 20 years later in 1862 when **Louis Pasteur** successfully **refuted the concept of spontaneous origin of life.** Today, the likelihood of the cell theory being rejected is almost zero.

✪ Any scientific finding should be published. publication not only helps in the spread of knowledge to the world communities but also facilitates further investigation and enrichment of treasures of knowledge.

Biology: The Science of Life

The living organisms interact with one another as well as with their physical and chemical environment. **Biology** (Bios : life; logos: to discover) is the scince that studies living organisms.

✪ The term 'Biology' was proposed by Lamarck & Traveranus in 1802.

Biology and its relation to other science

All the disciplines of science are interrelated. The approach of studying biology has presently become multi-disciplinary and more broad based then before. Today a new name-**life science** is often used in place of **Biology,** to cover its wide scope.

The study of life science involves the knowledge of other basic sciences, such as physics and chemistry.

This is because:-

(1) Living organisms are made of inorganic and organic compounds.
(2) Inorganic compounds form ions in water and influence life processes.
(3) The acid-base equilibrium maintains pH in living organisms.
(4) Molecules move in and out of cells by diffusion and osmosis.
(5) Energy transfers and transformations are important for living cells.

Biology – A science of exceptions

Biology, however, is a science of exceptions. This is because it deals with living organisms which show enormous variation and are capable of changes. Due to evolution living organism show a number of exceptions. Some important exceptions in biology are as follows –

✪ Mature RBC of mammals are enucleated except camel and llama (Nucleated RBC is present)
✪ Normally the root of plants are positively geotropic but in mangrove plants (Rhizophora) negatively geotropic pneumatophores are present.
✪ Plant virus TMV has RNA as genetic material instead of DNA
✪ **'Cuscuta',** a total stem parasite is a dicot without any cotyledons.
✪ Ostrich, Emu, Cassowary and Kiwi are birds which cannot fly.
✪ **Duckbilled platypus** and spiny ant eaters lay eggs like birds but they are mammals (cledoic egg)
✪ Crocodiles and alligators are reptiles having four chambered heart like mammals instead of incomplete four chambered heart of reptiles.
✪ Generally mammals have seven cervical vertebrae while sea cow has six and sloth has nine cervical vertebrae.
✪ Fishes have gills for respiration while lung has alveolar sac like lungs.

Scope of Biology –

✪ **Biology influences our daily life as well as our future.**
✪ The development and use of modern medicine depends on the understanding of structure and functions of cells, tissues, organs and organ-systems of the human body.
✪ Information about the life-histories of the causative agents of diseases and their relation with man are of much value for prevention and cure of many diseases.

- ✪ We can also develop the skill to understand the cause of many hereditary diseases and genetic disorders.
- ✪ Biology helps to understand how organisms interact with nature and the significance of maintaining biodiversity. It helps humans to assess their position in the living world as a part of the earth's ecosystems.
- ✪ Anatomy and physiology help people become aware of the structure and function of human body.
- ✪ A biologist can learn things related to economic uses of plants and animals .
- ✪ With modern biotechnology scientists have been able to produce **genetically modified (GM)** crops.
- ✪ Geneticists, evolutionists and ecologists, independently or collectively, can work to assess the efficacy of biotechnology and bring forth appropriate enlightenment in the modern society. The future directions of biotechnology, conservation of biodiversity maintenance of environment and human welfare are in the hands of biologists.

Biology in Ancient India –

- ✪ Cultivation of rice was most likely achieved at Mehergarh about 6,000 years ago. Wild rice was originated in the coast of Bengal (Andhra Pradesh, Orissa and Bengal).
- ✪ Our Vedic literature recorded about 740 plants and 250 animals. The first attempt of classification is observed in **Chandyogya Upanishad,** which classified animals into three categories – **Jivaja** (Viviparous), e.g. mammals, **Andaja** (Oviparous), e.g. birds, reptiles, insects and worms, and **Udbhija** (Vegetal origin), e.g. minute animals. Post-Vedic Indian literature, such as Susruta Samhita (600 BC) classified all 'substances' into **Sthavara** (immobile) e.g. plants. **Jangama** (mobile), e.g. animals.
- ✪ Susruta Samhita also mentioned about classification of animals, such as Kulacara (those herbivores who frequently visit the river banks. e.g. elephant, buffalo, etc.) Matsya (fish), Janghala (wild herbivorous quadrupeds, e.g. deer) Guhasaya (carnivorous quadrupeds like tiger, Lion, etc.)
- ✪ In Vedic time **Dhanvantari** was regarded as the God of Medicine. Actually, Susruta is one of the earliest scientists who studied human anatomy. He has described in detail, anatomy based on his studies on dead body. Susruta Samhita is considered as the oldest treatise on surgery. Susruta himself carried out plastic surgery of human nose **(rhinoplasty).** He used non-poisonous living leeches for preventing clotting of blood in the post-operative case.
- ✪ **Susruta** also specialized in **ophthalmic surgery** (extraction of cataracts). He is therefore acknowledged as the **'Father of Surgery'.**
- ✪ **Charaka** was the first physician to present the concepts of digestion, metabolism and immunity. According to him, a body function because it contains three doshas, namely, bile, phlegm (split) and wind and illness is caused when the balance among the three doshas in a human body is disturbed.
- ✪ **Charaka** knew the fundamentals of genetics. For instance, he knew the factore determinimg the sex of a child. The indigenous system of medicine in india is known as **Ayurveda,** which is the science of living or longevity.

Aristotle: An exceptionally talented person –

Aristotle relied on observations and contributed much in biology. About 90 percent of his writing are on scientific subjects, mostly on biological ones.

- ✪ Classified animal species and arranged them into hierarchies. His mode of classification was reasonable and in some cases strikingly modern.
- ✪ Formulated the concept of the **Great Chain of Being** or **Scala Naturae** – a chain of progressive change in nature . This corresponds to a sort of evolution.
- ✪ Dealt with over five hundred type of animals and dissected nearly fifty of them.✪Studied the developing embryo of a chick and reported that sharks give birth to live youngones (viviparous) but do not develop a placenta like mammals.
- ✪ Observed the placenta in dolphins as a means of nourishment to the foetus. Based on this similarity with mammals he classified dolphins with mammals.

Emergence of Contemporary Biology –

- The earliest record of scientific approach in biology is that of a Belgian scientist **Andreas Vesalius** (1514-1564). His treatise is named **De Humani Corporis Fabrica** (The structure of human body). In this book, he has mentioned that the human body is composed of many complex subsystems each with its own function. **Andreas Vesalius** is honoured as the **'Father of Anatomy'.**
- **William Harvey** (1578-1657), a British scientist, first demonstrated that the heart pumps blood and the blood circulates. His monograph was named as **Anatomical exercise on the motion of the Heart and Blood.**
- **Robert Hooke** (1635-1703), a British scientist, first coined the term cellulae in 1665 and this term is synonymous to cells. His book was named **Micrographia.**
- In 1670, a **Dutch** cloth merchant turned into a scientist. **Antony van Leeuwenhoek** (1632-1723), observed the real living cells with the aid of a **'simple microscope'** made by him. He is regarded as the inventor of 'simple microscope'. He was the first to draw a diagram of bacteria in 1683.
- Aristotle's work on classification went unchallenged until 1753 when **Carolus Linnaeus** (1707-1778) , a Swedish naturalist, published another book **Species plantarum.**Also he published another book **Systema Naturae** in 1758. Linnaeus introduced the method of naming of plants and animals known as the **Binomial Nomenclature.** Aristotle's **Scala Naturac** was the all to explain the cause of diversities of the living things.
- **Georges Leopold Cuvier** (1769-1832), a French palaeontologist, first rejected the traditional **Scala Naturae** as a unifying concept of evolution. He was also the first one to identify the fossils of extinct bird-like reptile and laid the foundation of **palaeontology,** the study of fossils, as a branch of biology. Cuvier also made major contributions in **comparative anatomy.**
- **Jean Baptiste Lamarck** (1744-1829), a French naturalist, was the first to discard the idea of 'fixity of species'. His book **Philosophie Zoologique** was published in 1809.
- **Charles Robert Darwin** (1809-1882), a British naturalist, is the pioneer in the field of biology in the nineteenth century. His monumental treatise on the **Origin of species by means of Natural Selection : The Preservation of Favoured Races in the struggle for life** was published in 1859.
- In 1862, **Louis Pasteur** (1822-1895), a French scientist, countered the prevailing concept of spontaneous origin of life . He established the **Germ Theory of disease.**
- **Gregor Johann Mendel** (1822-1884), is regarded as the 'Father of Genetics'.
- **Darwin: -** In his book **On the Variation of Animals and Plants and under Domestication** (1868), **Darwin** put forward his own **Theory of Pangenesis** as the mechanism of inheritance. According to this theory, every organ of the body produces minute hereditary particles called **pangenes** or **gemmules.** Darwin suggested that these gemmules were carried through blood from every organ of the body and were collected together into the gametes.
- **Lamarck's** concept of Inheritance of Acquired Characteristics and **Darwin's** theory of Pangenesis were **rejected** with the discovery of the **Theory of Germplasm** in 1892 by **August Weismann** (1834-1914), a **German** Biologist. Waismann's experiment on rate established that the germ (sex) cells are set apart from the body (somatic) cells early in the embryonic development and it is only the changes in the germplasm that can affect the characteristics of future generations.

