Biology Notes

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INTRODUCTION TO BIOLOGY CHAPTER 1

1. Biology

Bio mean **life** and **Logy** mean **study**

Definition

The study of living organisms is called Biology

Or

The science of life and living organisms is called Biology.

- Biology is divided into several specific fields that cover their morphology, physiology, anatomy, behavior, origin and distribution.
- An organism is a living entity containing of one cell e.g. bacteria
- An organism is a living entity containing of several cells e.g. animals, plants and fungi.

2. What is life?

Life is form from various chemical combination like carbon, hydrogen, nitrogen, oxygen, sulfur, and phosphorus. These form the nucleic acids, proteins, carbohydrates, and lipids that are the fundamental components of living matter.

3. Characteristics of life include:

1. Living organisms are responsiveness to the environment (nerve impulses).
2. They grow and change their body size and shape (cell division).
3. The have the ability to reproduce and increase their population (reproduction).
4. They are performing the function of metabolism and respiration (metabolisms).
5. They have ability to maintain homeostasis (excretion and Absorption).
6. They are made from cells.
7. There traits pass to offspring.

4. Main Branches of Biology

Some branches of biology are below:

1. **Botany:** The study of Plants and their features.
2. **Zoology:** The study of animals and their futures.
3. **Microbiology:** The study of Microorganisms and their features.
4. **Taxonomy:** It is the science of identification, nomenclature and classification of organisms.
5. **Morphology:** It is the study of external form, size, shape, color, structure and relative position of several living organ of living organisms.
6. **Anatomy:** It is the study of internal structure.
7. **Histology:** It is the study of tissue organization and structure.
8. **Cytology:** It is the study of form and structure of cells containing the behavior of nucleus and other organelles.

9. **Cell Biology:** It is the study of morphological, organizational, biochemical, physiological, genetic, developmental, pathological and evolutionary features of cell and its components.
10. **Molecular Biology:** It is the study of the nature of physicochemical organization, synthesis working and interaction of bio-molecules.
11. **Physiology:** It is the study of different types of body functions and procedures.
12. **Embryology:** It is the study of fertilization, growth, division and distinction of the zygote into embryo.
13. **Ecology:** It is the study of living organisms is relative to other organism and their environment.
14. **Genetics:** It is the study of inheritance of characters or heredity and variations.
15. **Evolution:** It is the study of the origin of life as well as new types of organism from the previous ones by modifications involving genetic changes and adaptations.
16. **Paleontology:** It deals with the study of fossils or remains and impressions of past organisms.
17. **Virology:** It is the study of viruses and all their aspects.

5. Linkage of Biology with Other Field Of Study

Biology constitutes the relation with every aspect of human and every sciences. The study of biology needs experiences of almost all the branches of science including chemistry, physics, sociology, geology, climatology etc.

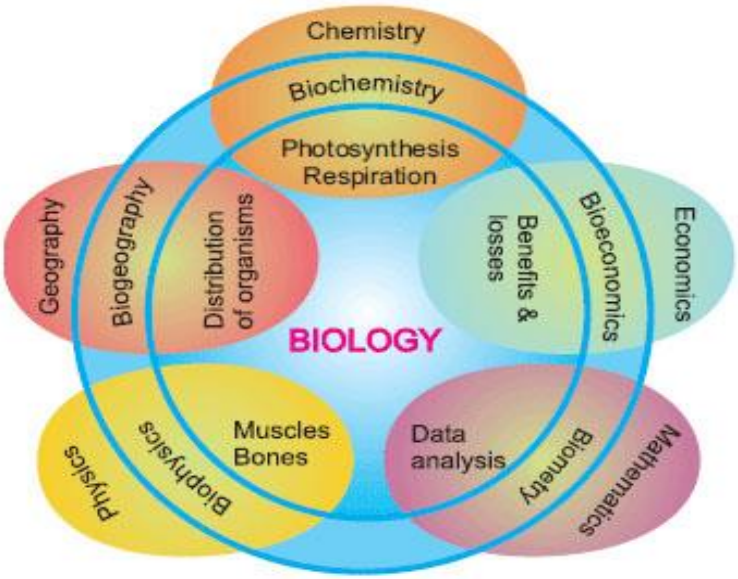
The linkage of biology and other sciences are mentioned below:

5.1. Biochemistry

Biological processes of living organisms depend upon the interactions of the atoms, molecules and compounds that make up living tissues and the environment in which life takes place e.g. Photosynthesis, Respiration and Digestion.

5.2. Biophysics

Biophysics studies life at every level, from atoms and molecules to cells, organisms and environments e.g. photosynthesis. Physics used in Physiology, Bioenergetics, Neurosciences, Pharmacology etc.



5.3. Biogeography

It is the study of the distribution of species and ecosystems in geographic space and through geological time. Organisms and biological societies often vary in a regular fashion along geographic gradients of latitude, elevation, isolation and habitat area e.g. polar bears live in arctic region.

5.4. Biostatistics

The study of biology focuses on living organisms, statistical analyses provide vital awareness into numerous biological procedures. Basic statistical ideas help biologists properly formulate experiments, confirm conclusions and correctly interpret results.

5.6. Bio-economics

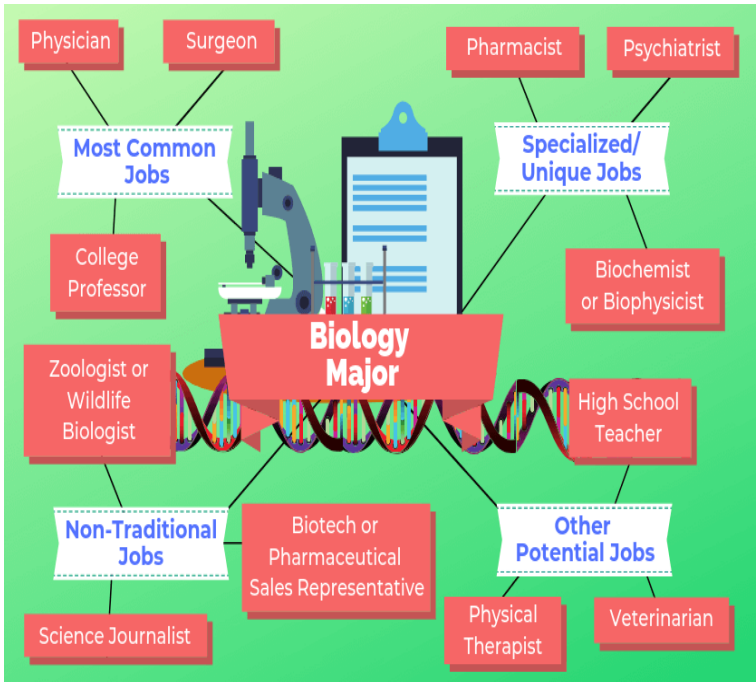
Bio-economics is an advanced branch of social science that seeks to assimilate the disciplines of economics and biology for the sole determination of creating theories that do a better job of explaining economic events using a biological basis and vice versa.

6. Careers in Biology

Careers with a biology which fall under this concern contain marine and aquatic biologist, zoo biologist, conservation biologist, ecologist and environmental manager. Biologists in these roles carry out recovery programs for endangered species and provide education for the general public.

6.1. Medicines or Surgery

Medicine is the field of health and healing. It comprises nurses, doctors and various authorities. It covers diagnosis, treatment and prevention of disease, medical research and various other aspects of health. Medicine aims to endorse and maintain health and wellbeing.



6.2. Fisheries

Maintainable, productive fisheries, aquaculture improve food and nutrition security increase income and improve livelihoods, promote economic growth and protect our environment and natural resources. Small scale aquaculture is particularly significant for conference the world growing petition for fish

6.3. Agricultures

It is a field area of land, enclosed or otherwise used for agricultural purposes such as cultivating crops or as a paddock or other enclosure for livestock. A field may also be an area left to lie fallow or as arable land.

6.4. Animal Sciences

Professional education in animal science prepares students for career opportunities in areas such as animal breeding, food, fiber production, nutrition, animal farming, animal behavior and welfare.

6.5. Horticultures

Horticulture is the science and art of the development, sustainable production, marketing and use of high value intensively cultivated food and ornamental plants. Horticultural crops are varied they contain annual and perennial species, pleasant fruits and vegetables and ornamental interior and landscape plants.

6.6. Forestry

Forestry is the science, practice of studying managing, forests and plantations and related natural resources. Silviculture a related science, involves the growing and tending of trees and forests. Industrial foresters are mainly involved in planning the timber harvests and forest regeneration.

6.7. Farming

A farm is an area of land that is devoted primarily to agricultural processes with the primary objective of producing food and other crops; it is the basic facility in food production. The name is used for specialized units such as arable farms, vegetable farms, fruit farms, dairy, pig and poultry farms and land used for the production of natural fibers, biofuel and other commodities. It includes ranches, feedlots, orchards, plantations and estates, smallholdings and hobby farms and comprises the farm and agricultural buildings as well as the land.

7. What is Kingdome?

Kingdom is a taxonomic rank that is composed of smaller groups called phyla (or divisions, in plants) Supplement. Historically kingdom is the uppermost taxonomic rank or the most common taxon used in classifying organisms.

There is five kingdom system:

The five kingdom system was developed by Robert H. Whittaker in 1969 and was built on the work of previous biologists such as Carolus Linnaeus.

Living things can be classified into five major kingdoms.

1. Kingdom prokaryote

Prokaryote is a kingdom or division in the classification organization developed for all life on Earth. This kingdom which is also elected as Monera contains all bacteria and blue-green algae (also known as Cyanobacteria).

2. Kingdom Protista or Protoctista

It is a kingdom of simple eukaryotic organisms usually made from a single cell or a colony of similar cells. Protists live in water, in moist terrestrial habitats, as parasites and other symbiotic in the bodies of multicellular eukaryotes.

3. Kingdome Fungi

A fungus is any member of the group of eukaryotic organisms that comprises microorganisms such as yeasts and molds as well as the more familiar mushrooms. These organisms are classified as a kingdom which is separate from the other eukaryotic life kingdoms of plants and animals.

4. Kingdome Plantae

This kingdom contains all land plants such as mosses, ferns, conifers and flowering plants etc. an amazing range of diverse forms. With more than 250,000 species they are second in size only to the arthropods. Plants have been around for a very long time.

5. Kingdome Animalia

All animals are members of the Kingdom Animalia, also called Metazoa. This Kingdom does not contain prokaryotes (Kingdom Monera, includes bacteria, blue-green algae) or protists (Kingdom Protista, includes unicellular eukaryotic organisms).

8. Holy Quran and Biological Science

Among these miracles said to be found in the Quran are "everything, from relativity, quantum mechanics, Big Bang theory, black holes and pulsars, genetics, embryology, modern geology, thermodynamics, even the laser and hydrogen fuel cells.

9. Muslim Scientist and Their Contribution

Abu Zakariya Yahya Ibn Muhammad Ibn Al-Awwan, a 12th Century Islamic scholar based in Seville, Spain, was one of the most important contributors to the history of biology, namely in the field of agriculture.

1. Jabir Bin Ayyan

Abu Musa Jabir Ibn Hayyan Al-Azdi, sometimes called al-Harrani and al-Sufi is considered the father of Arab chemistry and one of the founders of modern pharmacy. He was known to the Europeans as Geber. He was born in the city of Tus in the province of Khorasan in Iran in 721 AD. He systematized a “quantitative” analysis of substances and was the inspiration for Geber, a Latin alchemist who developed an important corpuscular theory of matter. He has written Seventy Books and Gold.

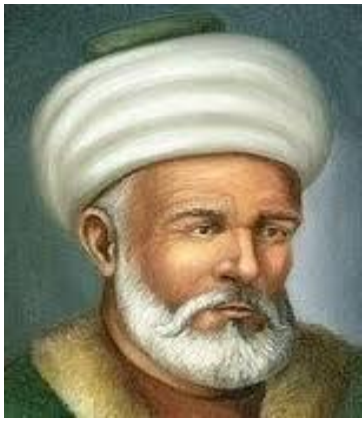
2. Abd al-Malik

Abd al-Malik ibn al-Quraib al-Asmai was born in Basrah in 740 C.E. He was a pious Arab and a good student of Arabic poetry. Al-Asmai is considered as the first Muslim scientist who contributed to Zoology, Botany and Animal Husbandry.

3. Bu Ali Sina

Avicenna (Abu Ali Sina), or Ibn Sina (980-1037). He was a Persian physician and philosopher. He was born near Bukhara then capital of the Samanid dynasty. By the time he was 10 years old he had learned the Koran as well as Arabic grammar and literature. He was a philosopher and has written The Book of Healing and The Canon.

