CHAPTER

1 Introduction

Animation 11.1: Levels of Organization
Source & Credit: wonderwhizkids

BIOLOGY AND SOME MAJOR FIELDS OF SPECIALIZATION

Biology is the study of living things. It is a branch of science and like other sciences it is a way of understanding nature. Biologists deal with the living part of nature and with the non-living things which affect the living things in any way. they strive to understand, explain, integrate and describe the natural world of living things. The literal meaning of biology is the study of life.

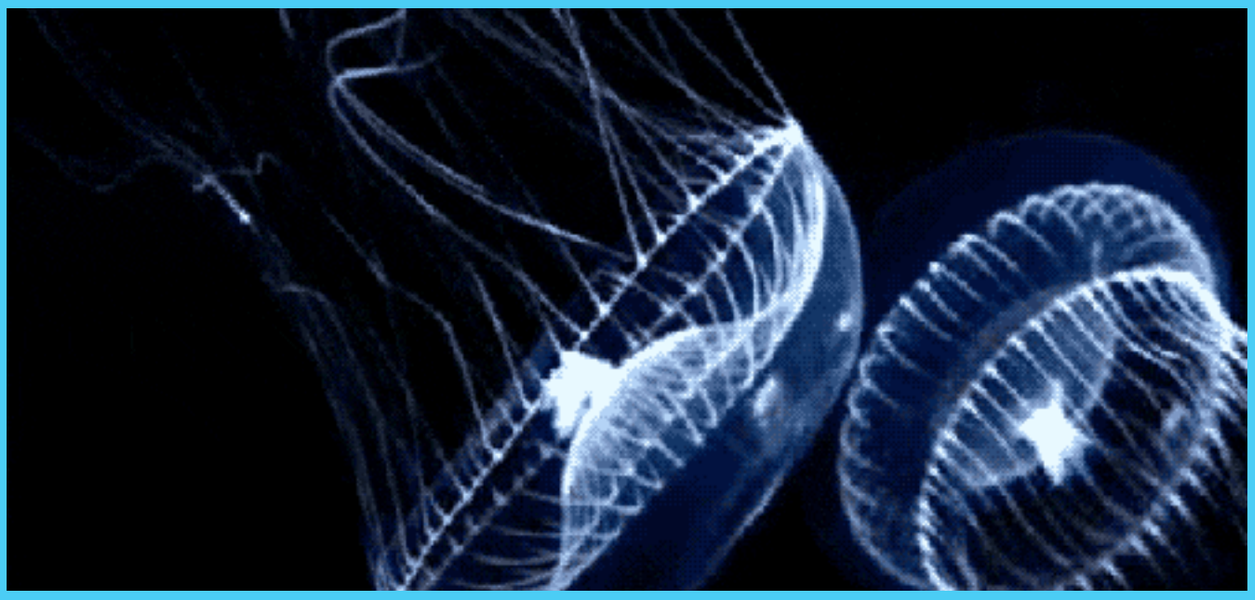
It is very difficult to define life. There are certain aspects of life that lie beyond the scope of the science of biology like the answers to the questions : what is the meaning of life? Why should there be life? These are the questions not usually taken up by Biologists and are left to philosophers and theologians. Biologists mainly deal with the matters relating to how life works.

Life, for biologists, is a set of characteristics that distinguish living organisms from non-living objects (including dead organisms). Living organisms are highly organized, complex entities; are composed of one or more cells; contain genetic program of their characteristics; can acquire and use energy; can carry out and control numerous chemical reactions; can grow in size; maintain a fairly constant internal environment; produce offspring similar to themselves; respond to changes in their environment.

Any object prossessing all these characteristics simultaneously can be declared as a living thing and in an object for biological studies.

The science of biology is a very wide based study. It includes every aspect of a living thing. Therefore, volumes and volumes of information are available under this major head. It is but natural to divide the science into quite a number of branches for our convenience of comprehending and studying biology.

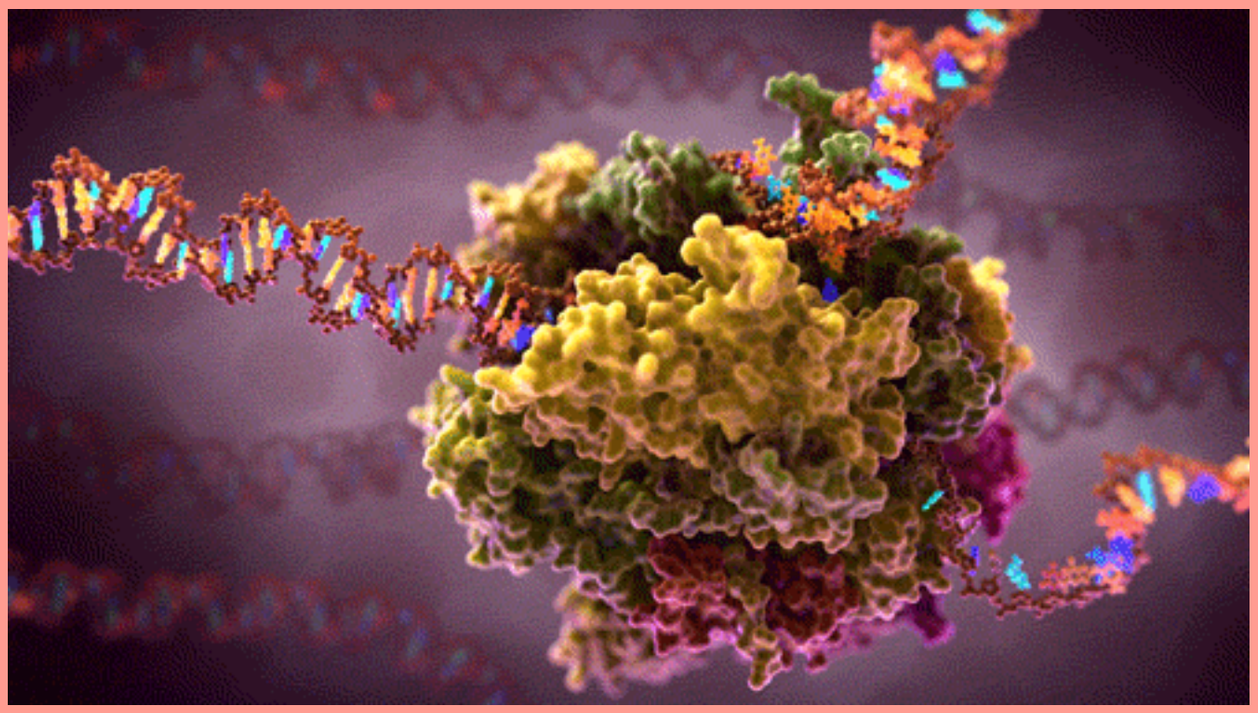
You are surely familiar, at this stage, with Ecology, Embryology, Physiology, Morphology (external Morphology or Anatomy), Palaeontology, Histology, Evolution, Genetics, Zoogeography etc. These are branches of biology which deal with environmental relations, development, functions, structure, form and internal gross structure, fossil, tissues, ancestral history, heredity and distribution of animals in nature, respectively. In addition to these branches there are a number of other branches of biology such as: Molecular Biology, microbiology, Marine Biology, Environmental Biology, Freshwater Biology, Parasitology, Human Biology, Social Biology, Biotechnology, etc.