Misuse of Biology –

(i) **Amniocentesis** is the removal of amniotic fluid via a needle inserted through the abedomen into the uterus and amniotic sac, in order to gain information about the foetus. The amniotic fluid contains cells (amniocytes) of the amniotic membrane and some foetal skin cells. The centres for genetic counseling offer amniocentesis on request of women for chromosome analysis. The amniocentesis technique has been developed for detecting foetal abnormalities by analyzing **chromosomal defect** or **aberration** of the foetus. With the realization that the test could reveal the sex of the foetus, people are seen to take the test the mostly for knowing the sex of the foetus instead of the possible genetic anomalies.

(ii) Alarmingly, biological techniques are being increasingly misused to produce improved variety of infective agents for using them as **bioweapons.** Such misuse includes the development of antibiotic-resistant micro-oranisms with increased infectivity.
For example, anthrax is an acute infectious disease caused by the spore-forming bacterium **Bacillus anthracis.** Spores of **B. anthracis** can be produced and stored in a dry form keeping them viable for decades in storage or after release. If a cloud of anthrax spores is released at a strategic location to be inhaled by the individuals under attack may act as an agent of effective weapon of **bioterrorism.**

Important points :-

- ✪ Steps of Scientific Method: - Observation, Hypothesis formulation, Testing of Hypothesis and Developing Theories.
- ✪ **Fleming** discovered penicillin in the culture of the bacterium , **Staphylococcus.** The penicillin found by Fleming was a toxic product of the blue mould **Penicillium notatum** that contaminated his culture of bacteria and was destroying the bacteria.
- ✪ **Cuvier** was the first to identify the fossils of extinct bird-like reptile and laid the foundation of palaeontology.
- ✪ **Lamarck** first **discarded** the idea of **'fixity'** of species. Schlieden the first statement on cell theory.
- ✪ **Darwin** proposed natural selection as a mechanism of evolution of species.
- ✪ The concept of spontaneous origin of life was countered by **Pasteur,** who proposed the germ theory of disease.
- ✪ **James D. Watson** and **Francis H.C. Crick** discovered the structure of Deoxyribo Nucleic Acid (DNA) in 1953 and this triggered a new ear of molecular biology.
- ✪ **W.T. Astbury,** a British scientist, first used and defined the term 'molecular biology' in 1950.
- ✪ **Har Gobind Khorana** shared the Nobel Prize in 1968 with **Robert W. Holley** and **Marshall W. Nirenberg** "for their interpretation of the genetic code and its function in protein synthesis."
- ✪ **Norman Ernest Borlaug** won Nobel Prize in 1970 for his "green revolution".
- ✪ **Ian Wilmut** and **Campbell** produced the first live, healthy sheep clone, **Dolly,** form fully differentiated adult mammary cells in 1996.
- ✪ In an attempt to reap the fruits of genetic engineering , the U.S. Department of Energy and the National Institute of Healths has launched the U.S. Human Genome project in 1990. The project aims to identify all the approximate 30,000 genes in human DNA determine the sequences of the 3 billion chemical base pairs that make up human DAN.
- ✪ The scientific classification of organisms, including their naming and identification is called **Taxonomy or Systematics.**
- ✪ **Morphology** is the aspect of biology that deals with the study of form, shape, size and structure of plants and animals.
- ✪ The study of morphology of internal systems or organs constitutes what is called **Anatomy.**
- ✪ The historical change in the properties of a population of organisms over generations is called **organic evolution** and this branch of biology is considered as **Evolutionary Biology.**
- ✪ The study of fossils is called **Palaeontology.**
- ✪ The study of the structure and composition of cells and tissues under the microscope is called **Cytology** and **Histology** respectively.
- ✪ The branch of biology that deals with the mechanism of functioning of the life processes is referred to as **Physiology.**

VARIOUS BRANCHES OR PROFESSIONS FOR BIOLOGIST

- **Agronomy** : Management of farms and the science of crop production.
- **Soil Science** : Study of soil and its conservation.
- **Pathology** : The science dealing with the nature of diseases, their causes, symptoms and effect.
- **Breeding** : To produce improved varieties by selective mating.
- **Veterinary medicine** : Science dealing with the diseases of domesticated animals and their health care.
- **Entomology** : A branch of zoology deals that with the structure, habits andclassification of insects.
- **Fishery** : The occupation or industry of catching fish or other products of the sea, lakes or rivers.
- **Poultry Science** : Science dealing with domestic fowls, such as chickens, Ducks and geese.
- **Sericulture** : The breeding and treatment of silkworms for producing raw silk.
- **Apiculture** : The rearing of bees, beekeeping for commercial purposes.
- **Forestry** : The science of developing and conserving forests.
- **Microbiology** : The science dealing with the structure, function, uses of microscopic organisms.
- **Food technology** : Processing and preservation of foods.
- **Biomedical Engineering** : Production of spare parts for man implants, artificial limbs, heart and lung machines etc.
- **Medicine** : The science of treating diseases with drugs or curative substances.

OTHER BRANCHES

- **Agrastology** : Study of grasses
- **Algalogy** : (Phycology). Study of algae.
- **Anaesthesiology** : Branch dealing with practice of anaesthesia (induction of inability to feel pain).
- **Angiology** : Study of blood vascular system including arteries and veins.
- **Anthology (Bessey)** : Study of flower and flowering plants.
- **Anthropology** : Study related to origin, development and culture of present and past races of humans.
- **Araneology** : Study of spiders.
- **Arboriculture** : Cultivation of trees and shrubs.
- **Arthrology** : Study of joints.
- **Auanology** : Study of growth
- **Bacteriology** : (Ehrenberg). Study of bacteria.
- **Biochemistry** : (Neuberg. 1903). Science connected with chemistry (composition, chemical nature, mode of formation, functioning) of living matter.

- **Bioenergetics** : Flow of energy and energy transformations.
- **Bionomics** : Ecology.
- **Bonsai** : The art and hobby of growing dwarf form of trees and shrubs in pots.
- **Bryology** : Study of bryphytes.
- **Cardiology** : Study of heart
- **Chirology** : (Cheirology). Communication system for deaf and mute by sign language.
- **Chondrology** : Study of cartilages
- **Cnidology** : Study of coelenterates
- **Craniology** : Study of skulls.
- **Demography** : Study of populations.
- **Dentistry** : Care of teeth including cure, removal, filling and replacement.
- **Dermatology** : Study of skin and other body coverings.
- **Desmology** : Anatomy / study of ligaments.
- **Endocrinology** : Study of endocrine glands, hormones and their effects.
- **Enzmology** : Study of enzymes and their functions.
- **Epidemiology** : Study of distributions, causes and control measures of infection diseases.
- **Ethology** : Study of animal behaviour.
- **Floriculture** : Cultivation of plants for their flowers.
- **Gastroenterology** : Study of alimentary canal or stomach, intestine and their diseases.
- **Geology** : Science of earth.
- **Gerontotherapy** : Treatment of disease in the aged.
- **Gerontology** : Study of ageing and senescence.
- **Gynaecology** : Study of female reproductive organs.
- **Haematology** : Study of blood.
- **Helminthology** : Study of parasitic worms.
- **Hepatology** : Study of liver.
- **Herpetology** : Study of reptiles and amphibians/creeping animals.
- **Hypnotherapy** : Treatment through hypnotism.
- **Ichthyology** : Study of fishes.
- **Immunology** : Study of immunity or resistance to disease.
- **Kinesiology** : Science dealing with inter-relationship of anatomy and physiology with respect to movements.
- **Laryngology** : Study of larynx.
- **Leprology** : Study of leprosy and its cure.
- **Lichenology** : Study of lichens.
- **Malariology** : Study of various aspects of malaria and its cure.
- **Mammology** : Study of mammals.
- **Mastology** : Study of breasts including teats.
- **Melanology** : Study of development and loss of body pigments.
- **Monerology** : Study of monera.