4. Abu Usman Aljahiz



A native of Basrah in Iraq, al-Jahiz was one of the non-Arabs who made up most of the intellectual and scholarly class in that country. Perhaps after a military revolt that killed his friend and patron in 861, he returned permanently to Basrah, where he died.

5. Al-Farabi

Al-Farabi had great influence on science and philosophy for several centuries, and was widely considered second only to Aristotle in knowledge (alluded to by his title of "the Second Teacher") in his time. His work, aimed at synthesis of philosophy and Sufism, paved the way for the work of Ibn Sina (Avicenna).

6. Abdul Qasim Ali Zahravi

Abdul Qasim Ali Zahravi 936–1013, popularly known as Al-Zahrawi was an Arab. Andalusian physician, surgeon and chemist. Considered to be the greatest surgeon of the middle Ages, he has been described as the father of surgery. Al-Zahrawi's principal work is the Kitab al-Tasrif, a thirty-volume encyclopedia of medical practices. Al-Zahrawi's pioneering contributions to the field of surgical procedures and instruments had an enormous impact in the East and West well into the modern period, where some of his discoveries are still applied in medicine to this day. He was the first physician to identify the hereditary nature of haemophilia and describe an abdominal pregnancy, a subtype of ectopic pregnancy that in those days was a fatal affliction, and was the first to discover the root cause of paralysis. He also developed surgical devices for Caesarean sections and cataract surgeries.

7. Ibn al-Nafis

He was born 1213 and lived most of his life in Egypt and witnessed several pivotal events like the fall of Baghdad and the rise of Mamluks. He even became the personal physician of the sultan Baibars and other prominent political leaders, thus showcasing himself as an authority among practitioners of medicine.

Profession: Physician, Polymath, Physiologist

Works written: Theologus Autodidactus

8. Ibn al-Haytham (Alhazen)

He was born c. 965 to an Arab family in Basra, Iraq, which was at the time part of the Buyid emirate. He held a position with the title vizier in his native Basra, and made a name for himself for his knowledge of applied mathematics. ... During this time, he wrote his influential Book of Optics

10. Level of Biological Organization

The biological levels of organization of living things organized from the simplest to most complex such as organelle, cells, tissues, organs, organ systems, organisms, populations, communities, ecosystem and biosphere.

10.1. Cellular organization

Cellular organization is the components that make up the cell and how they are organized inside it. Each component called an organelle performs a particular function that is vital for the cell

10.2. Unicellular organization

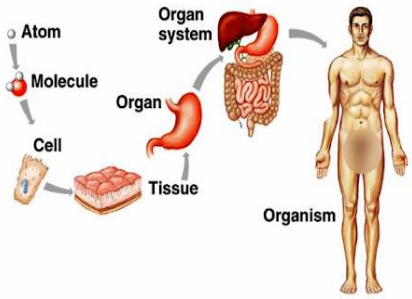
A unicellular organism is an organism that consists of a single cell. This means all life processes such as reproduction, feeding, digestion and excretion occur in one cell. Amoebas, bacteria and plankton are just some types of unicellular organisms. They are typically microscopic and cannot be seen with the naked eye

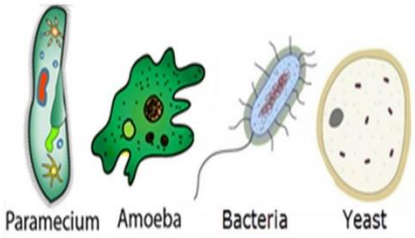
10.3. Multicellular

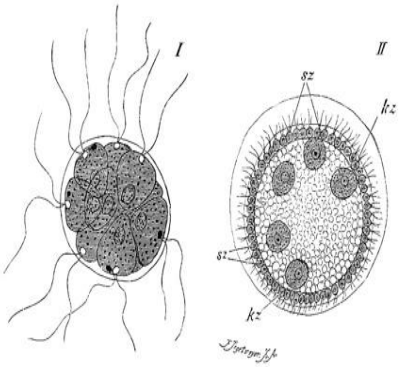
The body of a multicellular organism such as a tree or a cat shows organization at several levels tissues, organs, and organ systems. Similar cells are grouped into tissues, groups of tissues make up organs and organs with a similar function are grouped into an organ system.

10.4. Colonial organization

The cooperation among cells of the same species led to the development of a multicellular organism. Multicellular organisms depending on their complexity may be organized from cells to tissues, organs and organ systems.







The scientific method in which biological problems are solved is known as biological method.

1. Biological method

Biological methods are techniques or procedures that are used to study living things. They contain experimental and computational methods, approaches, protocols and tools for biological research.

2. The scientific method has six basic steps

- Recognition of Biological Problem
- Observation and previous research
- Hypothesis
- Deduction
- Experiments
- Conclusion and reporting

2.1. Recognition of Biological Problem

Formulation of a question relating to a problem e.g. what is the risk factor for heart attack.

2.3. Observation and previous research

Observation consists of getting knowledge of the outside world through our senses or recording information using scientific tools and instruments. Any data recorded during an experiment can be called an observation. Observations are made with five sense such as vision, hearing, smell, test and touch.

Example

- A scientist looking at a chemical reaction in an experiment.
- A doctor watching a patient after administering an injection.
- An astronomer looking at the night sky and recording data about the movement and brightness of the objects he sees.

2.4. Previous research

Studies published were disseminated in the past that report results of research findings. This could mean the authors tested a specific hypothesis, test the principles of the theory or tried to answer a specific research question.

2.5. Hypothesis

A supposition or tentative explanation for a group of phenomena, a set of facts, or a scientific analysis that may be established, verified or answered by further investigation or methodological experiment.

The basic steps of the scientific method are:

1) Make an observation that describes a problem,

2) create a hypothesis,

3) Test the hypothesis

4) Draw conclusions and refine the hypothesis.

2.6. Deduction

Deduction is the process of reasoning by which logical conclusions are drawn from a set of general premises. This approach is called deduction because research hypotheses are deduced from theory by a process of logical reasoning.

2.7. Experiment

Experimental biology is the set of approaches in the field of biology concerned with the conduction of experiments to investigate and understand biological phenomena.

2.8. Conclusion

The conclusion is proposed to help the reader understand why your research should matter to them after they have finished reading the paper. A conclusion is not merely a summary of your points or a re-statement of research problem but a synthesis of key points.

3. Example of Biological Methods

Biological techniques are methods or procedures that are used to study living things. They include experimental and computational methods, approaches, protocols and tools for biological research.

Biological Problem 1

What is the cause of malaria?

Step 1: Observation

The peoples and physician in ancient time almost 2000 before had some observation on malaria

Example

i. The patient faced chills and fevers.
ii. This diseases most common on the peoples who lived in low marshy regions.
iii. When some volunteers drank the water from marshes they did not developed malaria. So according to observation this disease cannot spread from drinking of marshes water.

Before the new observation peoples thought that immobile water of marshes poisoned the air when peoples breathed in this air so they got malaria. But this observation did not help much for solving the problem because the causing agent of malaria still unidentified.

History

After 2000 years it was proved that many diseases are caused by microorganisms like bacteria. Laveran in 1878 worked on the earliest observation and work. He observed the blood of malaria patient under microscope and noticed that some microorganisms in the blood. So he identified that the malarial disease caused by a microorganisms and he named it plasmodium.

Step 2: Hypothesis and deduction

After that some biologist worked on old study and observation of Lavern. So they developed a hypothesis

(Malaria is being caused by plasmodium). For testing the hypothesis through experiments, biologist made a deduction **(if plasmodium is the cause of malaria then all malarial patient should have plasmodium in their blood).**

Step 3: Experiments and Results

i. They examined the blood 100 malaria patients under microscope. It was labelled as the experimental group.
ii. They also examined the blood of 100 healthy persons under microscope and it was labelled as control group.

Result

They observed that all malarial patients have plasmodium in their blood while healthy were free from it. So the experiment was support the hypothesis.

Biological Problem 2: How is plasmodium transmitted to human beings?

Observation

- Malaria is associated with marshes
- Drinking water of marshes did not cause malaria

A. F. A king in 1883 was listed 20 more observation about malaria.

Some important observation were:

i. Peoples who slept in open area has more suffered than the indoor.
ii. The person who slept near smoky fir usually did not get malaria.
iii. Peoples who mostly used mosquito net has suffered less than who did not used.

Hypothesis and Deduction

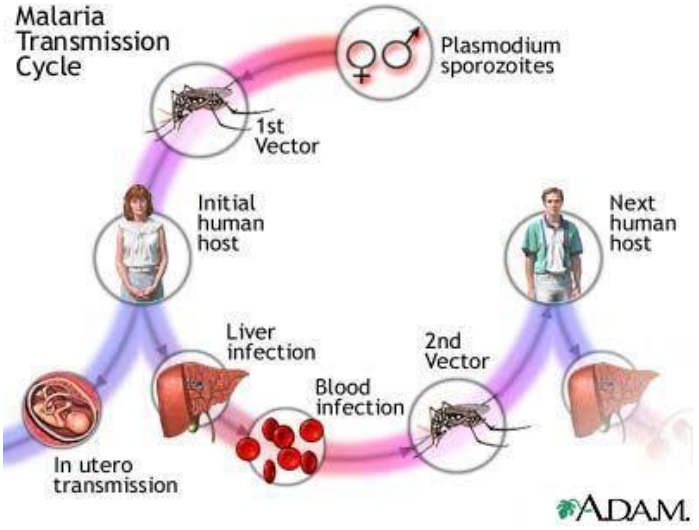
A.F.A king suggested a hypothesis on the basis of his observation

- If mosquito transmit plasmodium than plasmodium should be present in mosquito.

Step 3: Experiment and Results

The first was English physician Sir Ronald Ross scrupulous efforts to show the complex life cycle of the malarial parasite. In his Nobel Prize acceptance speech from 1902 Ross describes his search for both the species of mosquito responsible for transmission and the location of the parasites within the insect tissue. While initially using many subjects from the native Indian population in his experiments (allowing him to show that mosquitoes feeding on malaria victims contained parasites in their tissues), his later breakthrough came when lack of human participants forced Ross to employ birds9. He was ultimately able to observe not only the female and male versions of the malarial parasite in avian hosts but also the transmission of fertilized parasites from birds to the mosquitoes that fed upon them9. Interestingly, Ross was not a trained scientist, but received considerable guidance from another prominent malaria researcher.

The second revelation that mosquitoes could also pass the disease between human hosts was shown by Giovanni Grassi and his team of Italian investigators in the late 19th Century8. This was done by shuttling willing hospital patients in a room with Anopheles and observing the development and progression of malaria in the subject, a protocol many of Grassi's contemporaries found exploitative



Experiments on Human beings

One of Italian biologist in 1898 allowed an anopheles mosquito to bite a malarial patient and then allowed to bite a healthy man. The person has been suffered from malaria. So it was confirmed that mosquito has spread plasmodium and so are involve in the spread of malaria.

What is theory?

It is a thoughtful and rational type of abstract or generalizing thinking about a phenomenon or the results of such thinking. The process of thoughtful and rational thinking often is associated with such processes like observational study and research.

What is Law?

A law is a statement about an observed phenomenon or a unifying concept.

What is principles?

A principle provides a basis for the development of other laws and regulations. Laws and principles describe these two different ideas across physics, biology and other disciplines, theories are collections of concepts, laws and ideas to explain observations of the universe.

Data Organization and Data Analysis

Researcher collect and analysis the data such as names, dates, and value etc at various step in scientific methods. This data help them to make hypothesis from observation and to conclude results from experiments. In order to use data in scientific method scientist have organize and analysis it. Scientist organize data in the form of graphs, tables, flow chart, maps and diagram. The collected data is analyzed by using statistical method like ratio and proportion. A ratio is relationship with respect to relative size between two quantities of the same kind.

- A pure number to a pure number
- An amount of money to an amount of money
- A number of peoples to a number of peoples.
- Proportion mean to join two equal ratio, **a:b = c:d**
- a and d are called the extremes
- b and c are called the mean
- The product of extreme equal to the product of mean.

- When three values in a proportion are known the fourth one (a) can be calculated by using this rules.

Example

If biologist wants to know how many sparrow would be infected with malaria if he allow to culex mosquito to bite 50 sparrows. Previously in one of his findings he already noticed that 6 out of 10 sparrow get malaria if bitten by culex mosquito.

Rules

A : B = C : D

A: 50 = 6: 10

A/50 = 6/10

A x 10 = 50 x 6

A = 30

Mathematics as an integral part of scientific process

Mathematical rules have been used in biology for many decades. Recently however because of developments in our understanding of biology application of mathematical rules in all science has increased tremendously.