Animation 11.2 : Biology
Source & Credit: popkey

Molecular Biology

Molecular biology is a branch of biology which deals with the structure of organisms, the cells and their organelles at molecular level.



Animation 11.3 : Molecular Biology
Source & Credit: wifflegif

Environmental Biology

Environmental Biology is the study of organisms in relation to their environment. This includes interaction between the organism and their inorganic and organic environment, especially as it relates to human activities.

Microbiology

This is the study of microorganisms which include Bacteria, Viruses, Protozoa and microscopic algae and fungi..

Animation 11.4 : Microbiology
Source & Credit: giphy

Freshwater Biology

This branch of biology deals with the organisms living in freshwater bodies i.e., rivers, lakes etc and physical and chemical parameters of these water bodies.

Animation 11.5: Freshwater Biology
Source & Credit: primogif

Marine Biology

This is the study of life in seas and oceans. This includes the study of the marine life and the physical and chemical characteristics of the sea acting as factors for marine life.

Animation 11.6 : Mariene Biology
Source & Credit: rebloggy

Parasitology

This is the branch of biology which deals with the study of parasites. The structure, mode of transmission, life histories and host - parasite relationships are studied in parasitology.

Human Biology

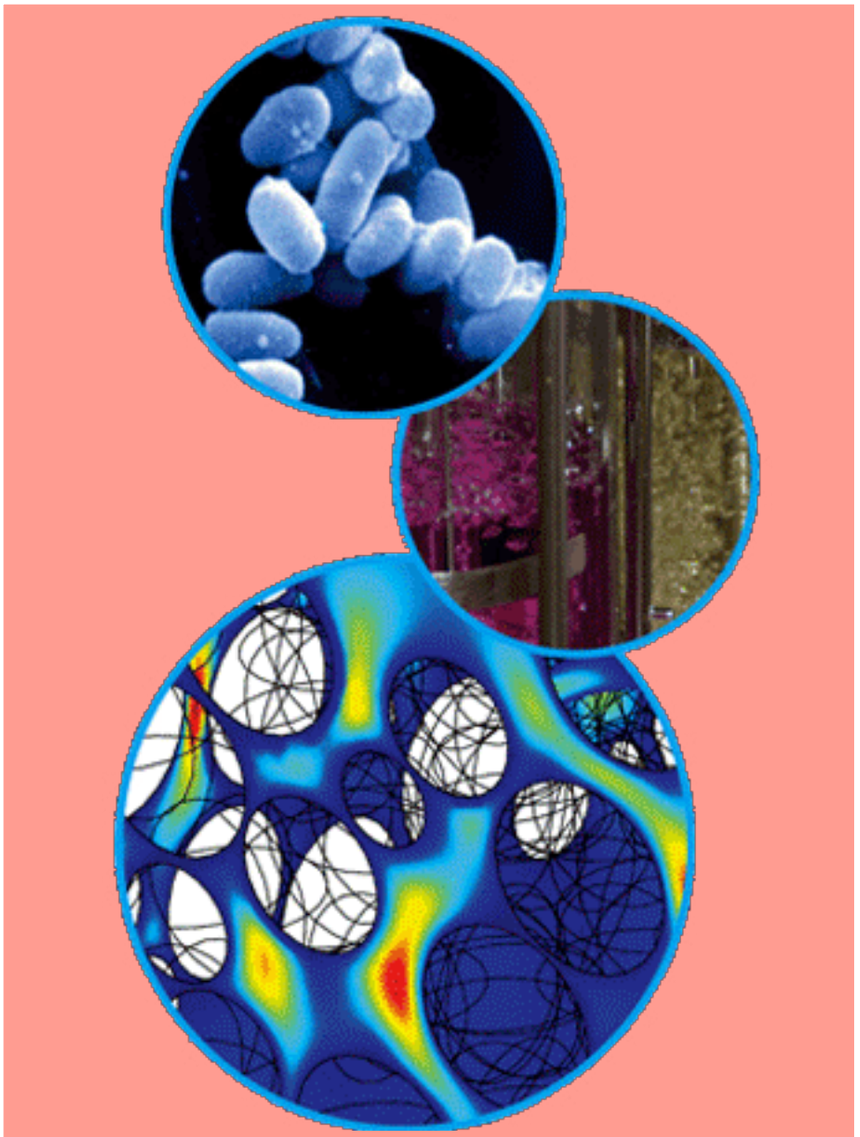
It deals with the study of man. This includes form and structure, function, histology, anatomy, morphology, evolution, genetics, cell biology and ecological studies etc. of human beings.

Social Biology

This is the branch of biology which deals with the study of social behaviour and communal life of human beings.

Biotechnology

It deals with the use of living organisms, systems or processes in manufacturing and service industries.