- **Mycology** : Study of fungi.
- **Myology (Sarcology)** : Study of muscles.
- **Neurology** : Study of nervous system.
- **Odontology** : Study of teeth and gums.
- **Oncology** : Study of cancers and tumours.
- **Ophthalmology** : Study of eyes.
- **Ornithology** : Study of birds.
- **Orthopaedics** : Diagnosis and repair of disorders of locomotory system (bones, joints, etc).
- **Osteology** : Study of bones
- **Paediatrics** : Branch of medicine dealing with children.
- **Parasitology** : Study of parasites.
- **Phylogeny** : Evolutionary history.
- **Physiotheraphy** : Treatment of body defects through massage and exercise.
- **Protistology** : Study of protests.
- **Radiology** : Science dealing with X-rays and other imaging techniques for medical diagnosis.
- **Rhinology** : Study of nose and olfactory organs.
- **Rhinoplasty** : External alteration of nose through surgery.
- **Serology** : Study of serum; interaction of antigens and antibodies in the blood.
- **Serpentology** : (= Ophiology), Study of snakes.
- **Sonography** : Ultrasound imaging.
- **Sonology** : Study of hearing.
- **Toxicology** : Study of harmful effects of drugs and other substances.
- **Tricology** : Study of hairs.
- **Urology** : Science dealing with structure, functions and disorders of urinary tract (urinogenital tract in males).
- **Virology** : Study of viruses.
- **Zoogeny** : Origin and development of animals.
- **Zoogeography** : Study of geographical distribution of animals.
- **Zoopathology** : Study of animal diseases.

Contributions	Contributors
Cell theory	Schleiden and Schwann
Central Dogma of Molecular Genetics (Name)	Crick
Chromosomal Theory of Linkage	Morgan and Castle
Chromosomal Theory of inheritance	Sutton and Boveri
Cohesion Theory of Ascent of Sap	Dixon and Jolly
Double fertilization of Angiosperms	Nawaschin and Guingard
Gene Theory (Linkage of genes)	Morgan
Germplasm Theory	Weissmann
Germ Theory of disease	L.Pasteur
Induced fit Hypothesis of enzyme	Koshland
Mutation Theory	Hugo de Vries
Omnis cellula e cellula	R. Virchow
One gene one enzyme theory	Beadle and Tatum
Operon Concept of Gene action	Jacob and Monod
Organic evolution	Darwin and Wallace
'Protoplasm is the physical basis of life' (Book)	Huxley
Sol gel theory of amoeba locomotion	Hyman, Pantin and Mast
Survival of the fittest (trrm)	Spencer
Telome Theory of Pteridophyta	Zimmermann
Theory of Accquired characters	Lamarck
Theory of Natural Selection	Charles Darwin
Tunica Corpus Theory	Schmidt

INVENTIONS AND DISCOVERIES

Inventions and discoveries	Contributors
ATP	Lohmann (1929)
Blood groups A, B and O	K. Landsteiner (1900)
Blood groups AB	de Castello and Sturli (1902)
C_3 pathway of plants	Malvin Calvin
C_4 pathway of plants	Hatch and Slack
Chargaff's rule of DNA base composition	Chargaff
First test tube baby	Edwards and Steptoe
First vaccination	Edward Jenner
Heterothallism in fungi	Blakeslee
Insecticidal properties of DDT	Muller (1939)
Jumping genes (transposons)	Mc Clintock
Patau's syndrome	K. Patau
Penicillin	A. Fleming (1920)
Photophosphorylation in chloroplast	Amon
TMV virus (discovery)	Lwanowski
Vitamin	Funk (1911)

CONNECTING AND MISSING LINKS OF BIOLOGICAL WORLD

Link	Between the groups
Actinomycetes	Bacteria and Fungi
Archaeopteryx	Birds and Reptiles
Balanoglossus	Chordates and nonchordates
Chimaera (rat or rabbit fish)	Bony and Cartilagenous fishes
Club moss	Bryophytes and Pteridophytes
Cycas	Pteridophytes and Gymnosperms
Gnetum	Gymnosperms and Angiosperms
Neopilina	Annelida and Mollusca
Ornithorhynchus (Duck billed Platypus)	Reptiles and Mammals
Peripatus (Walking worm)	Annelida and Arthropoda
Protopterus (Lungfish)	Pisces and Amphibia
Rickettsia	Virus and Bacteria
Virus	Living and non-living

COMMON ABBREVIATIONS IN BIOLOGY

ABA	Abscisic acid
ACTH	Adrenocorticotrophic Hormone
ADH	Antidiuretic Hormone
AIDS	Acquired Immuno Deficiency Syndrome
ATP	Adenosine triphosphate
ATPase	Adenosine triphosphatase
BCG	Bacille Calmette-Guerin (attenuated form of tuberculosis)
BMR	Basal Metabolic Rate
BOD	Biological Oxygen Demand
2,4-D	2,4-Dichlorophenoxyacetic acid
DDT	Dichloro diphenyl trichloroethane
DLC	Differential Leucocyte Count
ECG	Electrocardiogram
EDTA	Ethylenediamine tetra acetic acid
ELISA	Enzyme-Linked Immunosorbent Assay
FAD	Flavin adenine dinucleotide
FADH	Reduced Flavin adenine dinucleotide
FMN	Flavin mononucleotide
GDP	Guanosine diphosphate
GLC	Gas-Liquid Chromatography
Hfr	High frequency recombination cell
HIV	Human Immunodeficiency Virus
HMP	Hexose Monophosphate Pathway
IAA	Indole Acetic Acid
IMI	Intramuscular Injection

LH	Luteinizing Hormone
LSD	Lysergic Diethylamide
NAA	Naphthalene Acetic Acid
NADP	Nicotinamide adenine dinucleotide phosphate
NOR	Nucleolar organizing region
OPV	Oral Polio vaccine
P680	Reaction centre of Photosystem II
P700	Reaction centre of Photosystem I
PEP	Phosphoenol pyruvate
PFR	Phytochrome far red
PR	Phytochrome red
RB	Red blood corpuscles
RUBP (RUDP)	Ribulose bishosphate
Rubisco	Ribulose bisphosphate carboxylase oxygenase
TLC	Thin Layer Chromatography or Total Leucocyte Count
TMV	Tobacco mosaic virus
UTP	Uridine triphosphate
WBC	White blood corpuscles

TALLEST

Angiosperm	Eucalyptus (Australian species, 114m)
Animal	Giraffe (Giraffa camelopardalis)
Gymnosperm	Sequoia sempervirens (111.25 m)
Monocot Plant	Date palm (Phoenix dactylifera)

SMALLEST / SHORTEST

Angiospermic flower	Wolffia (0.1 mm)
Angiospermic plant	Lemna (Duckweed)
Ape	Gibbon
Bone in man	Ear ossical Stapes (2. 6-3.4mm)
Bird	Humming bird of Cuba, (helenae)
Cell	PPLO
Cell of vertebrate	Squamous epithelium
Endocrine gland	Pituitary
Gymnosperm	Zamia pygmea
Invertebrate Major Phyla	Porifera
Number of animal chromosome	Ascaris (2)
Number of plant chromosome	Haplopappus gracilis (2n =4)
Pollen grain	Orchid
Pteridophyta	Azolla

Longest

Bone of man	Femur
Cell	Neuron
Creeper (Plant)	Elephant creeper (Entada pursaetha)
Leaf	Raphia vinifera (30-50 ft)

Largest/Biggest/Heaviest

Alga	Macrocystis macrocarpa (Brown alga, Kelp 60 m)
Amphibian	Cryptobranchus
Antherozoid	Cycas circinalis
Archegonium	Bryophyte (Moss)
Biome (richest in terms of plant species)	Tropical rain forest
Bird sanctuary	Bharatpur
Class (of plantae)	Angiosperms
Coral reef in world	Great barrier reef of North East Coast of Australia (2 X 103 kms.)
Exocrine gland	Liver
Flower	Rafflesia arnoldi
Largest Forest area in India	Madha Pradesh
Number of Animal chromosomes	Aulocantha (Radiolarian; = 1600)
Number of Plant chromosomes	Ophioglossum (Pteridophyte, Adler's tongue, 2n = 1262)
Plant cell	Acetabularia (green alga)
Pollen grain in Angiosperms	Mirabilis
Primate	Gorilla
Phylum (of Animals)	Arthropoda

IMPORTANT DATES

Antileprosy day	30 th January
Blood Donation day	Ist October
Doctor's Day	Ist July
Human Right day	10th December (To commemorate the death of Alfred Nobel)
International day of Biodiversity	29th December
International Thalassaemia day & World Red. Cross day	8th May
Kisan Divas (National Farmer's Day)	23 rd December
National Pollution Prevention day	2 nd December
Van Mahotsava (Festival of tree Plantation)	1 st week of February and July
Vigyan Dives (National Science day)	28 February
World AIDS day	1 st December
World Earth day	22 nd April

World Environment day	5th June
World Forest day	21st March
World Health day	7th April
World Literacy day	8th September
World Ozone day	16th September
World Population day	11th July
World Wild Life Week day	1st Monday of October.