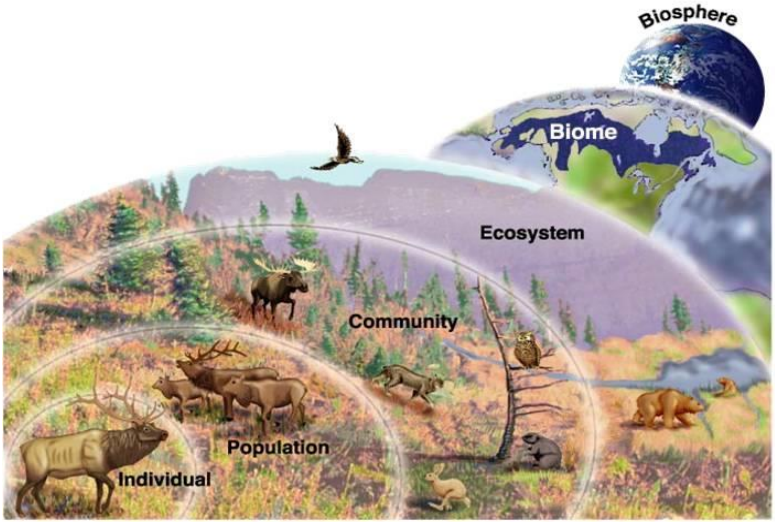
Examples

- Population studies
- Drugs studies
- Sequencing of plants
- Animals DNA

These all field required mathematical knowledge organizing and analyzing the data.

1. Biodiversity

It is the shortened form of two words biological and diversity. It refers to all the variety of life that can be found on Earth (plants, animals, fungi and micro-organisms) as well as to the communities that they form and the habitats in which they live. According to biologist there is more than 100 million kind of organisms, biodiversity depend on climate, altitude and structure of soil. Tropical areas of earth have richer biodiversity whereas Polar areas have less. There are 23, 000 different animals and 6000 plants in Pakistan.



1.1 Importance of Biodiversity

- Biodiversity provide great variety of food for human (crop, livestock, forestry and fish).
- It play a very key role in health of human and animals. We used fungi, plants and animals as medicines such as streptomycin, neomycin and erythromycin are obtained from fungi, drugs like caffeine, morphine, quinine etc. are acquired from plants.
- It is play very key role in the production of industrial material such as building material, fibers, dyes, resin, gums, adhesive rubber and oil are get from plants.
- It is a vital constituent of ecosystem. Species show contact among them, each species has been play a particular role in ecosystem.
- Lose of species make the ecosystem less productive e.g. water cycle, nitrogen etc. going on ecosystem.
- Fertility of soil, balanced climate and several other features depend on biodiversity.

2. Classification of organisms

Almost 2 million kinds of organisms identified by biologist (0.5 million plants and 1.5 million animals).

2.1. Classification

It is the process in which biologist distributed living organisms into group and subgroup on the basis of resemblances and difference.

2.2. Basis of Classification

Aristotle categorized organisms on the basis of habitat such as air, water and land. Though it was not correct as animals in one group may have nothing in common

excluding their habitat e.g. fish and turtle can't be placed in one group, higher plants and grasses can't be placed in same group.

Later some biologist classify organisms on the basis of their physical characteristics. Some of the characters which used to classify organisms are below.

- Prokaryotic or Eukaryotic cell
- Unicellular or multicellular
- Autotrophs or heterotrophs

i. Prokaryotic

Organisms that don't have true nucleus e.g. Bacteria.

ii. Eukaryotic

Organisms that have true nucleus e.g. plants and animals.

iii. Unicellular

Those organisms which are made from only one cell e.g. Bacteria and Fungi.

iv. Multicellular

Organisms which are made from many cells e.g. Animals and Plants.

v. Autotrophs

Living organisms which prepared their own food e.g. plants

vi. Heterotrophs

Living organisms that can't prepared their own food e.g. animals and fungi

3. Modern Classification

Nowadays Biologist classify organisms not only on the basis of habitat and physical features but also on the basis of genetic, anatomy, physiology and evolutionary history.

3.1. Aims of classification

Aims of classification are below:

- To determine resemblances and difference among organisms so it will be easy to study.
- To provide a knowledge about the system of evolution of organisms simple to complex.
- To precise association based on mutual features.
- To name and place the organisms in an accurate group.

3.2. Principles of classification

A few principles are:

- Organisms are classified on the basis of seeming resemblances among them.
- Organism are placed in one group or in closer group if they have more homologous structures.
- Also both of anatomical and evolutionary history considered during classification.

4. Hierarchy of Taxonomy

Definition

Taxonomic hierarchy is the process of arranging various organisms into successive levels of the biological classification either in a decreasing or an increasing order from kingdom to species and vice versa.

According to the history of biological classification, Aristotle, a Greek philosopher classified different animals based on the habitat, characteristics, etc. Later, a Swedish botanist Carolus Linnaeus introduced Taxonomic Hierarchy Categories during the 18th Century, and this system of classification is followed globally till date.

4.2. Taxonomic Hierarchy Categories

Following are the important taxonomic hierarchies in which different organisms are classified:

i. Kingdom

The kingdom is the highest level of classification, which is divided into subgroups at various levels. There are 5 kingdoms in which the living organisms are classified, namely, Animalia, Plantae, Fungi, Protista, and Monera.

Phylum

This is the next level of classification and is more specific than the kingdom. There are 35 phyla in kingdom Animalia. For Example – Porifera, Chordata, Arthropoda, etc.

ii. Class

Class was the most general rank in the taxonomic hierarchy until phyla were not introduced. Kingdom Animalia includes 108 classes including class mammalia, reptilia, aves, etc. However, the classes used today are different from those proposed by Linnaeus and are not used frequently.

iii. Order

Order is a more specific rank than class. The order constitutes one or more than one similar families. There are around 26 orders in class mammalia such as primates, carnivora, etc.

iv. Family

This category of taxonomic hierarchy includes various genera that share a few similarities. For eg. The families in the order Carnivora include Canidae, Felidae, Ursidae, etc.

Animal Example	Taxonomic Rank	Plant Example
Animalia	**Kingdom**	Plantae
Chordata	**Phylum**	Angiospermophyta
Mammalia	**Class**	Eudicotidae
Primate	**Order**	Ranunculales
Hominidae	**Family**	Ranunculacae
Homo	**Genus**	*Ranunculus*
sapiens	**Species**	*acris*
Human	Common Name	Buttercup

v. Genus

A group of similar species forms a genus. Some genera have only one species and is known as monotypic, whereas, some have more than one species and is known as polytypic. For eg., lion and tiger are placed under the genus Panthera.

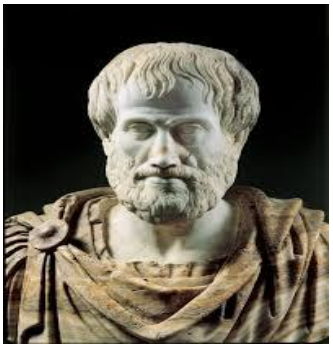
vi. Species

It is the lowest level of taxonomic hierarchy. There are about 8.7 million different species on earth. It refers to a group of organisms that are similar in shape, form, reproductive features. Species can be further divided into sub-species.

Taxonomic hierarchy of some of the common animals and plants.

	Amoeba	**Mustard**	**Mushroom**	**Man**
Kingdom	Protista	Plantae	Fungi	Animalia
Phylum	Protozoa	Tracheophyta	Mycota	Chordata
Class	Sarcodina	Angiospermea	Basidiomycota	Mammalia
Order	Ameobidales	Brassicales	Agricales	Primates
Family	Ameobidae	Brasicaceae	Agricaceae	Hominidae
Genus	Amoeba	Brassica	Agaricus	Homo
Species	Amoeba proteus	Brassica campestris	Agaricus compestris	Homo sapiens

5. History of Classification



Aristotle (384-322 BC)

He was a 4th century Greek philosopher. He divided organisms into two main groups, namely plants and animals. His system was used into the 1600's. People who wrote about animals and plants either used their common names in various languages or adopted more-or-less standardized descriptions.

Abu Usman Aljahiz

He was born in 776 and wrote a book on animals Kitab Al Hayawan. He explained features of 350 species of animals. He also gave detailed account of the social organization of Ants.

5.1 Caspar Bauhin (1560–1624)

He took some important steps towards the binomial system currently used by modifying many of the Latin descriptions to two words.

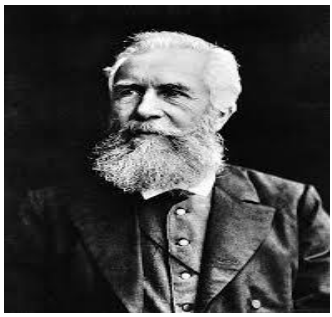
5.2. Carolus Linnaeus (1707–1778)

He was an 18th century Swedish botanist and physician. He classified plants and animals according to similarities in form and divided living things into two main kingdoms namely plant and animal kingdoms. He named the plants and animals in Latin or used Latinized names in his books Species Plantarum (1753) and Systema Naturae (1758).

Limitation of Two Kingdom system of Classification

1. Some organisms share the characteristics of both animals and plants. Example Euglena and Sponges. In Euglena, certain species contain chlorophyll and are autotrophic similar to plants. However similar to animals they are dependent on an exterior supply of vitamins B, and B12 that they cannot synthesize themselves.
2. Fungi are a class of organisms that contain features of their own. They lack chlorophyll. They are heterotrophic similar to animals. They are placed all along with green plants.
3. Most of the primitive organisms like bacteria did not fit into either group and organisms similar to slime molds are amoeboid however form fruiting bodies alike to fungi.
4. The status of virus whether they are non-living or living is a point of debate even today.

5.3. Ernst Haeckel (1834-1919)



He was able to observe microscopic single-celled organisms and he proposed a third kingdom of life, the Protista, in 1866. Protista were single celled organisms that were neither plant nor animal, but could have characteristics of either.

5.4. Herbert Faulkner Copeland (1902–1968)

He recognized the important difference between the single-celled eukaryotes and single-celled prokaryotes. He proposed a four-kingdom classification, and placed the bacteria and blue-green algae (prokaryotes) in a fourth kingdom Monera.

5.5. Robert Harding Whittaker (1920-1980)

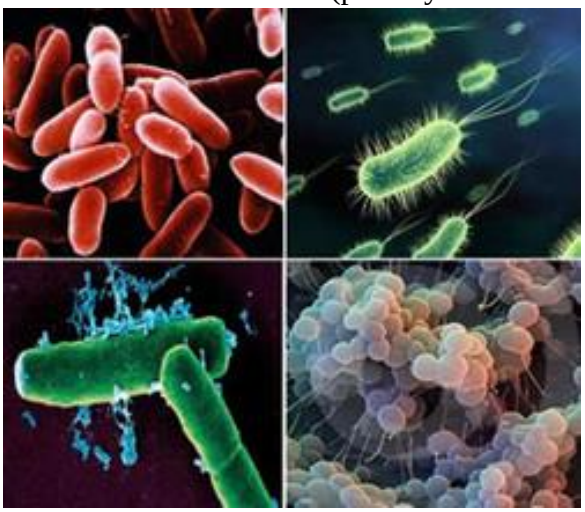
He devised a five kingdom system in 1969. He recognized that fungi belonged to their own kingdom. However, even today the five-kingdom system is under dispute. It is the nature of science that as more discoveries come to light, theories will continue to be improved upon and revised.

5.6. Margulis and Schwartz (1988)

The modifications suggested by Margulis and Schwartz and Whittaker's scheme was that they proposed the five kingdoms of organisms. They classified the world's ecologic distribution into five separate entities that are known as Plantae, Protista, Animalia, Monera and Fungi.

Kingdom Monera

Monera is a kingdom that contains unicellular organisms with a prokaryotic cell organization (having no nuclear membrane), such as bacteria. They are single-celled organisms with no true nuclear membrane (prokaryotic organisms.