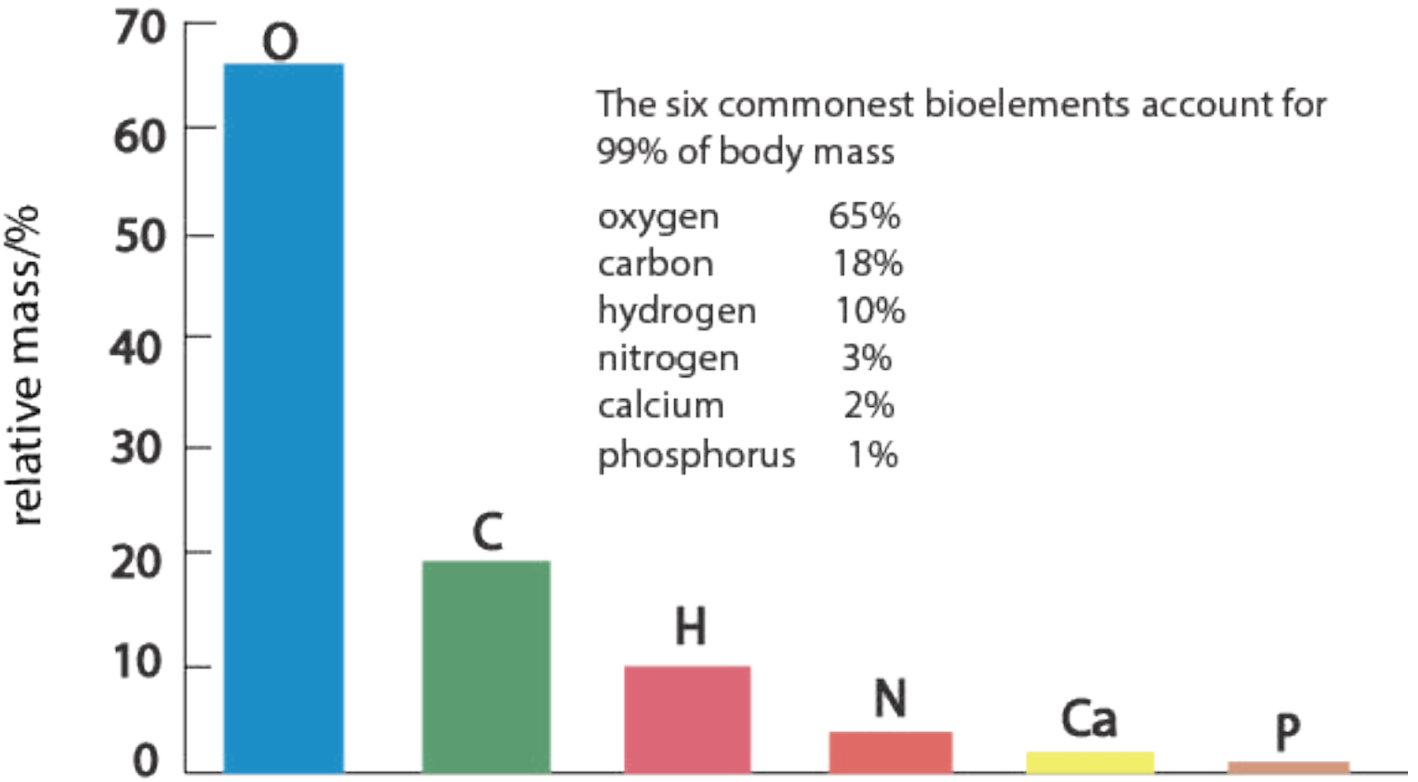


Animation 11.7 : Biotecnology
Source & Credit: fz-juelich

LEVELS OF BIOLOGICAL ORGANIZATION

Hundreds of chemical reactions are involved in maintaining life of even the simplest organism. In view of this, it is something of surprise to find that of the 92 naturally occurring chemical elements, only 16 are commonly used in forming the chemical compounds from which living organisms are made. These 16 elements and a few others which occur in a particular organism are called bioelements.

In the human body only six bio-elements account for 99%of the total mass.



Other bioelements include (about 1%) - potassium (0.35%), sulphur (0.25%), chlorine (0.15%), sodium (0.15%), magnesium (0.05%), iron (0.004%), copper (trace), manganese (trace), zinc (trace), iodine (trace).

Fig 1.1 Percentage composition of bioelements by mass of a human being

The fact that the same 16 chemical elements occur in all organisms, and the fact that their properties differ from those in the non living world, shows that bioelements have special properties which make them particularly appropriate as basis for life.

Biological organization is not simple. It has high degree of complexity because of which the living organisms are able to carry out a number of processes (some very complicated) which distinguish them from the non living things. A living thing has built-in regulatory mechanisms which interact with the environment to sustain its structural and functional integrity.

A living thing is, therefore, composed of highly structured living substance or protoplasm. In order to understand the various phenomena of life, biologists for their convenience, study the biological organization at different levels starting from the very basic level of sub atomic and atomic particles to the organism itself and beyond which the study of community, population and entire world are included.

Biological organization can be divided into the following levels.

Biosphere	That part of earth inhabited by living organism; includes both the living and the nonliving components
Ecosystem	A community together with its nonliving surroundings
Community	Two or more populations of different speices living and interacting in the same area
Population	Members of one species inhabiting the same area
Species	Very similar, potentially interbreeding organisms
Multicellular Organism	An individual living thing composed of many cellls
Organ System	Two or more organs working together in the execution of a specific body function
Organ	A structure normally composed of several tissue types that form a functional unit
Tissue	A group of similar cells that perform a specific function
Cell	The unit of life
Organelle	A structure within a cell that performs a specific function
Micro-molecules and Macro molecules	A combination of atoms
Atom	The smallest particle of an element that retains the properties of that element
Subatomic Particles	Particles that make up an atom