GLANCE AT HUMAN BODY

Largest artery		Abdominal aorta
Largest bone		Femur
Largest heterocrine organ		Alimentary canal
Largest endocrine gland		Thyroid
Largest gland		Liver
Largest salivary gland		Parotid gland
Largest vein		Inferior Vena cava
Least regenerative capacity		brain
Longest cell in the body		Neuron
Longest cranial nerve		Vagus
Longest nerve of the body		Sciatic
Muscles:	Number	639
	Smallest	Stapedius
	Largest	Gluteus maximus
	Longest	Sartorius
Number of cranial nerves		12 pairs
Number of spinal nerves		31 pairs
Smallest cranial nerve		Abducens
Smallest endocrine gland		Pituitary
Speed of Sneezing		60-100 miles/hour
spinal cord:	weight	35 gm.
	length	42-45 cm.

(2) UNDERSTANDING OF LIFE

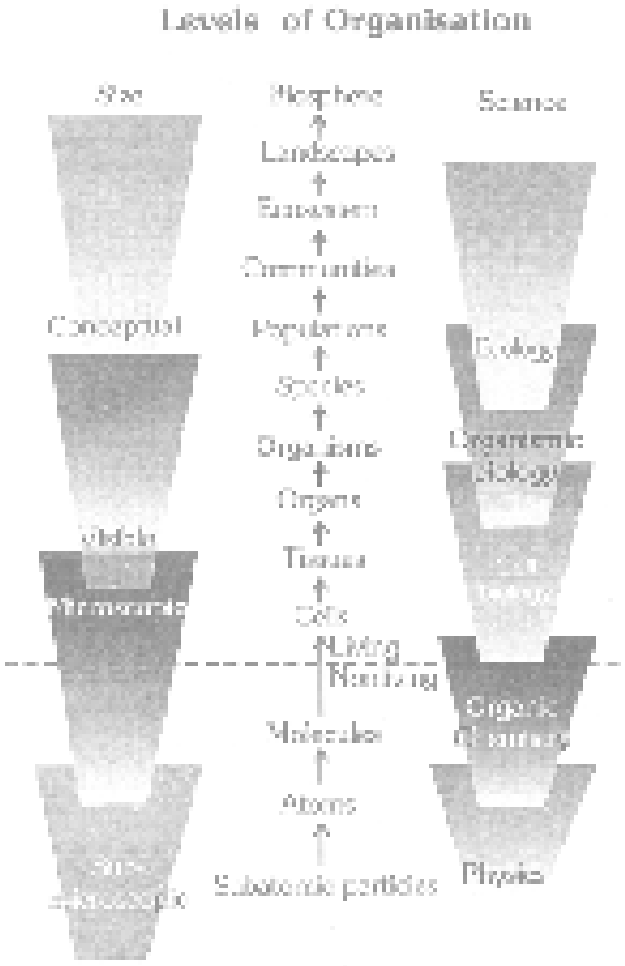
- ✪ The dictionary meaning of life is the property that distinguishes living beings from non-living objects.
- ✪ Protoplasm is the physical basis of life.

The basic features of living organisms:-

(i) Cellular structure (ii) Metabolism (iii) Irritability and Sensitivity (iv) Adaptation
(v) Growth and Development (vi) Reproduction (vii) Homeostasis

Levels of Biological Organisation –

- ✪ Biological organisation starts with submicroscopic **molecular level** passes through microscopic cellular level and microscopic or macroscopic **organismic level** and ends the **biosphere.**
- ✪ The hierarchy of biological organisation reveals that atoms are the lowest unit at the molecular level while the cells are smallest unit at microscopic level.
- ✪ With in the ecosystem, an individual forms the smallest unit. A larger unit then ecosystem is the landscape, which is a geographical unit with history.



Various levels of organisation and the related branches of science

Organisation is Regulated by four Processes :-

1. **Aggregation :** Coming together e,g. atoms molecules , cells form tissues and individuals form population.
2. **Interactions :** Partners of an aggregate are influenced by one another.
   e.g. hydrogen and oxygen in water, population forms a community.
3. **Equilibrium :** Development of coordination or stability e.g. Breathing by various organs.
4. **Change :** A new product or structure e.g. water and H_2O_2 from hydrogen and oxygen.
   In nonliving world the organisation level is upto the level of molecule and compounds they aggregate to form mixture, colloids and crystals.

Atoms :- Nature's building material -

- ✪ Any material in the universe that has mass and occupies a space is defined as matter. The building blocks of matter are atoms . Atoms aggregate and constitute elements.
- ✪ About 98 percent of the mass of every living organism , be that a bacterium or a human being is composed of just six elements, such as carbon (C) hydrogen (H), nitrogen (N), oxygen (O), phosphorous (P) and sulphur (S).
- ✪ Elements that are required by an organism in minute quantities are considered as trace element.
  e.g. Ca, K, Na,, Mg, I etc.

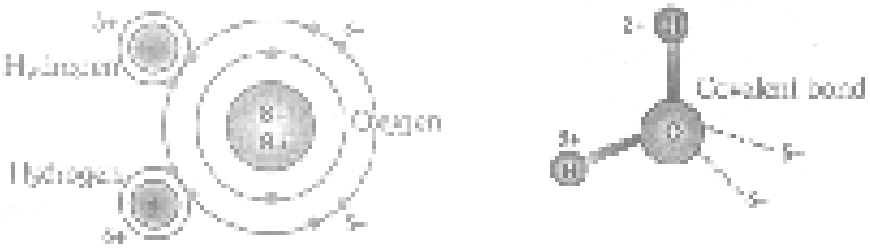
Micromolecules and Macromolecules

About 5000types of biomolecules are found in living beings, which are divided in two categories.

1. **Micromolecule:** They are small in size and have low molecular weight. e.g. H_2O, NaCl, Glucose, Amino Acids.
2. **Macromolecules:** They are large in size, have high molecular weight and are complex molecules. They are formed by the condensation or polymerization of micromolecules.
   e.g. Proteins, Polysaccharides, nucleic acids.

Water is the Polar Molecule –

Molecules that exhibit charge separation are called **polar molecules** because of their magnetic poles. Water is a polar molecule. In the water molecule, the oxygen atoms bears a partial negatively charge (δ-) and each hydrogen atom a partial positive charge (δ+) . In liquid water, the negatively charged oxygen atom of one molecule of water is attracted to the positively charged hydrogen atom of another molecule of water. The bond resulting from this attraction is called a **hydrogen bond.**

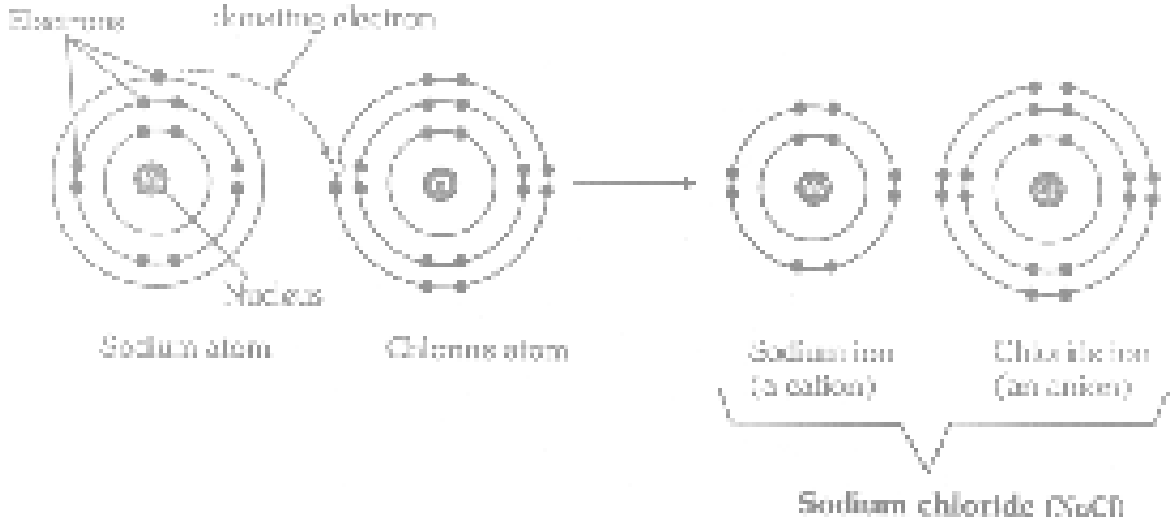


Water is a Polar Molecule

Hydrogen Bonds are of Great Advantage in the Biological System –

A hydrogen bond is a weak bond. It has about one-tenth (10%) of the strength of a covalent bond between a hydrogen atom and an oxygen atom. Weak hydrogen bonds are of great advantage in the biological systems. The reason is that the contact between the molecules becomes very brief. The molecules separate immediately after reacting with one another.

Electron Transfer and Ionic Bonding in Sodium Chloride:-



- ✪ Sodium chloride plays an important role in the maintenance of erythrocytes in the blood.
- ✪ Na+ and Cl-ions participate in the transport of materials through cell membrances.
- ✪ About two-third of our body is formed of water. Between 70% and 90% of living cells is water.
- ✪ Water is an effective solvent because it is capable of forming hydrogen bond.