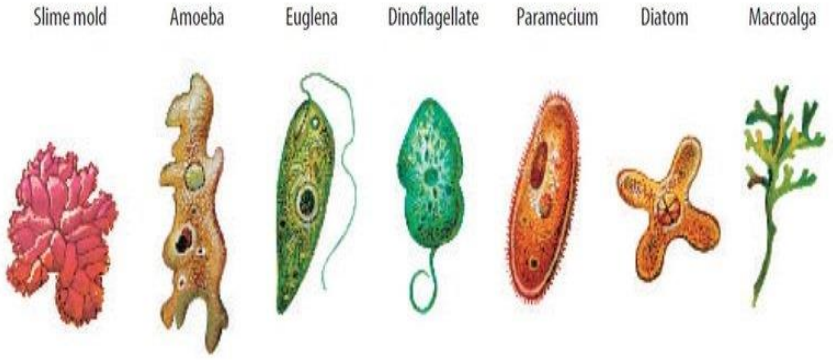


Characteristics

- They are typically unicellular organisms (but one group is mycelial).
- The genetic material in these organisms is the naked circular DNA.
- A nuclear envelope is absent.
- Both, ribosomes and simple chromatophores are the only subcellular organelles in the cytoplasm.
- Sap vacuoles do not occur. Instead, gas vacuole may be present.
- The predominant mode of nutrition is absorptive but some groups are photosynthetic (holophytic) and chemosynthetic.
- The organisms are non-motile or move by the beating of simple flagella or by gliding

Kingdome Protista

Kingdom Protista contains the protists, or all the organisms that do not fit into the other kingdoms of life. Protists can be heterotrophic or autotrophic, moveable or immovable single celled or multi celled, single or a member of a colony.



Characteristics

- They are eukaryotic, which means they have a nucleus.

- Most have mitochondria.
- They can be parasites.
- They all prefer aquatic or moist environments

Kingdome Fungi

Fungi are eukaryotic organisms that include microorganisms such as yeasts, molds and mushrooms. These organisms are classified under kingdom fungi. The organisms found in Kingdom fungi comprise a cell wall and are omnipresent. They are classified as heterotrophs among the living organisms.

Characteristics

- They are Eukaryotic in nature.
- They are Decomposers.
- They have no chlorophyll.
- Most are multicellular (hyphae) and some are unicellular (yeast)
- Non motile.
- Cell walls made of chitin instead of cellulose like that of a plant.
- Are more related to animals than plant kingdom

Kingdom Plantae

The Plantae includes all land plants: mosses, ferns, conifers, flowering plants, and so on and an amazing range of diverse forms. With more than 250,000 species they are second in size only to the arthropods. Plants have been around for a very long time.

Characteristics

- They are eukaryotic and multicellular.
- Their cells have cellulose walls.
- Majority have transport system.
- They have photosynthesis hence autotrophic.
- Reproduction is both asexual and sexual.
- They show alternation of generation

Kingdom Animalia

This kingdom also called Metazoa and all animals are members of the Kingdom Animalia. This Kingdom does not comprise prokaryotes (Kingdom Monera, contains bacteria and blue-green algae) or protists (Kingdom Protista contains unicellular eukaryotic organisms).

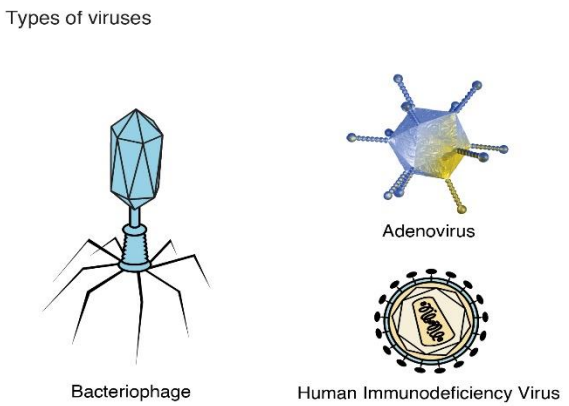
Characteristics

- These organisms are multicellular eukaryotic (having no chlorophyll).

- Their cells have no cell walls and plastids.
- Central vacuoles are absent but small vacuoles may occur.
- Most of them are free moving (excluding sponges and some coelenterates)
- It is herbivores, carnivores and omnivores.

Viruses

Viruses are unique because they are only alive and able to multiply inside the cells of other living things. The cell they multiply in is called the host cell.



Structure

A virus is made up of a core of genetic material either DNA or RNA, surrounded by a protective coat called a capsid which is made up of protein.

Features

- They are a-cellular (no cytoplasm or cellular organelles).
- They carry out no metabolism on their own and must replicate using the host cell metabolic machinery.
- In other words viruses do not grow and divide.
- The vast majority of viruses possess either DNA or RNA but not both

Binomial Nomenclature

The Binomial Nomenclature system is a formal system of naming that was introduced by a scientist Carolus Linnaeus. He is considered as the father of modern taxonomy. His books are considered as the beginning of modern biological nomenclature. They outlined the rules for assigning names to plants and animals in a certain format.

System and Rules Binomial Nomenclature

According to this system each organism is known by two names the Genus name and the species name. These names are all written in Latin. The genus name and species name of an organism written together are called its scientific name. Some rules that are followed while writing these names are mentioned hereunder.

- The name of the genus always begins with a capital letter.

			
Kingdom	Animalia	Animalia	Animalia
Phylum	Chordata	Chordata	Arthropoda
Class	Mammalia	Aves	Insecta
Order	Monotremata	Bucerotiformes	Lepidoptera
Family	Ornithorhynchidae	Bucerotidae	Nymphalidae
Genus and species	*Ornithorhynchus anatinus*	*Bycanistes subcylindricus*	*Callicore aegina*

- The species name begins with a small letter.
- The scientific names are always italicized.
- When handwritten, the genus name and species name have to be underlined

A few examples of names of organisms written in this system

1. Homo sapiens (Human Beings)
2. Helianthus annuus (Sunflower Plant)
3. Panthera tigris (Tiger)
4. Mangifera indica (Mango Plant)
5. Canis-lupus familiaris (Dog)

Importance Binomial Nomenclature

The binomial nomenclature or scientific name has a number of advantages over the everyday and common names.

Well Organized and Classified

The organism can be smoothly or easily categorized. This openly helps to make it easier and straight forward to understand the features of a particular organism.

Clarity and Precision

These names are always unique with each organism or creature having only one scientific name. It helps avoid confusion or turbulence created by the common names.

Universal Recognition

Scientific names are accepted and uniform universally. Though general or common name changes with area location or language. These names are always the same among the scientific people all over the World.

Stability

The Scientific Names are maintained even if the species are moved to the other genera based on new observations and knowledge. Using scientific names different characteristics or properties of the organism or species can be obtained.

Interspecific relationship

Binomial or Scientific terms help to know the differences and resemblances between different species or organisms belonging to the same genera. It is valuable in establishing a relation between the two species.

- A smaller or minor fault in communication concerning the information or studies of any organism because these names are unique to it and the same all over the globe.
- The scientific name big benefit is its accuracy.
- The scientific name or Binomial name is regulated by The International Code of Binomial Nomenclature

Biodiversity conservation

the practice of protecting and preserving the affluence and diversity of species, habitats, ecosystems and genetic diversity on the planet is significant for our health, wealth, food, fuel and services that we depend on. It plays an essential role in supporting several areas of development.

Biodiversity conservation in Pakistan

Protected Areas System has been established for in-situ conservation of biodiversity in the country. Pakistan Environmental Protection Act 1997 provides legal protection to the overall environment in Pakistan. A number of other laws do exist relating to conservation of various components of biodiversity. It is utterly disappointing to know that about 90 species of mammals, reptiles and birds are approaching the critical stage of extinction in Pakistan. A few mammals sadly have been reported to vanish from the wildlife's habitat, which includes tigers, deer, blackbucks, lions and Indian horned rhinoceros.

Impact of Human Being on Biodiversity

Human activities are causing major changes in biological communities worldwide, and these changes can harm biodiversity and ecosystem function.

The main threats facing biodiversity globally are:

- Destruction, degradation and fragmentation of habitats.
- Reduction of individual survival and reproductive rates through exploitation, pollution and introduction of alien species.

Habitat lose

The effects of habitat destruction are basically the loss of species and resources. Every type of habitat destruction results in a loss of species.

Causes

- Instant harm to habitats and kills many species in the process.
- Fragmentation results in the loss of resources, such as food and mates.

Deforestation

Deforestation is the permanent removal of trees to make room for something besides forest. This can include clearing the land for agriculture or grazing, or using the timber for fuel, construction or manufacturing.

- Worldwide forests cover 31 % area of the world. Just over 4 billion hectares. (One hectare = 2.47 acres.).
- In Pakistan 4.57 million hector area covered by forests (5.2%).

Causes

Natural Causes

- Storms
- Fires

- Parasites
- Floods.

Human Activities

- Agricultural expansion
- Cattle breeding
- Timber extraction
- Mining
- Oil extraction
- Dam construction
- Infrastructure development.

Over Hunting

Relentless chase for wild or game animals to kill or catch them for economic or personal gains or food.

Causes

- Overpopulation. ...
- Cosmetic Products.
- Overhunting For Food.
- Growing Demand for Animal Meat.
- Tradition and Culture.
- Hunting For Fun or Sport.
- Hunting For Fur, Decoration and Other Economic Values.
- Increased Affordability.

Rapid industrialization

- Due to industrialization and aggressive economic development biodiversity has been impacted significantly leading to inefficient use and exploitation of natural resources.
- This impact has led to a gradual and in some cases rapid extinction of species and loss of green cover.

Introduction of species

- Invasive species cause harm to wildlife in many ways.
- When a new and aggressive species is introduced into an ecosystem, it may not have any natural predators or controls.
- Invasive species can change the food web in an ecosystem by destroying or replacing native food sources.

Deforestation

Deforestation is the permanent removal of trees to make room for something besides forest. This can include clearing the land for agriculture or grazing, or using the timber for fuel, construction or manufacturing. Forests cover more than 30% of the Earth's land surface

Causes

Direct causes of deforestation

- Agricultural expansion, wood extraction (e.g., logging or wood harvest for domestic fuel or charcoal)
- Infrastructure expansion such as road building and urbanization.
- Rarely is there a single direct cause for deforestation.

Effect of Deforestation

- If forests are cleared, or even disturbed, they release carbon dioxide and other greenhouse gases.
- Forest loss and damage is the cause of around 10% of global warming

Conservation of biodiversity in Pakistan

The Government of Pakistan prepared the National Conservation Strategy (NCS) in 1992, with biodiversity conservation as an essential component. Pakistan is a signatory to many international initiatives and is making concerted efforts to conserve its biodiversity in all ecological regions.

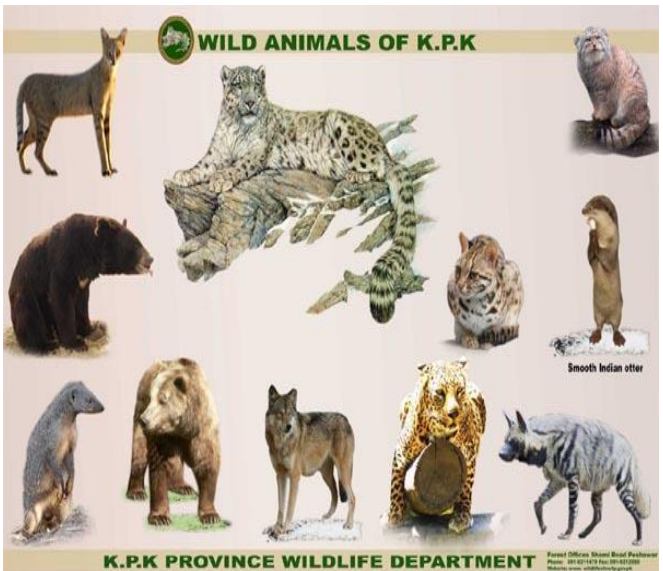
Endangered Species in Pakistan

Endangered animals are the type of animals that are in danger of disappearing forever.

Animals	Plants
Markhor	Asparagus gharoensis
Long billed vulture	Scaevola plumierii
Snow leopard	Scaevola taccada
Baluchistan black bear	Allium gilgiticum
Green turtles	Arabidopsis brevicaulis
Indus river dolphin	Christolea mirabilis
Marco polo sheep	Taxus

Conservation Strategies in Pakistan

- Maintaining soils in cropland;
- Increasing irrigation efficiency;
- Protecting watersheds;
- Supporting forestry and plantations;
- Restoring rangelands and improving livestock;
- Protecting water bodies and sustaining fisheries;
- Conserving biodiversity;



- Increasing energy efficiency;
- Developing and deploying material and energy renewables;
- Preventing/abating pollution;
- Managing urban wastes;
- Supporting institutions for common resources;
- Integrating population and environment programmes; and
- Preserving the cultural heritage

What is cell?

Cell is the basic structural and functional unit of all living organisms.

What is tissue?

When many same kind of cell join together to form tissue.

Microscopy

The use of microscope is called microscopy.

Who discover first microscope?

First microscope was discovered by Zacharia Janssen (1595) from Thailand. He discovered a simple tube with lenses of at each end and Its M.G.P (Magnification power) is 3x to 9x (times).

Who is Leeuwenhoek and what he did?