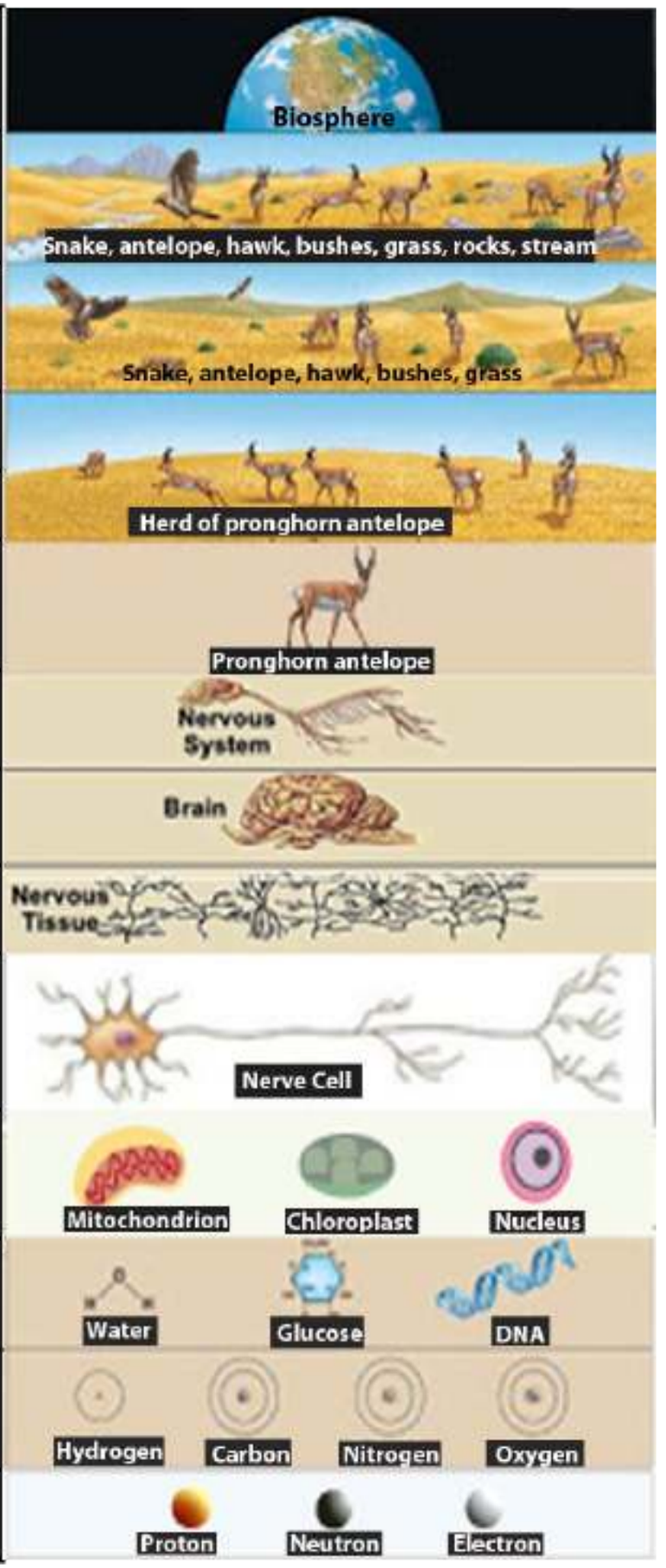


Fig 1.2 . Levels of Organization

Atomic & Subatomic Levels

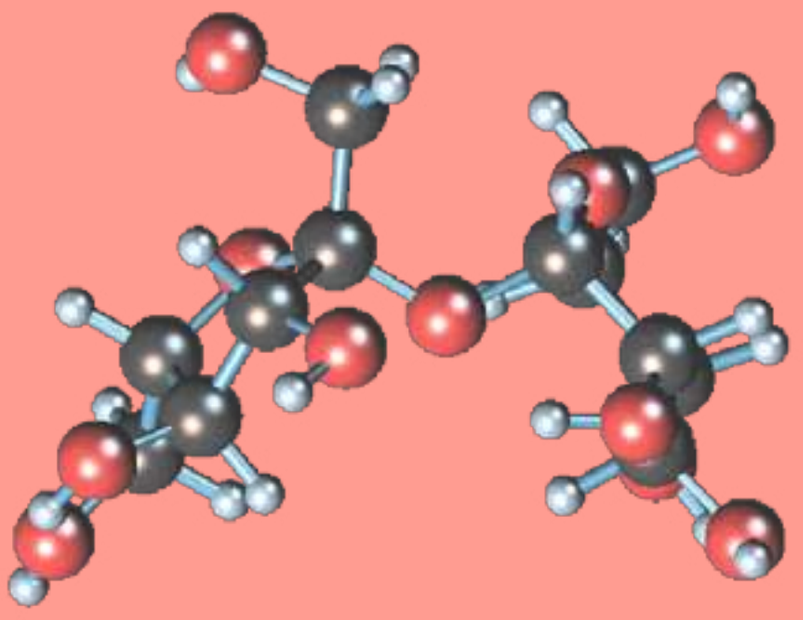
All living and nonliving matter is formed of simple units called atoms and sub atomic particles such as protons, electrons & neutrons.

Molecular Level

In organisms elements usually do not occur in isolated forms. The atoms of different elements combine with each other through ionic or covalent bonding to produce compounds. This stable form is called a molecule. Hydrogen, carbon, oxygen, nitrogen, phosphorous and Ca are the most common atoms found in biological molecules. The different types of bonding arrangement permit biological molecules to be constructed in great variety and complexity. These may be **micromolecules** with low molecular weight like $C0_2$, H_20 etc. or **macromolecules** with high molecular weights e.g. starch, proteins etc.

Biological world has two types of molecules: organic and inorganic. An organic molecule is any molecule containing both carbon and hydrogen. Inorganic molecules do not include carbon and hydrogen together in a molecule.

An organism is usually formed by enormous number of **micro** and **macro molecules** of hundreds of different types. Some most important and abundant organic molecules in organisms are glucose, amino acids, fatty acids, glycerol, nucleotides like ATP, ADP, AMP etc.



Animation 11.8 : Molecular Level
Source & Credit: answers

Orga. elles & Cell

Different and enormous number of micromolecules and macromolecules arrange themselves in a particular way to form cells and their organelles. In case of simple organisms like bacteria and most protists, the entire organism consists of a single cell. In most fungi, plants and animals, the organism may consist of up to trillions of cells.

Numerous sub-cellular structures like mitochondria, Golgi-complex, endoplasmic reticulum, ribosomes etc have been studied for their structure and function. It has become clear that functions of the cells are accomplished by these specialised structures comparable to the organs of the body. These structures are called **organelles**.

The arrangement of the organelles speaks of the division of labour within the cell. The prokaryotes have only a limited number and type of organelles in their cytoplasm. Eukaryotes are rich in number and kinds of membranous organelles. A cell membrane is however present in all cells whether prokoryotic or eukaryotic.