Principal Inorganic Source of Carbon (CO_2) –

Our atmosphere contains only about 0.03 percent carbon dioxide (CO_2). Before it can take part in chemical reactions, CO_2 needs to get dissolved in water. The thin aqueous film covering almost every cell is sufficient to dissolve CO_2 .The dissolved CO_2 then reacts with water and forms carbonic acid. CO_2 and H_2O are the raw materials from which plants produce many complex essential organic compounds.

Macro molecule –

- ✪ Large and complex assemblies of simple biological molecules are called macromolecules.
- ✪ Macromolecules are traditionally grouped into four major categories : carbohydrates, lipids or fats, proteins and nucleic acids.

Carbohydrates	**-**	**The Main Energy Storage Molecules**
Lipids	**-**	**Major Group of Insoluble Hydrocarbons having Many functions**
Protein	**-**	**A structural and Functional Make up of Cells**
Nucleic Acids	**-**	**Information Storage Device of Cells**

Important Points –

- ✪ Membranes often contain **steroids.** This is a type of lipid that contains **four carbon rings.** The steroid **cholesterol** is present on most of the animal cell membranes.
- ✪ **Terpenes,** component of many biological pigments (e.g. chlorophyll in plants and the visual retinal pigment of animals), are long chain lipids. **Rubber** is also a **terpene.**
- ✪ **Prostaglandins** are formed of 20 carbons and are modified fatty acids. **Prostaglandins act as local chemical messenger in many vertebrate tissues.**
- ✪ All proteins are formed of sub-units called amino acids.

- ✪ It is the chemical properties of the side groups of amino that determine the types and functions of proteins
- ✪ If the side group is polar or ionic, the amino acid is soluble in water and if it is nonpolar at a pH 6.5 to 7 the amino acid is insoluble in water.
- ✪ The amino acids building blocks linked together by covalent bonds called peptide bonds. These bonds form a chain of amino acid units which is called polypeptide chain. Protein molecules often consist of more then one polypeptide chain.
- ✪ About 50 percent of the dry weight of living matter is protein. Most organisms have between 1000 and 50,000 proteins.
- ✪ The nucleic are linear polymers of repeating monomer subunits called **nucleotides.** Each nucleotide is formed of a pentose sugar, a phosphate group and a nitrogenous base (purine or pyrimidine).

Energy:

- ✪ Energy is the capacity to do work. It exists in several forms – Eg. mechanical energy, sound energy, chemical energy, thermal energy, kinetic energy, potential energy etc.
- ✪ All the thing (Living or nonliving) contain energy in some or the other forms.

The Energy Transfer Devices of Life –

Cellular activities such as growth, motion and active transport of ions the cell membrane require energy. No cell manufactures energy but all organisms take in energy and transform it into other kind to do many kinds of work. Green plants and bacteria take in solar energy to produce their own chemical energy (food).

Energy is often Transferred with Electrons –

All atoms possess energy. It takes work to keep the electrons in the orbital of an atom. Virtually, all the energy for living organism comes as radiation in the form of photons from the and is captured by electrons.

During chemical reactions electrons are transferred from one atom to another. The loss of an electron is called oxidation, whereas the gain of an electron is regarded as reduction. Oxidation-reduction (redox) reactions play a key role in the flow of energy through biological systems.

What is Enthalpy and Free Energy?

- ✪ In a biological system, the total energy including usable energy that can do work and unusable energy that is lost to disorder is called **enthalpy.**
- ✪ The amount of usable energy that is available for doing work temperature and pressure are uniform throughout the system is the **free energy.** It is 'free' because it is available for work under certain conditions.

Note:

Activation Energy:- The energy required to destabilize chemical bonds and to initiate a chemical reaction is called **activation energy.**

Spontaneous Reactions: - Reactions that occur without outside intervention, release free energy and can perform work are called **spontaneous reactions.**

Exergonic Reactions: - Energy yielding chemical reactions are known as **Exergonic reactions.**

- ✪ An Exergonic reaction has an endergonic first step because for two molecules to combine, they must come unusually close and one or more pre-existing bonds must break frequently.

Endergonic Reaction: - A chemical reaction to which a net input of free energy from outside source is needed for its initiation is called endergonic reaction.

How Energy Flows :-

✪ **Energy and its transformation is governed by two basic laws thermodynamics –**

1. First Law of Thermodynamics :-

Energy can neither be created nor destroyed. Energy keeps changing from to another form.
Eg.Radiant energy into chemical energy in photosynthesis. Chemical energy of cell is transformed into various forms of energy.

2. Second Law of Thermodynamics or Law of Entropy:

✪ Any system like this universe when left to itself tends to increase 'Entropy'. Entropy means disorder or randomness.

✪ This law states that every transfer or transformation of energy makes the universe disordered. Energy keeps flowing from higher to lower energy areas, the loss of energy occurs in these energy changing reactions . This loss of energy is always dispersed into unailable heat energy. So no transformation of energy is 100% efficient . This loss energy increase entropy in a system.
Free energy from sun minimizes entropy. All living things need a continuous input of energy so as to maintain order. This is taken from sun either directly like green plants or indirectly from food.

Energy transfer or energy transformation

All matter (living or non living) contains energy. Energy is the capacity to do work. Energy can neither be created nor destroyed. This is the first law of thermodynamics.
Whenever work is done energy is either transformed or transferred . Such change in energy occur continuously in a living cell.

✪ **Example of energy transformation:-**

Light energy from Sun → By photosynthesis in green cells → Into chemical energy in the form of food molecules.

✪ **Example of energy transfer:-**

Respiration → Energy formed (Stored in the form of ATP) → Used in synthesis, growth, development, repair

Entropy

When there is a transfer of energy from one system to another then, there is a loss of energy in this process i.e. whole (100%) energy is not transferred.
When continuous loss of energy takes place then entropy increases (i.e. degree of randomness increases) and due to much increase in entropy, cell or organism (system) can die. Therefore in case of high entropy or in conditions of high energy loss, the cell is provided with an extra source of free energy. And the loss of energy is maintained.
The free energy decreases the entropy i.e. balance the loss of energy. There are many sources of free energy **– for e.g. –**

(1) Trapping of solar energy by autotrophic plants.
(2) Synthesis of energy from food.

Organisms are Open systems

If energy can never be destroyed (First law of Thermodynamics) then what prevents the recycling of energy ? Answer to this question can be found in the Second law of Thermodynamics. The term 'system' denotes any part of the universe containing specified matter and energy and whose energy transformations are studied in thermodynamics . The rest of the universe remains outside the system and is considered as surroundings. In an open system, such as living cells, matter and energy can be transferred between the system and the surroundings. The very term 'open' refers to the fact that there is exchange of materials and energy between the organisms and their surroundings.

- ✪ **Organisms are open systems because they interact continuously with their environment.**
- ✪ A **closed system** is one that does not exchange matter and energy with its surroundings. For instance, a warm liquid is placed in a thermos flask or a bottle and the lids are tightened . The thermos flask more or less represents a **closed system.** There is no question of exchange of matter between the internal environment of the thermos flask and its surroundings. So far as energy is concerned, the liquid remains warm for considerable period of time, dependignupon the efficiency of the thermos flask. During this period, the heat energy of the liquid is not released outside and it moves inside. This keeps the liquid warm. Hence thermos flask represents an example of closed system.
- ✪ The first law of thermodynamics applies to the universe as a whole or to any close system in the universe.

Open system, Steady state and Homeostasis

- ✪ **Open system:** The system which has a continuous inflow of energy (direct of indirect) is called an open system. A living organium must have constant access to free energy or also its organisation will collapse over time, leading to death.
- ✪ **Steady state :** When the rate of input of matter and energy equals to the rate of output of matter and energy it is called steady system.

  For e.g., living organism must be continuously supplied with inputs such as water, O_2, energy and a variety of materials. Without these, the organism can not maintain itself. There must also be an output of CO_2, nitrogenous waste and heat which are products of chemical reactions, and which would be harmful to the organism if they are allowed to accumulate.

  O_2 → Cell → CO_2

  Glucose → Cell → Waste products (Nitrogenous compound)

Homeostasis – A function of Regulatory system

All organisms maintain relatively constant internal conditions different from their environment. For this, many organisms have regulatory mechanisms, which co-ordinate their functions, such as providing the cells with nutrients, transporting substances through the body. Others simply adjust to the environment by adopting the temperature, salinity and other physical aspects of their surroundings.

- ✪ **In any case, maintenance of a dynamic constancy of the internal environment or steady state is termed as homeostasis.**

Example of Homeostasis :-

(1) When you enter a darkened cinema hall from bright you can see almost nothing at first. Within a few seconds you are able to adjust your sight to the dim light and move about.