He was a Dutch scientist (1632 to 1723) and discovered a much better microscope, so he is considered to be first microscopist. Its magnification power was 250x (times) and he observed microorganisms under it.

What is magnification?

The increase the image size of an object is called magnification.

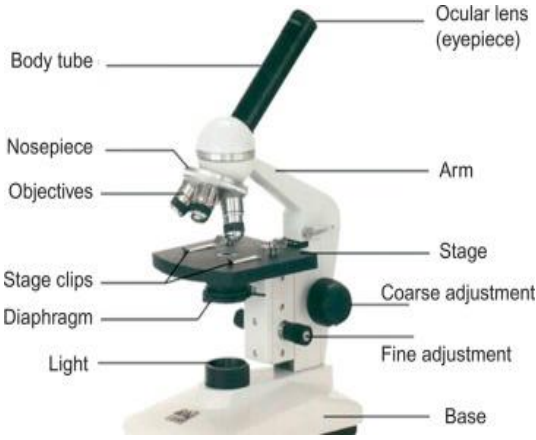
What is resolution?

The instrument which show object separately is called resolution.

- Human eye resolution power is 0.1.

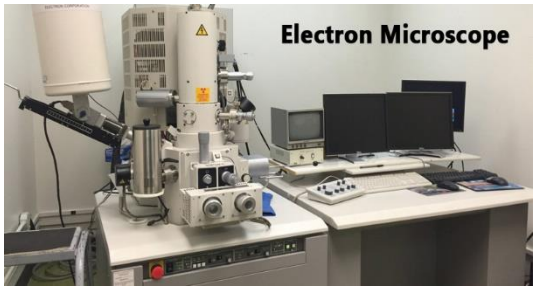
Light Microscope

The light microscope is an instrument for imagining fine detail of an object. It magnified the object through the series of glass lenses which first focus a beam of light onto or through an object, and convex objective lenses to enlarge the image formed. The magnification of a light microscope is formed using a mixture of the powers of the eyepiece and the objective lens. The eyepiece produces a power of 10x and the objective lens can produce various different powers, so if it were to produce a power of 100x, the final magnification would be 1000x (10 x 100).



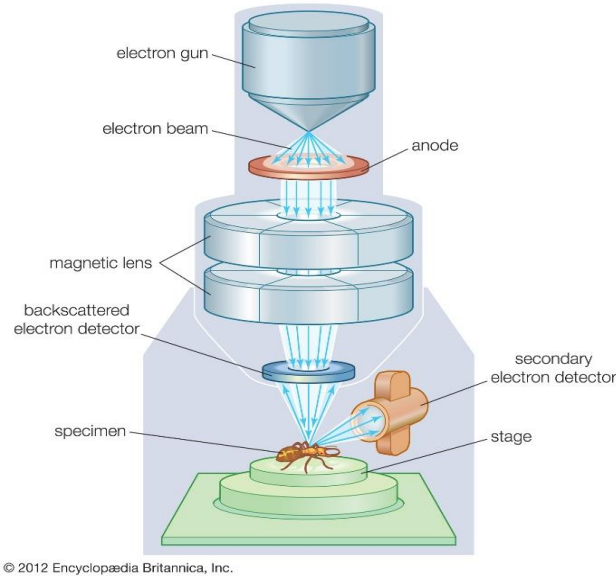
Electron Microscope

Electron microscopy (EM) is a technique for obtaining high resolution images of biological and non-biological samples. It is used to study the complete structure of tissues, cells, organelles and macromolecular complexes. The resolution limit of electron microscopes is about 0.2nm, the maximum useful magnification an electron microscope can provide is about 1,000,000x.



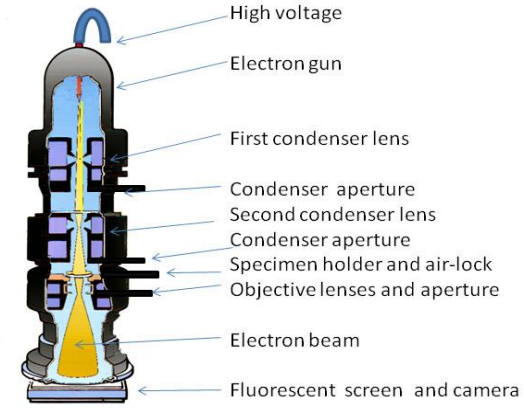
Transmission Electron Microscope

It is used to view thin specimens (tissue sections, molecules etc) through which electrons can pass generating a projection image. The TEM is similar in many ways to the conventional (compound) light microscope.



Scanning Electron Microscope

The scanning electron microscope is the Electronic Microscope analog of a stereo light microscope. It provides detailed images of the surfaces of cells and whole organisms that are not possible by TEM. It can also be used for particle counting, size determination and for process control.



Comparison between light and electron microscope

	Light Microscope	**Electron Microscope**
Radiation Type	Light	Beams Of Electron
Lenses	Optical	Magnetic
Magnification	10000x	10,0000x
Resolution	50x	200000
Image	2D	3D

Emergence of Cell Theory

Robert Hook (1565)

He is best known today for his identification of the cellular structure of plants. He used a simple microscope its magnification power up to 30x, he looked at a sliver of cork through his microscope, he noticed some pores or

cells in it. Hooke believed the cells had served as containers for the noble juices or fibrous threads of the once living cork tree.

Anton van Leeuwenhoek

He is another scientist who saw these cells soon after Hooke did. He made use of a microscope comprising better lenses that could magnify objects nearly 300x or 270x. Leeuwenhoek named these animalcules which included protozoa and other unicellular organisms like bacteria.

Jean Baptist De-Lamarck 1809

He studied both animal and plant under the microscope, so he observed that all living organisms are made from cell.

Robert Brown (1831)

He described cell having a circular body in the center and also told that cell had empty chamber.

Matthias Jacob Schleiden (1838)

He told that plants were made from cell and later it was supported by German zoologist Theodor Schwan in 1839 and said animals are also made from cells.

Jan Evangelista Purkinje (1839)

He concluded that protoplasm is the fluid substance of the cell.

Rudolf Virchow (1855)

He changed all previous theory and said all cells come from the cells.

Louis Pasteur (1962)

He was the first scientist to demonstrate that cells can only form from preexisting cells. He did this by creating an experiment that showed cells would only grow in broth if air was exposed.

Matthias Schleiden and Theodor Schwann (1830)

Matthias Schleiden and Theodor Schwann were studying tissues and suggested the combined cell theory. The combined cell theory states that all living things are composed from one or more cells, so the cell is the basic unit of life and new cells arise from existing cells.

Conclusions of cell theory

- All living organisms are composed of one or more cells.
- The cell is the basic unit of structure and function in organisms.
- Cells arise from pre-existing cells

What are a-cellular particles?

Virus, viroid and prion are a-cellular particles. A-cellular particles are not alive, which means they are not made from cells.

Cellular Structure and Function

Cell structure comprises diverse components with specific functions to carry out life progressions. These components comprise cell wall, cell membrane, cytoplasm, nucleus and other cell organelles.

What is cell?

Cells are the basic unit of a living organism and where all life processes are carried out.

- Animal cells and plant cells share the common components of a nucleus, cytoplasm, mitochondria and cell membrane.
- Plant cells have three extra components, vacuole, chloroplast and cell wall.

Plant Cell

- Plant cells are eukaryotic cells.
- Plant cell contains some organelles that are not found in an animal cell e.g. cell wall, large vacuole and plastids.
- Plastids such as chloroplasts help in storage and harvesting needed substances for the plant.

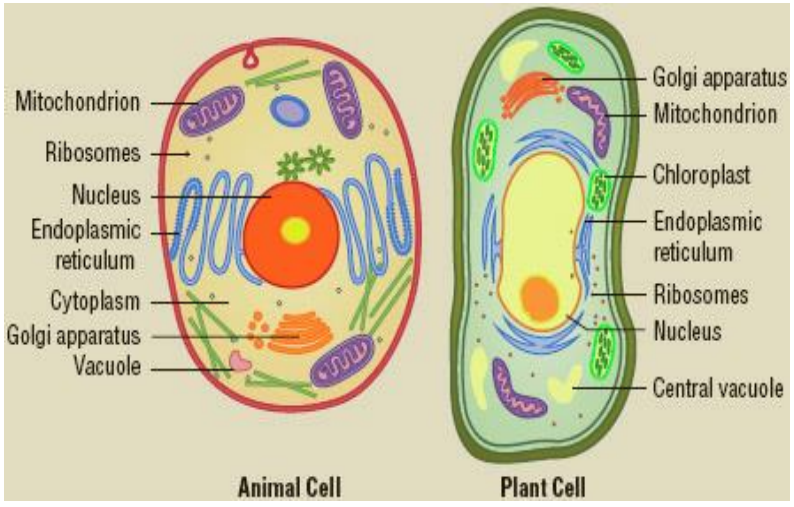
Plant cell contains the following organelles.

- Nucleus.
- Cell Wall.
- Plastids.
- Central Vacuole.
- Golgi apparatus.
- Ribosomes.
- Mitochondria

Animal Cell

Animal cell contains the following organelles.

- Cell Membrane.
- Nuclear Membrane.
- Nucleus.
- Centrosome.
- Lysosome (Cell Vesicles)
- Cytoplasm.
- Golgi apparatus.
- Mitochondrion.

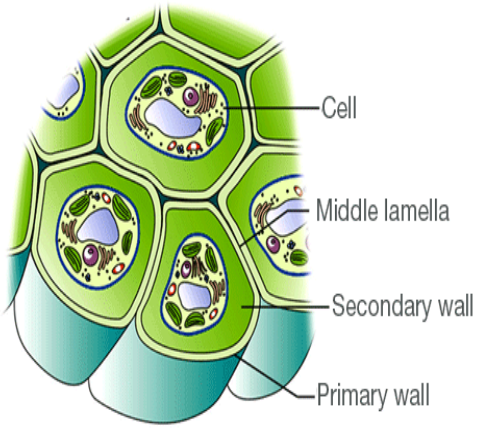


What is Cell Wall?

It is the outer most membrane of plants cells and it is lack in animal cells.

Formation of cell wall

Plant cell walls are primarily made of cellulose which is the most abundant macromolecule on Earth. Cellulose fibers are long, linear polymers of hundreds of glucose molecules. These fibers aggregate into bundles of about 40 which are called micro-fibrils.

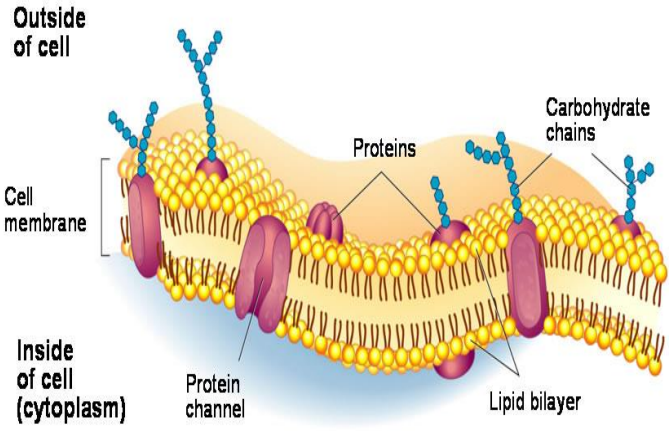


Characteristics

- It is found in plants, bacteria and fungi cells.
- It can be tough, flexible, and sometimes rigid.
- It provides the cell with both structural support and protection.
- It also acts as a filtering mechanism

The Plasma Membrane

It also called the cell membrane and it is the membrane found in all cells that separates the interior of the cell from the outside environment. In bacterial, fungi and plant cells, a cell wall is attached to the plasma membrane on its outside surface.



Formation of Cell Membrane

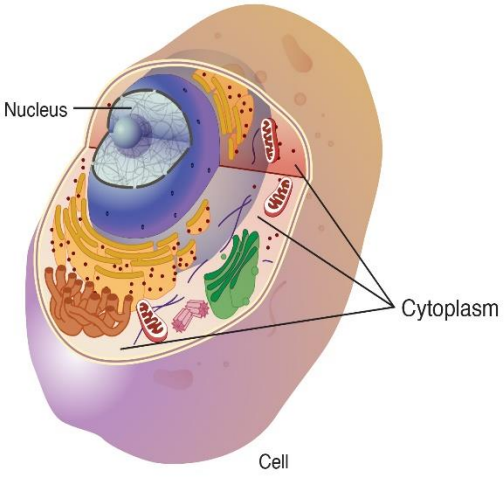
The plasma membrane is composed of a phospholipid bilayer, which is two layers of phospholipids back to back. Phospholipids are lipids with a phosphate group attached to them. The phospholipids have one head and two tails. The head is polar and hydrophilic (water loving). .