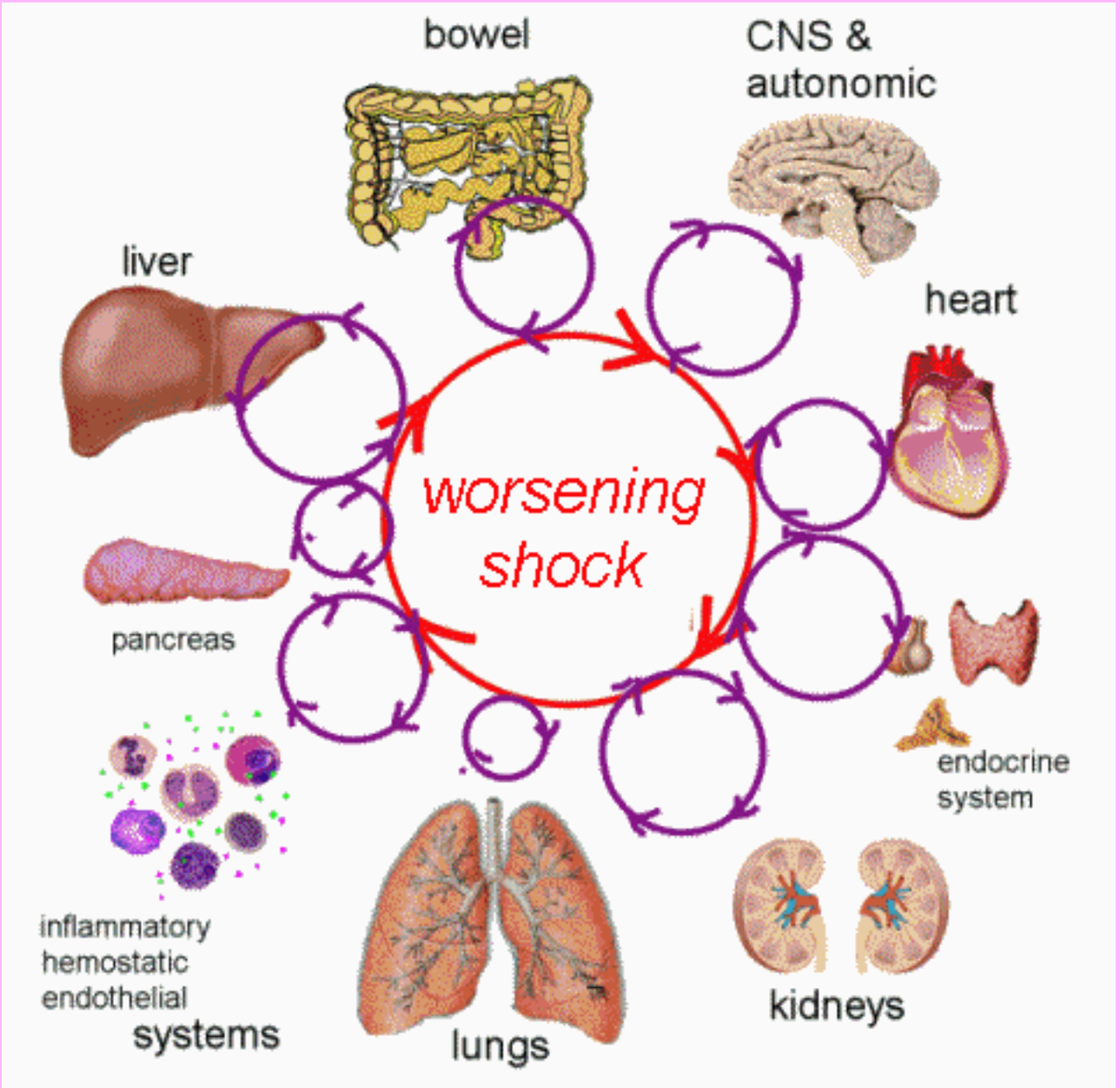
Animation 11.9 : Cell Organelles
Source & Credit: answers

Tissue Level

In multicellular animals and plants, groups of similar cells are organized into loose sheets or bundles performing similar functions; these are called tissues. Each tissue has a particular function in the life of the organism e.g. muscle tissue, glandular tissue, xylem tissue, phloem tissue etc. They are specialized for contraction (movement), secretion, conducting water and for translocation of sugar, proteins etc.

Orga. & System

Different tissues having related functions, assemble together in a structure to carry out its function with great efficiency. Such structures are called organs and they are specialized to perform particular functions. For example stomach which is an organ has a function of food digestion (protein part), has a secretory epithelium which secretes the gastric juice, and a muscular tissue (smooth) for contracting the walls of the stomach and mixing the food with the enzyme thoroughly and moving the food to the posterior end. The formation of organs also has a selective value because this leads to an efficient accomplishment of their functions both qualitatively and quantitatively. In animals



Animation 11.10: Cell Organelles
Source & Credit: answers

organ formation is far more complex and defined. Organs are part of organ systems where total functions involved in one process or phenomenon are carried out.

The organ level of organization is much less definite in plants than it is in animals. At the most, we might distinguish roots, stems, leaves and reproductive structures. Clear cut functions, the distinguishing features, can be assigned to each of these structures. Roots are involved in anchoring the plant, storage of food and procuring water and minerals. The shoot supports the entire plant while the leaves are primary organs for food manufacture. Flowers or other reproductive structures are involved in producing the next generation (reproduction).
The complexity of the organ systems of animals is associated with a far greater range of functions and activities than is found in plants.

I. dividual (Whole Orga. ism)

Various organs in plants and various organ systems in animals are assembled together to form an individual - the whole organism. The whole organism has its individuality as far as its characteristics are concerned. It is different from other members of the same species in certain respects. The various functions, processes, activities of an organism are coordinated. In an animal all the systems work in coordination with each other. For instance if a man is engaged in continuous and hard exercise, not only his muscles are working but there is an increase in the rate of respiration and heart beat to supply the muscles with increased oxygen and food which they need for continuous exercise. In animals the coordination is achieved by means of nervous system and endocrine system, whereas in plants only long term regulation of activities is brought about by hormones.

Organism works as a whole and it interacts and responds to the environmental changes as a whole.

Populatio.

A population is a group of living organisms of the same species located in the same place at the same time. Examples are the number of rats in a field of rice, the number of students in your biology class, or human population in a city.

Population is a higher level of biological organization than organism (whole) because here a group of organisms of the same species is involved. This level of organization has its own attributes which come into being by living together of a group of organisms of the same species.

Some of these attributes are gene frequency, gene flow, age distribution, population density, population pressure etc. All these are new parameters which have appeared due to population of an organism. You will study them in detail in population ecology.

Commu. ity

Populations of different species (plants and animals) living in the same habitat form a community. Communities are dynamic collections of organisms, in which one population may increase and others may decrease due to fluctuation in abiotic factors. Some communities are complex and well interrelated, other communities may be simple. In a simple community any change can have drastic and long lasting effects.

The foregoing account makes it clear that an organism can be studied at different levels of organization. It can be studied at subatomic, atomic, molecular, macromolecular, organelle, cell, tissue, organ and organ system level. We can also look at it as an individual, as a part of population of similar individuals, as a part of a community that includes other populations and a part of community of an ecosystem which includes abiotic factors as well as living organisms, Fig. 1.2.

The organisms, interaction can take many shapes. It may be predation, parasitism, commensalism, mutualism and competition.

Livi. g World i. Space

Living world of today is enormous in size. It has been reproducing and evolving since the time of its origin on this planet. Today almost all parts of the world abounds in living organisms. The distribution of organisms in space can be studied through biomes.