(2) Our heart normally beats at a constant pace of 72 times per minute. Bu t when we run, the rate of heart beat increases. This is because of the need for increased and faster blood supply to the tissues which have done extra work. But after sometime the normal rate of heart beat is restored.

(3) The body temperature rises after exercise. It leads to increased sweating. As the sweat evaporates the body cools and the body temperature lowers down.

(4) Soon after meals blood glucose level rises due to absorption from alimentary canal. Pancreas produces insulin which induces glycogenesis in liver and muscles (Glucose→ Glycogen). Due to this glucose level in blood falls.

(5) Concentrated urine is produced whenever the body has less water availability. This is done by ADH (Secreted by pituitary gland). This hormone increases the permeability of the wall of DCT and collecting duct. While in case of excess water ADH is not secreted and dilute urine is passed out.

Thermoregulation

- ✪ In the living cells, thermal energy (heat) is produced during exergonic reactions of metabolism . The vast majority of vertebrates (fishes, amphibians, reptiles) and plants lose most of their thermal energy to their environment. Such animals are called **ectothermic.** These organisms often depend on their environment for temperature regulation. Their skin may appear as either cold or warm, depending on the environment from which they have been taken for examination. If any one of them is picked up from a hibernaculum or caught beside a cold body of water, it is likely that the skin will be cold. This is the reason for calling them as **poikilothermous.** Alternatively, if an animal is examined during warm afternoon while it was basking in the sun, its skin will appear warm. Actually, these animals save energy for utilizing it in other functions like reproduction.
- ✪ Mammals, birds and a few fishes (e.g. tuna fish and sword fish), instead of losing thermal energy, actually retain it for use. They have developed insulating devices, such as fat, hair, feathers, etc., for retardation of heat loss to the environment. They are **endothermic.** Their body temperature remains relatively constant, which is usually higher then that of the environment. For this reason they are called **homeothermous.**

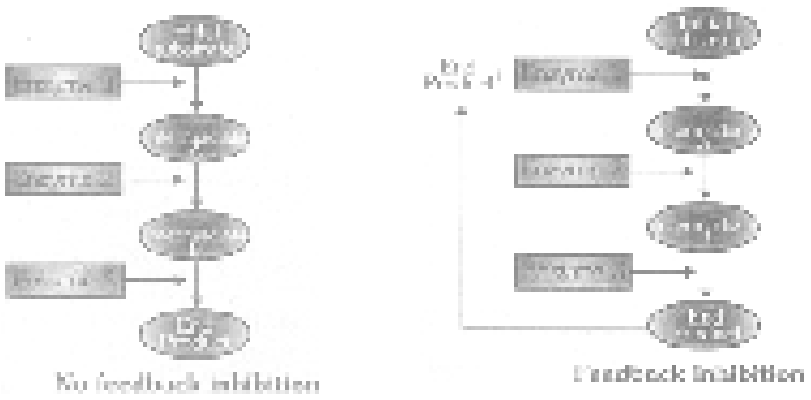
- ✪ **Mammals, birds and a few fishes are endothermic and homeothermous because they retain thermal energy with the aid of thermoreceptors.**

Homeothermy in Humans

- ✪ Being a mammal we are endothermic and homoeothermic as well. To maintain the body temperature, which is 37^0C(98.6^0F), we havesensors that detect the set point. This can be compared with the functioning of the thermostat of a room air-conditioner machine . Usually , the temperature of the thermostat is set at 21 0 C (700 F). If the temperature of the room rises sufficiently above the set point, a sensor present within the thermostat detects the change and activates the effector of the machine. The air-conditioner then reverses the deviation from the set point of the thermostat. Finally, the room temperature is controlled at the set point of the thermostat.
- ✪ Our skin contains two types of sensory neurons . They are sensitive to the changes in temperature outside our bodies. They are termed as **thermoreceptors.** Some of them are sensitive to cooler temperatures and are called **cold receptors,** while the others are sensitive to warmer temperatures and are called **warm receptors.** The former set is stimulated by fall in temperature and the rise in temperature. **Conversely, warming inhibits cold receptors and cooling inhibits warm receptors.** The warm receptors are located immediately below the epidermis (skin), while the cold receptors are located slightly deeper in the dermis. We have thermoreceptors also within the hypothalamus of our brain. These receptors monitor the temperature of the circulating blood and send the information of the body's internal (core) temperature to the brain.
- ✪ The thermoreceptors of the skin sense, say for example , any rise in external temperature caused by a perturbing factor like the sun, and send the message to the thermoreceptors of the hypothalamus, which detect the change in the accompanying body temperature. The hypothalamus now responds by activating the effector, that is, the sweat glands and the blood vessels of the skin. As a result, release of sweat and dilation of the blood vessels are initiated, which cause cooling and diffusion of body temperature. In other words, the set point is defended by the hypothalamus. Since the regulation of temperature is by cooling the body, in this case, it is in the negative side or reverse direction. This type of control system is called **negative feedback loop.**

Biochemical Pathways are Tightly Regulated:-

- ✪ Operation of each metabolic pathway is tightly under the control of cell's regulatory systems. Enzyme activity is sensitive to the presence of specific substances that bind to the enzymes. A substance that binds to an enzyme and decreases its activity is called an **inhibitor,** if it increases the activity of an enzyme it becomes an **activator.**
- ✪ The regulation of simple biochemical pathways often depends on the allosteric site on the enzyme that catalyses the first reaction in the pathway. **An allosteric site is the part of an enzyme, away from its active site, that can switch on/off the enzyme's function.** In the metabolic pathways, the product of one reaction may serve as the substarate for the next reaction. When necessary, the final end product of one pathway may become the **allosteric inhibitor** for the action of the first enzyme of that pathway. This method of regulating mechanism is called **feedback mechanism.** Thus the regulation of simple biochemical pathways often depends on the feedback mechanism.



Adaptation –

- ✪ Adaptation to the environment is one of the most distinctive features of living beings.
- ✪ **Adaptation** may be defined as any characteristic of an organism, which makes the organism better suited to its environment.
- ✪ Adaptation may be structural, physiological or behavioural in response to the environment.

Types of Adaptations:-

1. **Long term Adaptations: -** They are permanent inheritable changes in structure and function produced in an organism due to evolution for better mode of living and adjustment with the environment.
   - **(a)** Protrusion of ankle bone for standing erect.
   - **(b)** Opposable thumb for holding and gripping
   - **(c)** The beaks of birds are of different shape for their specific feeding habits.
   - **(d)** The kangaroo uses its thick tail as a fifth limb to balance its body.
   - **(e)** The desert plants are either leaf less or have leaves modified to spines to check the loss of water, stem are water storing and have thick cuticle covered by layer of wax.
   - **(f)** Female anopheles requires mammalian proteins for egg formation so their mouth parts are adapted for sucking blood.
2. **Short term adaptations :**They are temporary changes that are produced in response to specific conditions and are meant for adjustment to unfavourable conditions.
   - (a) Skin becomes dark on exposure to sun light due to accumulation of skin pigment melanin in the epidermis. It helps in protecting the underlying tissue from ultra violet rays of the sun.
   - (b) The dormant seeds suspend their activities and appear to be dead. In favourable conditions dormancy is broken and the seeds germinate.
   - (c) A hibernating animal suspends all the activities to save energy. It keeps its metabolic rate very low. It survives on stored fats.
   - (d) Plants show adaptative reactions e.g. phototropism (The shoot grows towards the light) Geotropism (The root grow towards the gravity)

Important Point:-

- ✪ Longest living plant – 43000 years old specimen of shrub **Lomatia termanica.**
- ✪ A living individual contains over 5000 types of biomolecules.
- ✪ Water constitutes 70-80% of living cells. Other constituents are 10-15 % protein, 10-15% Lipids 5% other inorganic substance are 1 % carbohydrates.
- ✪ Sodium chloride occurs in concentration of 0.9 gm/100 ml blood.
- ✪ Blood glucose level for normal functioning should be 100 mg/100 ml blood.
- ✪ Unit of measurement in cell biology is nanometer or millimicron.
- ✪ 3-D images are obtained with the help of scanning electron microscope and x-ray microscope, All others give 2-D images.
- ✪ SUDAN –III/IV is used for identification of FATS.
- ✪ Schiff reagent is specific for DNA. This reagent was developed by Schiff.