Characteristics

- The primary function of the plasma membrane is to protect the cell from its surroundings.
- the plasma membrane is selectively permeable to ions or organic molecules and regulates the movement of substances in and out of cells

Cytoplasm

It is a thick solution that fills each cell and is enclosed by the cell membrane. It is mainly composed of water, salts and proteins. In eukaryotic cells the cytoplasm contains all of the material inside the cell and outside of the nucleus.



Formation

Cytoplasm is made up of three parts: cytosol, organelles and inclusions.

Characteristics

- Cytoplasm consists of all of the contents outside of the nucleus and enclosed within the cell membrane of a cell.

- It is clear in color and has a gel like appearance.
- Cytoplasm is composed mostly of water but also contains enzymes, salts, organelles and several organic molecules

Endoplasmic reticulum (ER)

A continuous membrane system that forms a series of flattened sacs within the cytoplasm of eukaryotic cells.

Functions

It important organelles mainly in the synthesis, folding, modification and transport of proteins.

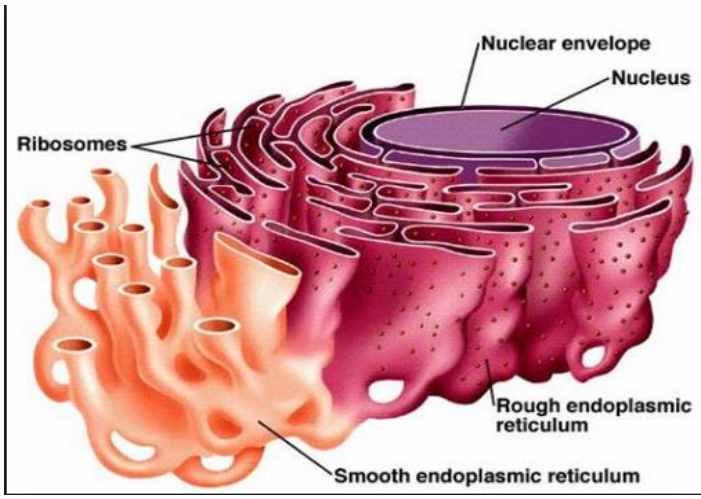
It have two types

Smooth endoplasmic reticulum (SER)

It is meshwork of fine disk like tubular membrane vesicles, part of a continuous membrane organelle within the cytoplasm of eukaryotic cells.

Function

It is involved in the synthesis and storage of lipids, including cholesterol and phospholipids which are used in the production of new cellular.



Rough Endoplasmic Reticulum

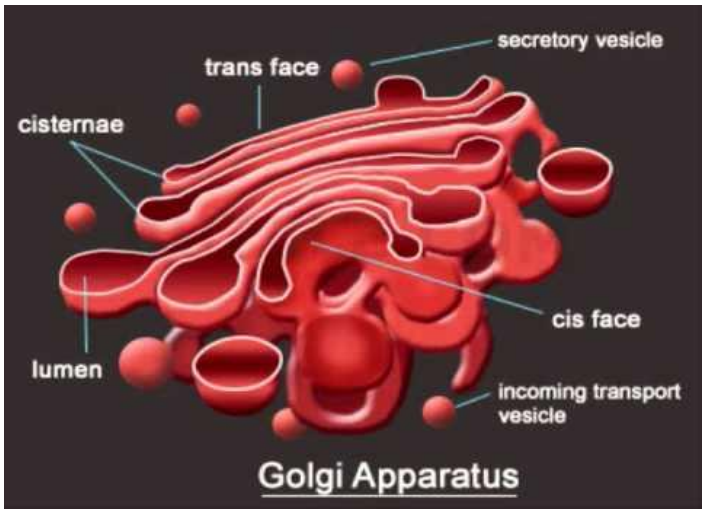
A series of connected flattened sacs part of a continuous membrane organelle within the cytoplasm of eukaryotic cells,

Function

It plays a central role in the synthesis of proteins.

Golgi apparatus

It is also called Golgi complex or Golgi body. It is an organelle found in most eukaryotic cells. Part of the endomembrane system in the cytoplasm it packages proteins into membrane bound vesicles inside the cell before the vesicles are sent to their destination.



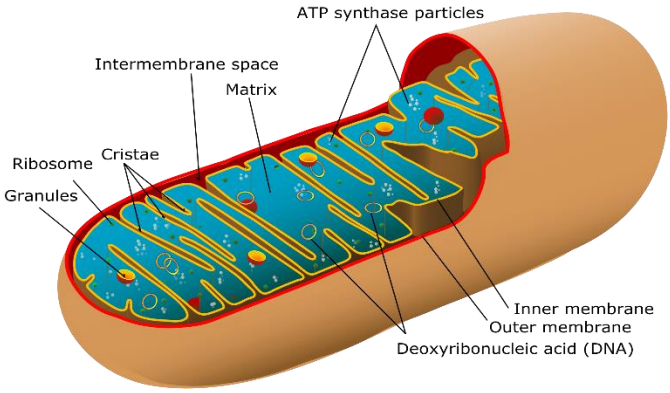
Function

It helps in the process of package proteins and lipid molecules especially proteins intended to be transferred from the cell.

Mitochondria

- Mitochondria are membrane bound cell organelles that make most of the chemical energy required to power the cell biochemical reactions.

- Chemical energy produced by the mitochondria is stored in a small molecule called adenosine triphosphate (ATP).

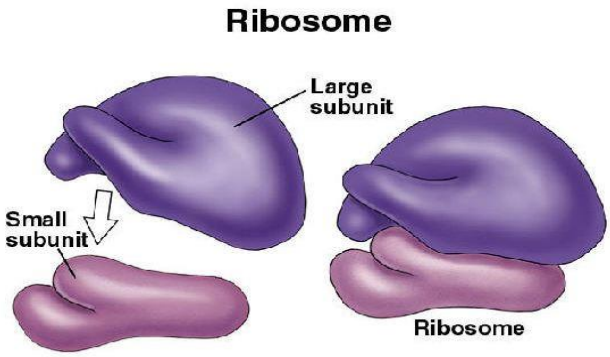


Shape

- Mitochondria are shaped perfectly to maximize their productivity. They are made of two membranes.
- The outer membrane covers the organelle and contains it like a skin.
- The inner membrane folds over many times and creates layered structures called cristae.

Ribosome

- Ribosomes are tiny particles comprising of RNA and related proteins that function to synthesize proteins.
- Proteins are essential for numerous cellular functions such as repairing damage or directing chemical processes.
- Ribosomes can be found floating within the cytoplasm or attached to the endoplasmic reticulum.



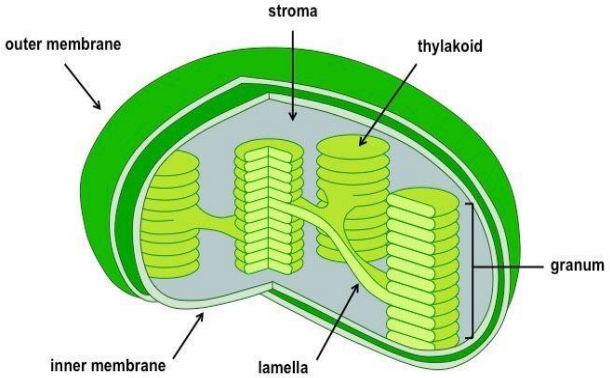
Plastids

- They are double membrane organelle which are found in the cells of plants and algae.
- They are responsible for development and storing of food.
- They commonly contain pigments that are used in photosynthesis.
- The different types of pigments that can change the color of the cell.

It is divided into three types

Chloroplast

- It is an organelle that found in plant cells and eukaryotic algae.
- It conduct the function of photosynthesis.
- Chloroplasts absorb sunlight and use it in combination with water and carbon dioxide to produce energy for the plant.



Chlorophyll

Green pigment found in leaves. They have three part.

Thylakoid

- It is membrane bounded section inside chloroplast and cyanobacteria.
- It is the site of the light dependent reactions of photosynthesis.
- Thylakoids consist of a thylakoid membrane surrounding a thylakoid lumen.

Stroma

- It comprise the enzymes which essential for carbon fixation,
- It also succeeds the chloroplast response to cellular stresses and signaling between various organelles.
- It plays a key role in both the light dependent and light independent reactions of photosynthesis (light and Dark Reaction).

Granum

It is a stack of thylakoid discs. Chloroplasts can have from 10 to 100 grana. Grana are connected by stroma thylakoids, also called intergranal thylakoids or lamellae. Grana thylakoids and stroma thylakoids can be distinguished by their different protein composition.

Chromoplast

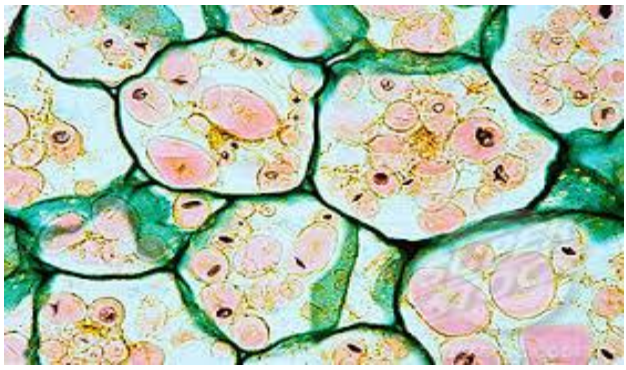
It Contains carotene and xanthophylls. Thus both of them convey a particular color to flowers and fruits which help in pollination and dispersal of seeds.

What is Carotenes?

- They are photosynthetic pigments and contain no oxygen atoms.
- They absorb ultraviolet, violet, blue light, scatter orange or red light and (in low concentrations) yellow light.

What is Xanthophyll?

- They are a class of oxygen comprising carotenoid pigments.
- Responsible for the color of many of the yellow, orange, and red kinds of flowers, fruits, vegetables (corn, pepper, etc.)
- It is also found in egg yolks, feathers, shells or flesh of many animal species (flamingo, canary, shrimp, lobster, chicken, or salmonids).

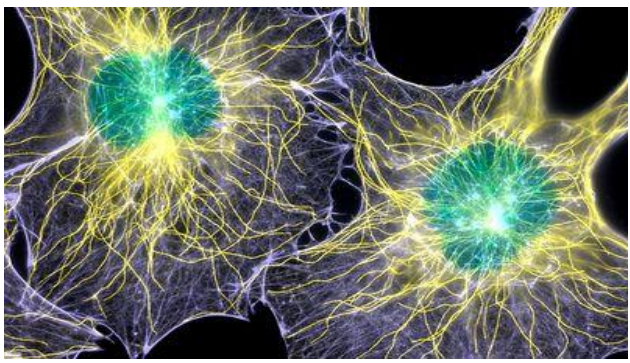


Leucoplast

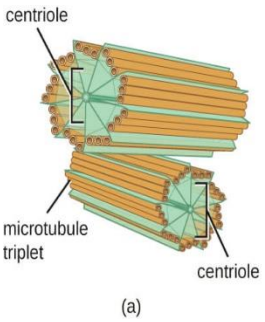
It is colorless plastids located in roots and non-photosynthetic tissues of plants.

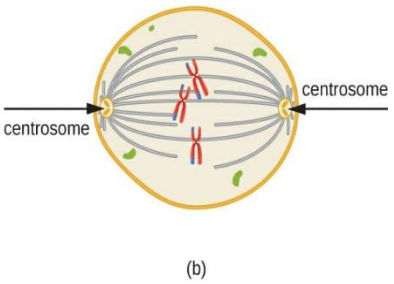
Cytoskeleton

- The cytoskeleton is a network of filaments and tubules that extends throughout a cell.
- It is found in all cells however the proteins that it is made of vary between organisms.



Centriole



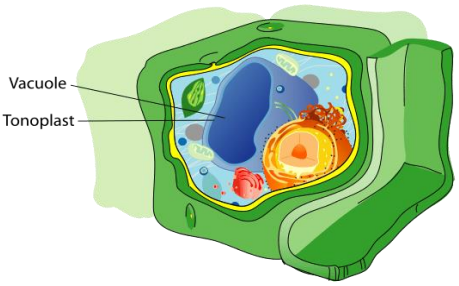


- A centriole is a small set of microtubules arranged in a specific way.
- There are nine groups of microtubules.
- When two centrioles are found next to each other, they are usually at right angles.
- The centrioles are found in pairs and move towards the poles (opposite ends) of the nucleus when it is time for cell division.