A **biome** is a large regional community primarily determined by climate. It has been found that the major type of plant determines the other kind of plants and animals. These biomes have, therefore, been named after the type of major plants or major feature of the ecosystem. The major biomes of the world you will study in the chapter of ecology.

LIVING WORLD IN TIME

Since the time of origin of life on this planet, various organisms were evolved and dominated this planet during various periods of geological time chart. This has been found by the evidence obtained from the discovery and study of fossils which allows biologists to place organisms in a time sequence. As geological time passes and new layers of sediments are laid down, the older organisms should be in deeper layer, provided the sequence of the layers has not been disturbed.

In addition it is possible to date/age rocks by comparing the amounts of certain radioactive isotopes they contain. The older sediment layers have less of these specific radioactive isotopes than the younger layers. A comparison of the layers gives an indication of the relative age of the fossils found in the rocks. Therefore, the fossils found in the same layer must have been alive during the same geological period.

You can have an idea about the temporal distribution of various forms of life both plants and animals in the various geological periods (fig.1.3).

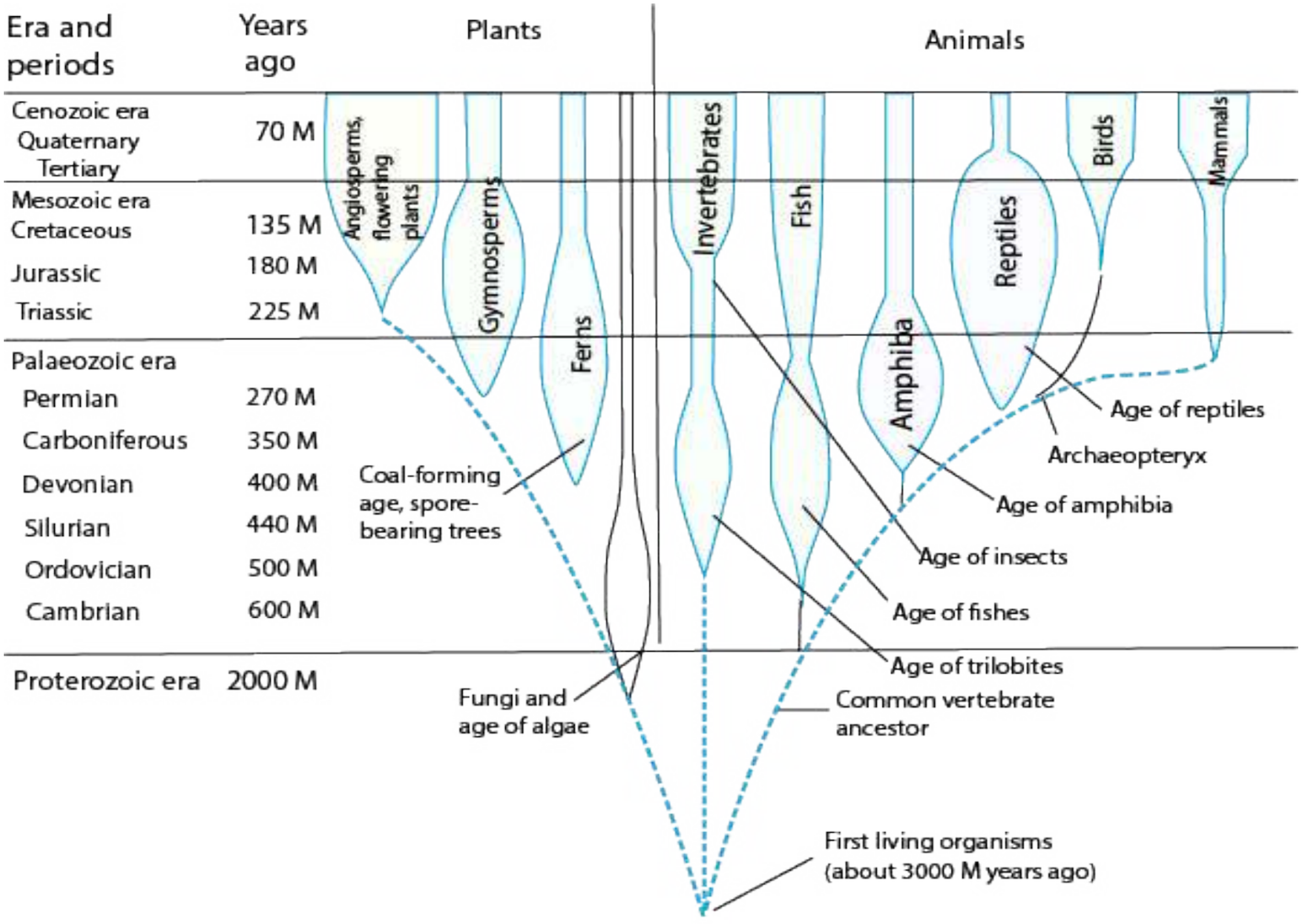


Fig 1.3. Fossil record of plants and animals shown in a geological time chart

Phyletic Li. eage

When we look at the biodiversity (the number and variety of species in a place), we find that there are nearly 2,500,000 species of organisms, currently known to science. More than half of these are insects (53.1%) and another 17.6 % are vascular plants. Animals other than insects are 19.9 % (species) and 9.4 % are fungi, algae, protozoa, and various prokaryotes.

This list is far from being complete. Various careful estimates put the total number of species between 5 and 30 millions. Out of these only 2.5 million species have been identified so far.

The life today has come into existence through Phyletic lineages or evolving populations of the organisms living in the remote past. Evolutionary change often produces new species and then increases biodiversity. A phyletic lineage is an unbroken series of species arranged in ancestor to descendant sequence with each later species having evolved from one that immediately proceded it. If we had a complete record of the history of life on this planet, every lineage would extend back in time to the common origin of all early life. We lack that record because many soft bodied organisms of the past had not left their preserved record as fossils.

Biological Method

Science is a systematized knowledge. Like other sciences, biological sciences also have a set methodology. It is based on experimental inquiry. It always begins with chance observation. Observations are made with five senses viz, vision, hearing, smell, taste and touch, depending upon their functional ability. Observations can both be qualitative and quantitative. Quantitative observations have accuracy over qualitative as in the former variables are measurable and are recorded in terms of numbers. An observer organizes observations into data form and gives a statement as per experience and background knowledge of the event. This statement is the **hypothesis,** which is tentative explanation of observations.