NATURE & SCOPE OF BIOLOGY EXERCISE-1

1. In ancient India which of the following is regarded as God of Medicine ?
(1) Susruta (2) Charaka
(3) Dhanvantari (4) Atreya

2. Who was the first physician in ancient India who developed the concept of digestion, metabolism and immunity ?
(1) Atreya (2) Charaka
(3) Agnivesa (4) Susruta

3. Which of the following is regarded as Father of surgery?
(1) Andreas (2) William Harvey
(3) Susruta (4) Atreya

4. Which of the following is honoured as Father of anatomy?
(1) Susruta (2) William Harvey
(3) Andreas Vesalius (4) Atreya

5. A plant classified as dicot but without visible cotyledon is:-
(1) Cuscta (2) Charaka
(3) Drosera (4) Dionaea

6. Science dealing with nose and olfactory organs is
(1) Rhinology (2) Radiology
(3) Dermatology (4) Kinesiology

7. The physical sufferings are often caused by bad deeds in the previous birth. It may be called:-
(1) Serenidipty (2) Teleology
(3) Control experiment (4) Hypothesis

8. Herpetology is study of:-
(1) Reptiles and amphibians
(2)Snake
(3) Helminths (4) Mammals

9. Lightest wood is:-
(1) Tectona (2) Morus
(3) Hard Wichita (4) Ochroma

10. The correct match is –

Scientists	**Associated with**
(i) William Bateson	A. Rediscovered Mendel's contribution
(ii) T.H. Morgan	B. Discovered that genes are made up of D.N.A.
(iii) O.T. Avery	C. Introduced the term genetics
(iv) Hugo de Vries	D.Created first gene map

	A	**B**	**C**	**D**
(1)	(i)	(ii)	(iii)	(iv)
(2)	(iv)	(iii)	(i)	(ii)
(3)	(iii)	(iv)	(i)	(ii)
(4)	(iii)	(iv)	(ii)	(i)

11. Match the names of branches of science listed under **Column I** with the fields of study given under **Column II.** Choose the correct combination of alphabets:-

Column I (Branch of science)	**Column II (Fields of study)**
A. Mycology	P. Study of bird
B. Ornithology	Q. Study of worms
C. Herpetology	R. Study of fishes
D. Ichthyology	S. Study of fungi
	T. Study of snakes

(1) A-P, B-S, C-R, D-T
(2) A-S, B-T, C-P, D-R
(3) A-Q, B-S, C-R, D-T
(4) A-S, B-P, C-T, D-R

12. Study of nuclcytology is:-
(1) Neurology (2) Mycology
(3) Rhinology (4) Karyology

13. Chemotherapeutic value of penicillin was given by
(1) A. Fleming
(2) Florey and chin
(3) Schultz and Waksman
(4) Flemming and Waksman

14. The correct match is:-

Column I (Science)	**Column II (Contribution)**
A. Andreas Vesalius	P. Micrographia
B. A.V. Leeuwenhoek	Q. De Humani Corporis Fabrica
C. W. Harvey	R. Species plantarum
D. C. Linnaeus	S. Philosophic Zoologique
E. Robert Hooke	T. Anatomical Exercise on the motion of the heart and blood
F. Lamarck	

(1) A-P, B-S, C-R, D-T
(2) A-S, B-T, C-P, D-R
(3) A-Q, B-S, C-R, D-T
(4) A-S, B-P, C-T, D-R

15. Scientist associated with Indian Palaeobotany is: **[BHU-93.Manipal-97]**
(1) P. Maheswari (2) Birbal Sahni
(3) M.O.P. Iyengar (4) Swaminathan

16. Circulation of blood was discovered by :- **[Manipal-95]**
(1) William Harvey (2) Karl Landsteiner
(3) Watson and Crick (4) Bose

17. Rearing of bees is:- **[RPMT-96]**
(1) Horticulture
(2) Apiary
(3) Apiculture
(4) Poultry

18. Branch of science connected with diagnosis, prevention and cure of mental disorders is :- **[AIMS-97]**
(1) Psychiatry
(2) Psychology
(3) Neurology
(4) Neuropsychiatry

19. Mexican dwart varieties of wheat were developed by:- **[C.E.T. chd.-97]**
(1) Sahani
(2) Swaminathan
(3) Borlaug
(4) Khush

20. Genetic engineering is connected with:-
(1) Development of transgenic plants
(2) Development of vaccination **[A.F.M.C.97]**
(3) Gene therapy
(4) All the above

21. Irrationalfearof disease is – **[AIMS-97]**
(1Algophobia
(2)Mysophobia
(3)Pathophobi
(4) Haematophobia

22. Improvement of human race through improvement of human environment is- **[MPPMT-98]**
(1) Eugenics (2)Euphenics
(3) Euthenics (4)Anthropology

23. Utilisation of living organisms for human welfare is: - **[Manipal, 98]**
(1) Ecobiology (2) Applied
(3) Basic biology (4) Biophysics

24. Metamorphosis is studied under: - **[B.V.-2000]**
(1) Neurology (2) Embryology
(3) Cardiology (4) Physiology

25. Study of human population growth comes under **[Kerla-2000]**
(1) Anthropology (2) Sociology
(3) Demography (4) Geography

26. Scientific enquiry about life in outer space is : **[Kerla-2000]**
(1) Exobiology (2)Cryobiology
(3) Investigative (4) Euphenics

27. In 1928, a scientist discovered the first effective antibiotic. Scientist and antibiotics are : **[A.I.I.M.S.2000, Manipal, 2000]**
(1) Fleming – streptomycin
(2) Fleming –pencillin
(3) Waksman – pencillin
(4) Waksman – streptomycin

28. Choose the correct pair :-
(1) Sericulture-Fish
(2) Apiculture-Honey Bee
(3) Pisciculture-Silkworm
(4) Silviculture-Silkworm

29. Match the columns **[Karnataka-2001]**

Column I	**Column II**
a Palynology	p Silkworms
b Oncolohy	q Pollen grain
c Phycology	r Cancer
d Sericulture	s Algae

(1) a – s, b – r, c – q, d – p
(2) a – q, b – r, c – s, d – p
(3) a –s, b – q, c – r, d – p
(4) a – r, b – q, c – s, d – p

30. Prevention of deterioration of human race through reducing birth rate among defective individuals is **[TNPCEE-2001]**

(1) Positive euthenics
(2) Negative euthenics
(3)Negative euthenics
(4) Positive euthenics

31. Which one of the following sequence is correct:

(1) Problem, defining, hypothesis, observation, experiment **[Pb. P.M.T. 2002]**
(2) Observation, problem, hypothesis, defining, experiment
(3) Observation, problem, defining, hypothesis, experiment
(4) experiment hypothesis, problem, defining, observation,

32. Match the columns and pick up the correct combination: - **[Har. PMT-2002]**

Column I	**Column II**
(a) Mendel	(i) Zoology
(b) Borlaug	(ii) Genetics
(c) Galton	(iii) Green revolution
(d) Aristotle	(iv) Eugenics

(1) a – (i), b – (ii), c – (iii), d – (iv)
(2) a – (ii), b – (iv), c – (i), d – (iii)
(3) a – (ii), b – (iii), c – (iv), d – (i)
(4) a – (iii), b – (iv), c – (i), d – (ii)

33. Study of ants in :- **[JIPMER-2002]**

(1) Mycology (2) Myrmecology
(3) Malacology (4) Myology

34. Branch of botany connected with food, fibre and wood yielding plants is :- **[MPPMT-2002]**

(1) Suaruta (2) Charaka
(3) Dhanvantari (4) Atreya

35. Acarology is study of:- **[MPPMT-2002]**

(1) Suaruta (2) Charaka
(3) Dhanvantari (4) Atreya

36. For solving a scientific problem which is not correct

(1) Suaruta (2) Charaka
(3) Dhanvantari (4) Atreya

37. Science of engineering and technology which is applied to life sciences is :- **[AFMC-2003]**

(1) Suaruta (2) Charaka
(3) Dhanvantari (4) Atreya

38. Match the column I and II and choose the correct answer :- **[Karnataka-2003]**

Column I	**Column II**
(a) Helminthology	p Study of insects
(b) Entomology	q Study of fungi
(c) Ornithology	r Study of algae
(d) Phycology	s Study of birds
(e) Phycology	t Study of worms

(1) a –p. b – s, c – q, d – t
(2) a – t, b – p, c – s, d – r
(3) a – s, b – t, c – r, d – p
(4) a–r, b–p, c–s, d–q

ANSWER KEY **EXERISE – 1**

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
24	**3**	**2**	**3**	**3**	**1**	**1**	**2**	**1**	**4**	**2**	**4**	**4**	**2**	**1**	**2**	**1**	**3**	**1**	**3**	**4**	**3**	**3**	**2**

Q.	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
A.	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**3**	**4**	**3**	**1**	**2**