Function

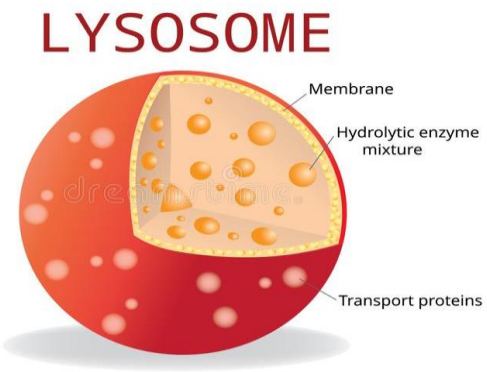
- Centrioles are a very important part of centrosomes, which are involved in organizing microtubules in the cytoplasm.
- The position of the centriole determines the position of the nucleus and plays a crucial role in the spatial arrangement of the cell.

Vacuole



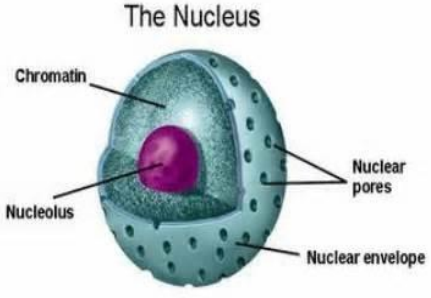
- Vacuoles are storage bubbles found in cells.
- They are found in both animal and plant cells but are much larger in plant cells.
- Vacuoles might store food or any variety of nutrients a cell might need to survive.
- They can even store waste products so the rest of the cell is protected from contamination

Lysosome



- A lysosome is a membrane bound cell organelle that comprises digestive enzymes.
- They break down extra or worn out cell parts.
- They may be used to destroy attacking viruses and bacteria.
- If the cell is damaged beyond repair, lysosomes can help it to destruct it so the process called programmed cell death or apoptosis.

Nucleus



- The nucleus is the information center of the cell and is surrounded by a nuclear membrane in all eukaryotic.
- A cell normally contains only one nucleus.

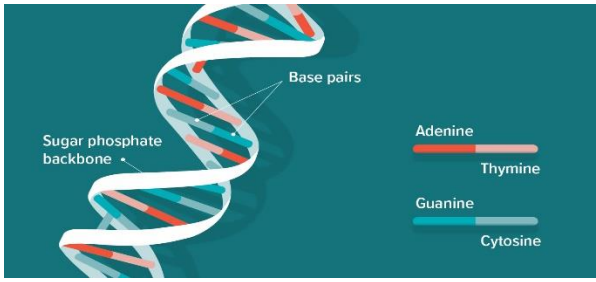
Formation

- The structure of a nucleus contains the nuclear membrane, nucleoplasm, chromosomes and nucleolus.
- The nuclear membrane is a double layered structure that encloses the contents of the nucleus.
- The nucleus communicates with the remaining of the cell or the cytoplasm through several openings called nuclear pores.

Function

The nucleus controls and regulates the activities of the cell (e.g., growth and metabolism).

It carries the genes, structures that contain the hereditary information.

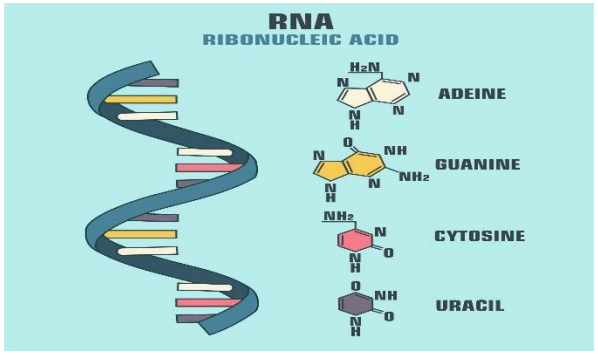


DNA

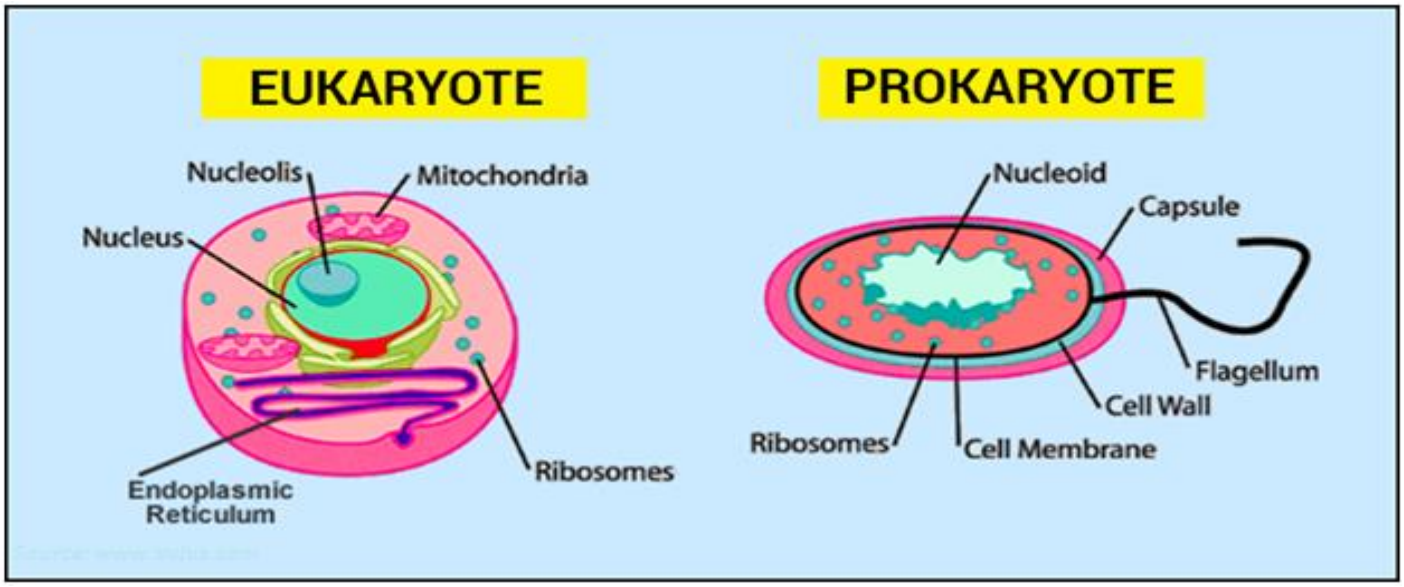
- Deoxyribonucleic acid a self-replicating material which is present in nearly all living organisms as the main constituent of chromosomes.
- It is the carrier of genetic information.

RNA

Ribonucleic acid, a nucleic acid present in all living cells. Its principal role is to act as a messenger carrying instructions from DNA for controlling the synthesis of proteins, although in some viruses RNA rather than DNA carries the genetic information.



Difference between Prokaryotic and Eukaryotic Cell



Prokaryotic Cell	Eukaryotic cell
Size is 0.1- 5.0 um	Size is 5-100 um

Nucleus is absent	Nucleus is present
Membrane bound nucleus absent.	Membrane bound Nucleus is present.
One chromosome is present, but not true chromosome plastids	More than one number of chromosomes is present.
Unicellular	Multicellular
Lysosomes and Peroxisomes absent	Lysosomes and Peroxisomes present
Microtubules absent	Microtubules present
Endoplasmic reticulum absent	Endoplasmic reticulum present
Mitochondria absent	Mitochondria present
Cytoskeleton absent	Cytoskeleton present
Ribosomes smaller	Ribosomes larger
Vesicles present	Vesicles present
Golgi apparatus absent	Golgi apparatus present
Chloroplasts absent, chlorophyll scattered in the cytoplasm	Chloroplasts present in plants
Submicroscopic in size Flagella is present made up of only one fiber	Microscopic in size, membrane bound
Cell wall chemically complexes	Cell wall is present in plants and fungi and chemically simpler
Vacuoles absent	Vacuoles absent
Permeability of Nuclear membrane is not present	Permeability of Nuclear membrane is selective
Sexual reproduction is absent	Sexual reproduction is present
Endocytosis and exocytosis are absent.	Endocytosis and exocytosis occurred
It may have pili and fimbriae.	Pili and fimbriae are absent
Transcription occurs in the cytoplasm	Transcription occurs inside the nucleus.

Cell and their Specificity

- Cell is the basic unite of life.
- In unicellular organisms a single cell perform all the function.
- And multicellular organisms different cell perform different function.

Examples

- **Epithelial Cells:** These cells are tightly attached to one another (skin).
- **Nerve Cells:** These cells are specialized for communication (nervous system).

- **Muscle Cells:** These cells are specialized for contraction (muscles).
- **Connective Tissue Cells:** These cells provide structural strength to the body and also defend against foreign attackers like bacteria.

For example

In Plants

1. **Xylem cells** conduct water from root to shoot of the plants.
2. **Phloem cells** conduct food from leaves to whole other part of the plants.

In Animals

1. **Nerve Cells** conduct nerve impulse and thus contribute in coordination in the body.
2. **Muscle cell** conduct contraction and relaxation and cause movement.
3. **Red Blood cell** carry oxygen while White blood cell kill foreign agents

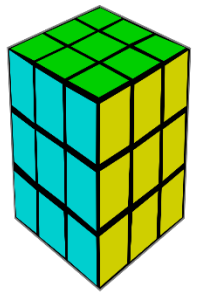
Cell execute their particular work due to their size and shape and existence of organelles.

For Example

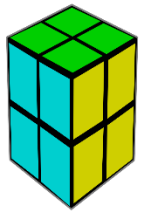
- **Nerve cells** are long for the transmission of nerve impulses.
- **Xylem cells** are tube like and have thick wall for conduction of water and support.

Cell as open system

Cell is an open system and energy is exchanged between them and their surrounding as they consume energy storing molecules and release energy to the environment by doing work.



sides = 3
surface = $3^2 \times 6 = 54$
volume = $3^3 = 27$
surface/volume = 2



sides = 2
surface = $2^2 \times 6 = 24$
volume = $2^3 = 3$
surface/volume = 3

sides = 1
surface = $1^2 \times 6 = 6$
volume = $1^3 = 1$
surface/volume = 6

Surface area to volume ratio

The important point is that the surface area to the volume ratio gets smaller as the cell gets larger. Thus, if the cell grows beyond a certain limit, not enough material will be able to cross the membrane fast enough to accommodate the increased cellular volume.

- Large cell have less surface area in relation to their volume
- Small cell have more surface
- Cells need to produce chemical energy (via metabolism) to survive and this requires the exchange of materials with the environment
- The rate of metabolism of a cell is a function of its mass / volume (larger cells need more energy to sustain vital functions)
- The rate of material exchange is a function of its surface area (large membrane surface associates to more material movement)

- As a cell grows, volume (units3) increases faster than surface area (units2), leading to a decreased SA:Vol ratio
- If metabolic rate exceeds the rate of exchange of vital materials and wastes (low SA:Vol ratio), the cell will eventually die
- Therefore growing cells tend to divide and remain small in order to maintain a high SA:Vol ratio suitable for survival

Increasing SA: Vol Ratio

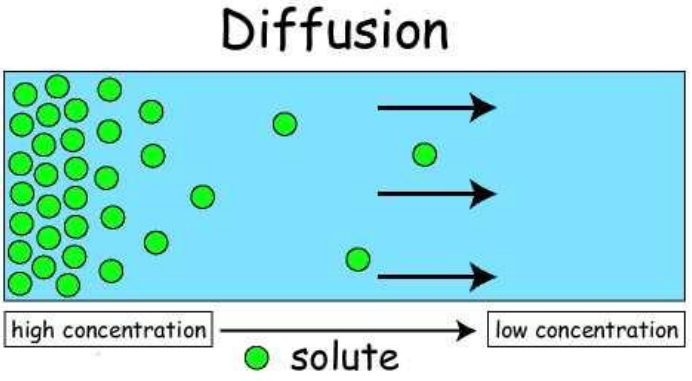
- Cells and tissues that are specific for gas or material exchanges will increase their surface area to enhance material conduction.
- Intestinal tissue of the digestive tract may form a ruffled structure (villi) to increase the surface area of the inner lining
- Alveoli within the lungs have membranous extensions called microvilli, which function to increase the total membrane surface

Passage of Molecules into and out of Cell

Diffusion is one of standard process for movement of materials within cells as well as the method for important minor molecules to cross the cell membrane. Osmosis is the diffusion of water across a semi-permeable (or differentially permeable or selectively permeable) membrane.

Diffusion

Diffusion is the process of movement of molecules from a region of higher concentration to a region of lower concentration.