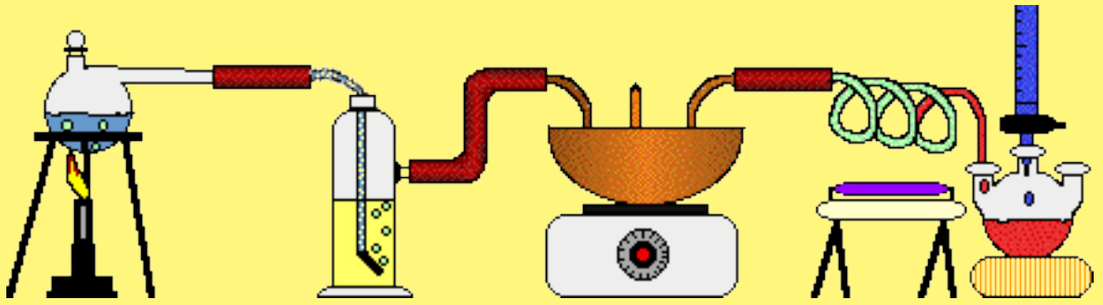
At this stage you should look at the ways of devising hypothesis. There are two ways of formulating hypothesis. A hypothesis can be the result of deductive reasoning or it can be the consequence of inductive reasoning.

Deductive reasoning moves from the general to the specific. It involves drawing specific conclusion from some general principle/assumptions. Deductive logic of "if ..... then" is frequently used to frame testable hypothesis. For example, if we accept that all birds have wings (premise #1), and that sparrows are birds (premise # 2), then we conclude that sparrows have wings. If all green plants

require sunlight for photosynthesis, then any green plant when placed in dark would not synthesize glucose, the end product of photosynthesis. The other way of reasoning used in the formulation of hypothesis is **inductive reasoning** which is reasoning from the specific to the general. It begins with specific observations, and leads to the formation of general principle. For instance, if we know that sparrows have wings and are birds, and we know that eagle, parrot, hawk, crow are birds, then we induce (draw conclusion) that all birds have wings. The science also, therefore, uses inductive methods to generalize from specific events.

In fact sometimes scientists also use other ways to form a hypothesis, which may include (1) intuition or imagination (2) esthetic preference (3) religious or philosophical ideas (4) comparison and analogy with other processes (5) discovery of one thing while looking for some other thing. These ways can also sometimes form basis for scientific hypothesis. Hypotheses as you already know, are subjected to rigorous testing.

Repeated exposure of a hypothesis to possible falsification increases scientist's confidence in the hypothesis when it is not falsified. Any hypothesis that is tested again and again without ever being falsified is considered well supported and is generally accepted. This may be used as the basis for formulating further hypothesis. So there is soon a series of hypotheses supported by the results of many tests which is then called a theory. A good theory is predictive and has explanatory power. One of the most important features of a good theory is that it may suggest new and different hypotheses. A theory of this kind is called productive.



Animation 11.11 : Biological Method
Source & Credit: wikispace

However even in the case of productive theory the testing goes on. In fact many scientists take it as a challenge and exert even greater efforts to disprove the theory. If a theory survives this skeptical approach and continues to be supported by experimental evidence, it becomes a scientific law. A **scientific law** is a uniform or constant fact of nature, it is virtually an irrefutable theory. Biology is short in laws because of elusive nature of life.

Examples of biological laws are Hardy-Weinberg law and Mendel's laws of inheritance. You will learn about them in later chapters. You can see that laws are even more general than theories and afford answers to even more complex questions, therefore there are relatively a few laws in biology.

BIOLOGY AND THE SERVICE OF MANKIND

The science of biology has been helping mankind in many ways in increasing food production; in combating diseases and in protecting and conserving environment. Biological advances in the field of food and health have resulted in high standard of living.

Plant production has been tremendously increased by improving existing varieties and developing new high-yield and disease - resistant varieties of plants and animals used as food.

Plant and animal breeders have developed, through selective breeding, using the principles of genetics, new better varieties of wheat, rice, corn, chicken, cow and sheep. Poultry breeders have developed broilers for getting quick and cheap white meat. Genes for disease resistance and other desirable characters are introduced into plant, using the techniques of **genetic engineering**. Such **transgenic plants** (plants having foreign DNA incorporated into their cells) can be propagated by **cloning** (production of genetically identical copies of organisms/cells by asexual reproduction) using special techniques such as **tissue culture techniques** etc. Plant pathogenic fungi and insect pests of crops which weaken the plants and reduce the yield had traditionally been controlled by using chemical fungicides and insecticides (pesticides). Use of these chemicals poses toxicity problems for human beings as well as environmental pollution. Moreover, there are chances of insects becoming resistant to the effect of these chemicals. **Biological control** (control by some living organisms) eliminates all such hazards. In biological control, pests are destroyed by using some living organisms that compete with or even eat them up. An aphid that attacks walnut tree is being controlled biologically by a wasp that parasitizes this aphid.

Even some bacteria are being used as bio-pesticides. Effective control of a particular disastrous disease, or all the common diseases of a plant can be achieved by using all relevant, appropriate methods of disease control. Such an approach of disease control is called "**integrated disease management**".

Soil is a complex medium. It is almost impossible to conduct experiments on nutrient requirements of plants by growing them in soil. **Hydroponic culture technique** is used to test whether a certain nutrient is essential for plant or not. In this technique the plants are grown in aerated water to which nutrient mineral salts have been added. Hydroponic farming, however, is yet not feasible. Astronauts may use it for growing vegetables.

Different techniques of food preservation have been developed for protecting food from spoilage and for its use and transport over long distance without damaging its quality. One of these is **pasteurization,** developed by Louis Pasteur. It is being widely used for preservation of milk and milk products.

Disease Control

There has been fantastic progress in the area of health and disease control. Three pronged actions are usually taken against various diseases.

1. Preventive measures
2. Vaccination/Immunization
3. Drug treatment/Gene therapy

Preventive measures

The advances in biological sciences have provided us information about the causative agents of the diseases and their mode of transmission. For instance the AIDS (Acquired Immune Deficiency Syndrome) is caused by HIV (human immuno deficiency virus) and it spreads through free sexual contact, through blood transfusion, by using contaminated syringes or surgical instruments etc. Therefore, doctors advise us to take precautions on these fronts so that we do not contract the disease, which is at present incurable. Similarly hepatitis is caused by H.virus which is spread through blood transfusion by using contaminated syringes and surgical instruments etc. In this case also doctors advise us to be careful and avoid the point of contact.