1. All living beings show :-
(1) Irritability
(2) Irregular shape
(3) Locomotion
(4) Absence of coordination

2. Bending of a shoot towards light is :-
(1) Irritability
(2) Healing
(3) Regeneration
(4) A photochemical reaction

3. Physical basis of life is :-
(1) Cell (2) Nucleus
(3) Protoplasm (4) Food

4. Fuelgen test is specific for :-
(1) Proteins (2) RNA
(3) Lipids (4) DNA

5. Which type of organisation is found in only living beings :-
(1) Atomic (2) Mixture
(3) Molecular (4) Subcellular

6. Organisation formed by individuals of a species is :-
(1) Population (2) Ecosystem
(3) Community (4) All the above

7. Number of chemicals found in living cell is :-
(1) 25,000 (2) 2000
(3) 5000 (4) 500

8. Which one is a micromolecule :-
(1) Glucose (2) Protein
(3) DNA (4) Glycogen

9. Salt concentration of blood is :-
(1) 0.9 gm/100 ml (2) 9 gm/100 ml
(3) 100 mg/100ml (4)500mg/100 ml

10. Glucose concentration of blood for normal body function is :-
(1) 0.9 gm/100 ml
(2) 200 gm/100 ml
(3) 100 mg/100ml
(4) 500 mg/100 ml

11. Energy currency of a cell is :-
(1) Mitochondria (2) Golgi body
(3) DNA (4) ATP

12. Energy transfers or transformations are never 100% efficient . This is due to :-
(1) Entropy (2)Homeostasis
(3) Aggregation (4) Adaptation

13. During nerve conduction, electric energy is produced . What is the source of this energy:-
(1) DNA (2) RNA (3) ATP (4) ACTH

14. What type of energy is needed to make up the loss of energy in a living system :-
(1) Heat energy
(2) Free energy
(3) Light energy (4)Mechanical energy

15. Use of tail as fifth limb by Kangaroo is an example of-
(1) Short term adaptation
(2) Homeostasis
(3) Long term adaptation
(4) Energy transformation

16. Long term adaptation is :-
(1) Inheritable
(2) Formed due to evolution
(3) Permanent (4) All the above

17. Which organ remains functional for a few hours even after clinical death :-
(1) Minerals (2) Proteins
(3) Water (4) Fats

18. 80% of the living material of a cell is made of
(1) Minerals (2) Proteins
(3) Water (4) Fats

19. Sweating is meant for :-
(1) Killing of skin bacteria
(2) Regulation of body temperature
(3) Removal of excess salt
(4) Removal of excess water

20. 99% of living system is formed of four elements :-
(1) CHOP (2) CHOS
(3) CNOP (4) CHON

21. Ultimate source of energy is :-
(1) ATP (2) Sun
(3) Glucose (4) Food

22. Pox virus contains ..... vitamin :-
(1) Riboflavin (2) Biotin
(3) Both (1) & (2) (4) Transcriptase

23. If feedback inhibition a metabolic pathway gets 'Switched off' by :-
(1) Lack of substrate
(2) Accumulation of end product
(3) A rise in temperature
(4) Competitive inhibition

24. ACTH consists ..... amino acids units :-
(1) 8500 (2) 39
(3) 4500 (4) 910,000

25. Hemocyanin of snail consists of ..... amino acids :-
(1) 910,000 (2) 8200
(3) 39 (4) 4500

26. The molecule which contain all the information for carrying all the life process
(1) DNA (2) m-RNA
(3) r-RNA (4) t-RNA

27. An example of short term adaptation is –
(a) Accumulation of melanin in the skin
(b) The use of stored fat in animals undergoing hibernation.
(c) Dormancy of seeds.
(d) Phototropism of stems and geotropism of roots.
(1) a and b are correct
(2) b and c are correct
(3) All are correct
(4) None of the above is correct

28. Long term adaptation helps in]
(1) Evolution (2) Survival
(30 Both (1) & (2) (4) None of these

29. The species which grow on exposed rocks is :-
(1) Selaginella lepidophylla
(2) Myrothammus
(3) Craterostigma (4) Nepenthes

30. The largest macromolecule is :-
(1) RNA (2) DNA
(3) Proteins (4) Fats

31. Who pointed out that "Life results due to a relationship of molecules and is not the property of any one molecule" :-
(1) Darwin (2) Weismann
(3) L. Pauling (4) None of these

32. What is the energy required in calories for formation of energy rich bond between phosphorous and ADP molecule in DNA :-
(1) 2000 cal (2) 7600 cal
(3) 12.060 cal (4) 20,000 cal

33. Homeostasis refers to :-
(1) Positive and negative feedback
(2) Positive feedback
(3) Negative feedback
(4) None of these

34. Dodo (flightless bird) recently got extinct from :-
(1) Indonesia (2) Mauritius
(3) Australia (4) India

35. The simplest amino acid is :-
[B.H.U. 1986, Manipal 1999. P.M.T. 1999]
(1) Glycine (2) Lysine
(3) Tyrosine (4) Aspartic acid

36. Steroid is :- **[D.P.M.T.1999]**
(1) Cholesterol (2) Thyroxine
(3) Vitamin A (4) Fatty acid ester

37. Water protects organisms from thermal shock due to its high :- **[A.M.U. 1991]**
(1) Thermal conductivity (2) Latent heat
(3) Dielectric constant (4) All the above

38. Homeostasis is :- **[C.B.S.E..1991]**
(1) Tendency to change with change in environment
(2) Tendency to resist change
(3) Disturbance in regulatory control
(4) None of these

39. Cholesterol is :- **[B.H.U.-1997]**

(1)Monosaccharide (2) Protein

(3) Sterol (4) Wax

40. Maintenance of internal favourable conditions despite changes in external environment is :-

(1) Enthalpy (2) Homoestasis

(3) Entropy (4) Steady state

41. Total heat content of a system is : **[Kamataka 2000]**

(1) Free energy (2) Enthalpy

(3) Entropy (4) Kinetic energy

42. A person exposed to cold environment does not show :- **[D.P.M.T. 2001]**

(1) Shivering

(2) Vasoconstriction of peripheral vessels

(3) Increased secretion of thyroid and adrenal medulla

(4) Increased heart beat and volume per stoke

43. Which is correct about energy changes in living cells **[A.M.U. 2001]**

(1) First energy transfer, then energy transformation

(2) First energy transformation then energy transfer

(3) Both occur discontinuously

(4) Both occur continuously

44. Animals not possessing a fixed temperature are called:- **[C.M.C.2002]**

(1)Homeotherms

(2)Mexotherms

(3) Poikilotherms

(4) Heterotherms

45. Which one is incorrect :- **[C.E.T. Chd. 2002]**

(1) New individuals replace the dead ones

(2) Homeostasis produces a self regulated s teady state

(3) Most homeostatic mechanisms operate through feed-back systems

(4) Cell obtains instructions for division from a hereditary protein

ANSWER KEY **EXERCISE-2**

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A.	**1**	**1**	**3**	**4**	**4**	**1**	**3**	**1**	**1**	**3**	**4**	**1**	**3**	**2**	**3**	**4**	**4**	**3**
Q.	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
A.	**2**	**4**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**1**	**1**	**2**	**3**	**2**	**1**	**2**	**1**	**1**
Q.	37	38	39	40	41	42	43	44	45									
A.	**4**	**2**	**3**	**2**	**2**	**4**	**4**	**3**	**4**									

NATURE & SCOPE OF BIOLOGY STAT PMT EXAMS EXERCISE

1. The study of the energy transfer and relationships between all living organisms is known as : **[JHARKHAND -2000]**
(1) Thermodynamics (2) Bioenergetics
(3) Kinetic energy (4)1st December

2. On which day we celebrate malarial day ? **[BIHAR-2003]**
(1) 5th June (2) 15th August
(3) 20th October (4) Spencer

3. 'Philosophic zoologique' was written by : **[UP CPMT-2001, BIHAR-03]**
(1) Lamarck
(2) de Vries
(3) Mendal
(4) Spencer

4. The book 'Micrographia' was written by : **[BIHAR-2002]**
(1) Huxley
(2) Robert Hooke
(3) Fritsch
(4) J.D.Hooker

5. 5th June is celebrated as **[UP CPMT-2002]**
(1) World forest day
(2) World environment day
(3) World red cross day
(4) World food day

6. Study of environment and animal relation is **[UP CPMT-2002]**
(1) Ecosystem (2) phytosociology
(3) Biotic community (4) Ecology

7. Which of the following is connecting link between reptiles and birds? **[UP CPMT-2002]**
(1) Archaeopterix (2) Euglena
(3) Neopiline (4) Latimeria

8. Cuscuta is a **[UP CPMT-2003]**
(1) Parasitic plant (2) Symbiotic
(3) Predator (4) Decomposer

9. Which organism was used by Beadle and Tatum to proposed one gene-one enzyme hypothesis? **[UP CPMT-2004]**
(1) E. coli (2) Nostoc
(3) Drosophila (4) Neurospora

10. Pangenesis hypothesis was proposed by: **[MP PMT-2001]**
(1) Weismann
(2) Gelton
(3) Wagner
(4) Darwin

11. World AID's day is organised every year on: **[MP PMT-2002]**
(1) 1st December (2) 6th December
(3) 15th December (4) 31st December

STATE PMT EXAMS EXERCISE ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11
Ans.	**2**	**3**	**1**	**2**	**2**	**4**	**1**	**1**	**4**	**4**	**1**