Vaccination / Immunization

Many diseases such as polio, whooping cough, measles, mumps etc can easily be controlled by vaccination or "shots".

Edward Jenner first developed the technique of vaccination in 1796, cowpox pus is known as vacca (from latin vacca=cow). From this word evolved the present term vaccination and vaccine. You will learn more about vaccination in chapter 6.

Since then, inoculation or vaccination is carried out to make the people immune from viral or bacterial epidemics or, for some diseases the individuals are vaccinated in their early life to make them immune to those diseases.

It is claimed that small pox has been totally eliminated from the world by using this method. Scientists are making continuous efforts to develop vaccine against other diseases. Even vaccine against AIDS is being administered in humans on experimental basis.

Drug treatment / Gene therapy

If a person becomes sick with disease, he is subjected to the action of **antibiotics** which can kill bacteria. The antibiotics are, however, useful in bacterial disease and that only when bacteria have not developed resistance to antibiotics. In cancer, **radiotherapy** and **chemotherapy** are also used. In radiotherapy, the cancerous part is exposed to short wave radiations from the radioactive material repeatedly at regular intervals. In Pakistan there are several centres which are carrying out radiotherapy to control cancer. Chemotherapy consists of administrating certain anticancer chemicals to the patients at regular intervals. These chemicals may kill both cancerous and normal cells.

Recently a new technique has been developed to repair defective genes. This consists of isolating the normal gene and inserting it into the host through bone marrow cells. This is called **gene therapy.**

Combating disease utilizing all methods as and when required and ensuring a participation of community in this programme is known as **integrated disease management**. This requires awareness of the community about the severity of the problem, its causes and its remedies. This is a very effective programme for elimination and control of dangerous diseases from the human society.

Besides its contribution to food production and health of man, biology has discovered a number of means and developed technologies for the welfare of mankind as for example cloning, protection and conservation of environment etc.

Cloning: Cloning is a technology for achieving **eugenic aims**. A **clone** is defined as a cell or individual and all its asexually produced offspring. All members of a clone are genetically identical except when a mutation occurs.

Generally no normal animal reproduces naturally by cloning. Several insects and many plants do, in some circumstances whereas few do so regularly.

In 1997 scientists in Scotland succeeded in cloning a sheep. Other mammalian species (mice and cows) have since been cloned. In this procedure the nucleus from a fertilized egg is removed and a nucleus from a cell of a fully developed individual is inserted in its place. The altered zygote is then implanted in a suitable womb where it completes its development. The new individual formed in this way is a genetically identical clone of the individual whose nucleus was used. Thus cloning could make multiple copies of a desired genotype.

Another type of cloning is the division of a single egg or early embryo into one or more separate embryos. This is the same process that normally creates identical twins. Offspring from this type of cloning are genetically identical but carry chromosomes from each of the two parents. This type of cloning has already been used to produce genetically identical cattle and other farm animals.

Man is likely to adopt cloning techniques for commercial production of valuable animals of known pedigree such as horses etc.

At some places scientists are making attempts to clone human embryo which they believe can serve as transplant donor. There is a lot of controversy on this issue as to whether human cloning should be attempted or not.

PROTECTION AND CONSERVATION OF ENVIRONMENT

Industrialization has helped mankind to raise the standard of living. It has at the same time destroyed our environment. Tons of industrial waste, and effluents in solid, liquid or gas form are being injected into the environment by the industries. These effluents frequently contain sizeable amount of certain very toxic even carcinogenic materials. Heavy metals like lead from automobiles, chromium from tanneries, are playing havoc to human health. Environmental pollution has reached alarming level in some countries.

This problem, therefore, needs to be addressed or else it would soon be out of control in which case the biocomponents of the world ecosystem would suffer irreparable loss and this environment would no longer support life on this planet.

Biology has helped mankind in attracting attention to this problem and the biologists are striving to find the solution to set this environment right wherever it has deteriorated: Biologists have already asked for the treatment of industrial effluents to be made obligatory. Several ways of bioremediation (removal or degradation of environmental pollutants or toxic materials by living organisms) are also under investigation. For example algae have been found to reduce pollution of heavy metals by bioabsorption.

Biologists are also working out the list of **endangered species** of plants and animals which if not protected would soon be extinct. They have, therefore, stressed the needs for their protection.

The environmental pollution is a national problem in Pakistan. Our rivers, canals are highly polluted with the mixing of city sewage and industrial wastes. The life in fresh water of Pakistan is towards decline. Fish populations have been most adversely affected. We need to take protective measures as early as possible. In cities, particularly the exhaust from automobiles is enormously adding lead into the atmosphere. There is then a need for lead free petrol to reduce the pollution.

Animation 11.12 : Protection and Conservatin of Environment
Source & Credit: epd.ntpc

Exercise

Q.1. Fill in the blanks

(i) _____ is the study of organisms in relation to their environment.

(ii) The study of organisms living in fresh water bodies like rivers, lakes etc is called _____.

(iii) _____ is the branch of biology which deals with the study of social behaviour and communal life of human beings.

(iv) In the _____ body only six bio-elements accounts for 99% of the total mass.

(v) All living things and nonliving things are formed of simple units called _____.

(vi) Various organs in plants and various organ systems in animals are assembled together to form an _____.

(vii) A _____ is a group of organisms of the same species located in the same place at the same time.

(viii) A _____ is based upon observations.

(ix) A hypothesis is a result of deductive reasoning or it can be the consequence of _____ reasoning.

Q.2. Write whether the statement is 'true' or 'false' and write the correct statement if it is false.

(i) Penicillin was discovered by Edward Jenner from a fungus Penicillium.

(ii) Many diseases such as polio, whooping cough, measles, mumps etc can be controlled by antibiotics.

(iii) Exposure to the small pox virus allows the body to develop immunity against cowpox virus.

(iv) AIDS is caused by HIV and it spreads through sexual contacts, blood transfusion, by contaminated syringe or surgical instruments.

Q.4. Short questions.

(i) What do you mean by hypothesis?
(ii) How does law differ from theory?
(iii) What is deductive reasoning ?
(iv) Define vaccination.
(v) Write a short note on cloning.

Q.5. Extensive question.

(i) Define the following branches of biology:
Molecular Biology, Microbiology, Marine Biology, Biotechnology

(ii) Discuss briefly phyletic lineage in biological organization.

(iii) Write notes on the following:

(a) Living world in space and time
(b) Population (c) Community

(iv) Explain the biological method for solving a biological problem. How do deductive and inductive reasoning play an important role in it?

(v) What is the role of the study of Biology in the welfareof mankind?