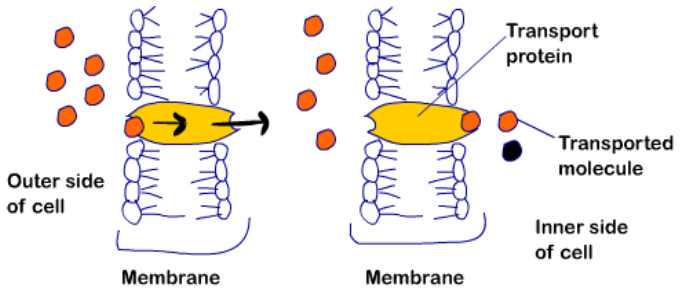


Diffusion in Plants

Diffusion is a very important process for photosynthesis where carbon dioxide from the stomata diffuses into the leaves and finally into the cells.

Facilitated Diffusion

It is the process of spontaneous passive transport of molecules or ions across a biological membrane via specific transmembrane integral proteins.



FACILITATED DIFFUSION

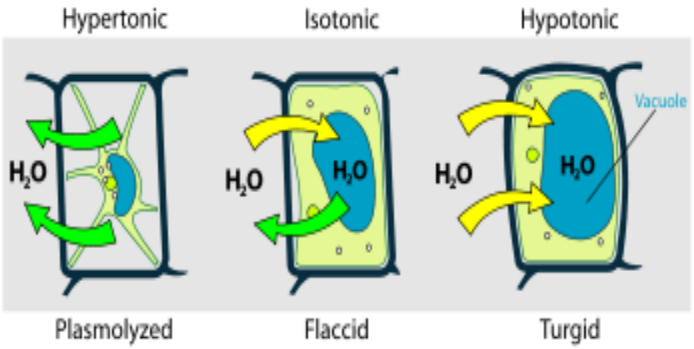
Osmosis

Osmosis is the spontaneous net movement of solvent molecules through a selectively permeable membrane into a region of higher solute concentration in the direction that tends to balance the solute concentrations on the two sides.

Examples

Hypotonic Solution

In a hypotonic solution the solute concentration is lower than inside the cell. Depending on the amount of water that enters the cell may look enlarged or bloated. If the water continues to move into the cell, it can stretch the cell membrane to the point the cell bursts (lyses) and dies.



Isotonic Solutions

When two environments are isotonic the total molar concentration of dissolved solutes is the same in both of them. When cells are in isotonic solution movement of water out of the cell is accurately balanced by movement of water into the cell

Hypertonic Solution

If a cell is placed in a hypertonic solution, water will leave the cell and the cell will shrink. In an isotonic environment, the relative concentrations of solute and water are equal on both sides of the membrane. When a cell is placed in a hypotonic environment, water will enter the cell and the cell will swell

Turgor

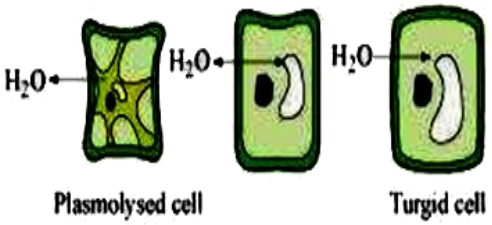
- Turgor, Pressure exerted by fluid in a cell that presses the cell membrane against the cell wall.
- Turgor is what makes living plant tissue rigid.
- Loss of turgor resulting from the loss of water from plant cells causes flowers and leaves to droop.

Importance of Turgor

- This is also important because this function regulates water loss within the plant.
- Lower turgor pressure can mean that the cell has a low water concentration and closing the stomata would help to preserve water.
- High turgor pressure possesses the stomata open for gas exchanges essential for photosynthesis
- Plant cells need turgor pressure to sustain their inflexibility and strength.
- This is what gives a plant the ability to grow and stand tall.
- When the concentration of solutes is higher outside the cell, the plant cell loses water and the plant droops.

Plasmolysis

Plasmolysis is the process in which cells lose water in a hypertonic solution. The opposite process de-plasmolysis or cytolysis can occur if the cell is in a hypotonic solution resulting in a lower external osmotic pressure and a net flow of water into the cell.



Active transport

The movement of molecules across a cell membrane from a region of lower concentration to a region of higher concentration against the concentration gradient.

- It requires cellular energy to complete this movement.

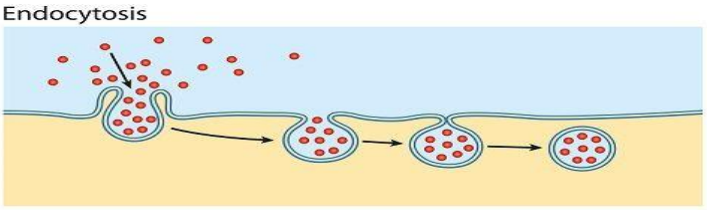
Examples

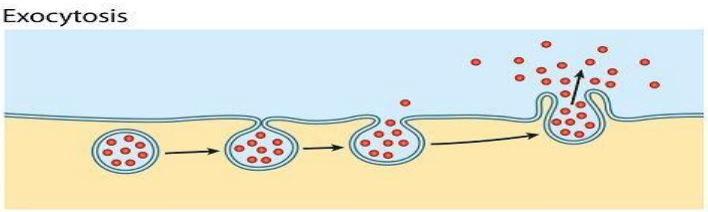
- The uptake of glucose in the intestines in humans
- The uptake of mineral ions into root hair cells of plants

Endocytosis

It is a type of active transport that moves particles such as large molecules, parts of cells and even whole cells into a cell.

- There are different variations of endocytosis but all share a common characteristic.
- The plasma membrane of the cell invaginates forming a pocket around the target particle





Exocytosis

It is the process by which cargo laden transport vesicles move through the cytoplasm to the plasma membrane.

- This happens in calcium dependent (regulated) exocytosis.
- Other times the vesicle does not dock.
- Instead, it fuses with the plasma membrane and secretes its contents into the extracellular environment

Filtration

It is movement of water and solute molecules across the cell membrane due to hydrostatic pressure generated by the cardiovascular system.

- It is depending on the size of the membrane pores, only solutes of a certain size may pass through it

Tissue

Tissues are groups of cells that have a similar structure and act together to perform a specific function.

- The word tissue comes from a form of an old French verb meaning “to weave”.

Plants Tissue

Plants tissue are divided into three types.

Simple Tissue

A simple tissue is made up of similar type of cells which have common origin and function

They are divided in to three types.

Meristematic tissues

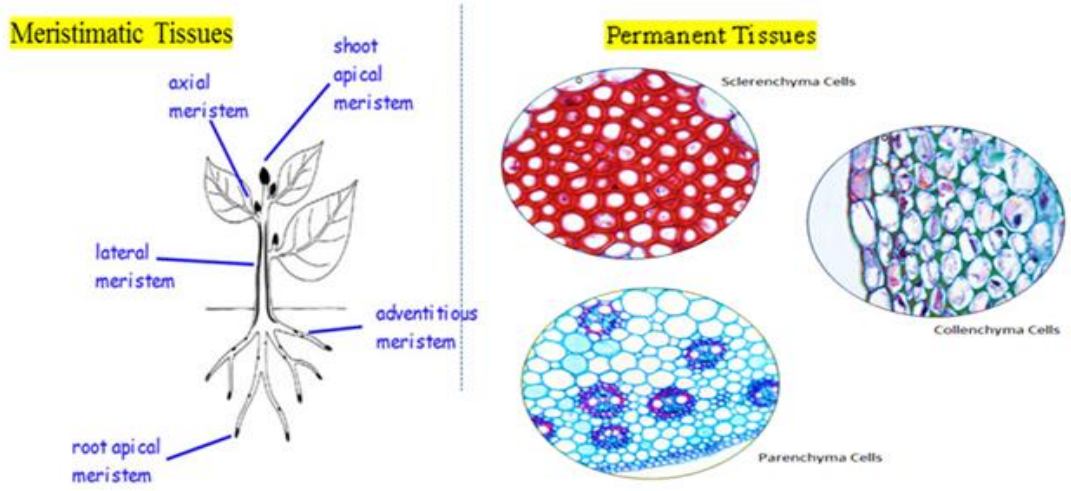
They are tissues in which the cells remain forever young and divide actively throughout the life of the plant.

They are divided into two types.

The apical meristem

It founds within the root tips and the tips of the new shoots and leaves. Apical meristem is the tissue which can differentiate into different cell types.

It is the tissue in which growth occurs in plants.



Lateral Meristem

It is arranged parallel to the sides of plants and that is responsible for increase in diameter of the plants.

Permanent Tissue

Permanent plant tissues are found in mature plants.

Epidermal Tissue

It is the outermost protoderm derived layer of cells covering the stem, root, leaf, flower, fruit and seed parts of a plant. The epidermis and its waxy cuticle provide a protective wall against mechanical damage and water loss.

Ground Tissue

It arises from the ground meristem. It fills in the soft parts of the plants, such as cortex, pith, pericycle,

Supporting or Mechanical Tissue

The tissue that supports a plant and their growing organs against any deformation and provides mechanical strength. Haberlandt (1914) called the mechanical tissue as stereome. Schwendener in 1874 termed the mechanical cells (e.g. collenchyma, bast fibres and libriform fibres) as stereids.

Collenchyma tissue

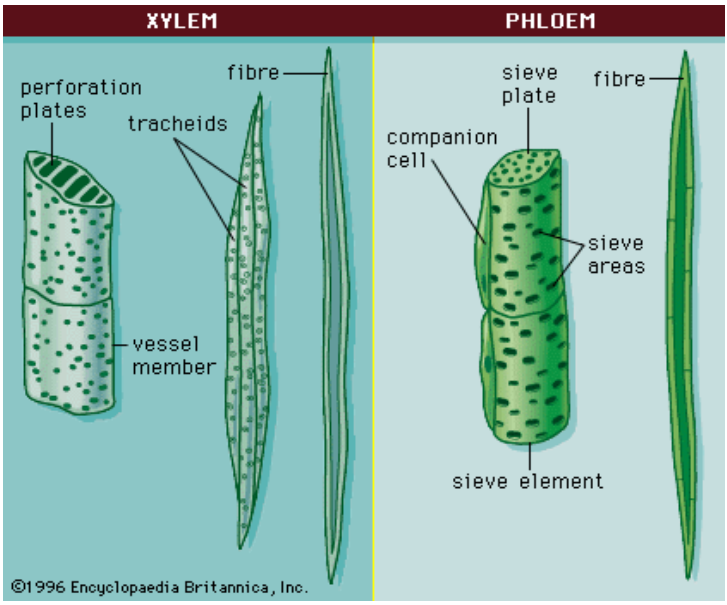
It is composed of elongated cells with irregularly thickened walls. They provide structural support chiefly in growing shoots and leaves. Collenchyma tissue makes up things such as the strong strands in stalks of celery.

Sclerenchyma tissue

It is composed of dead cells that have deeply thickened walls comprising lignin and a high cellulose content (60%–80%) and serves the function of providing structural support in plants.

Compound tissue

The compound tissue is a type of plant tissue that consists of several types of cells. The two types of compound tissue are xylem and phloem. The main function of the compound tissues is conduction. Moreover, the cells of the compound tissue have thick cell walls made up of lignin depositions



Xylem Tissue

These tissues convey water and dissolved minerals from the roots to the rest of the plant and also provides physical support. Xylem tissue consists of a variety of specialized cells water conducting cells known as tracheary elements

Phloem tissue

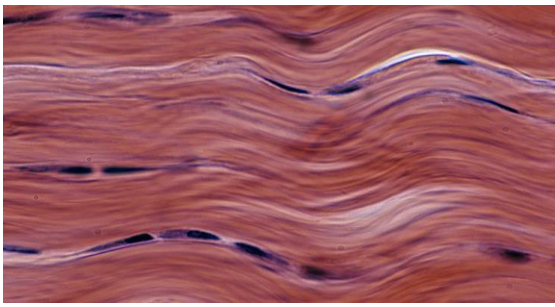
It is also called bast tissues that conduct foods made in the leaves to all other parts of the plant. Phloem is composed of several specialized cells called sieve tubes, companion cells, phloem fibers and phloem parenchyma cells

Animals Tissue

There are four types of animal tissues: epithelial tissue, connective tissue, muscle tissue and nervous tissue.

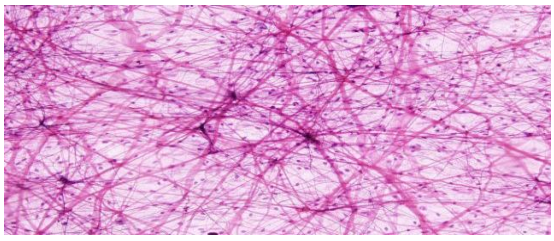
Epithelium Tissue

Epithelial tissues line the outer surfaces of organs and blood vessels throughout the body as well as the inner surfaces of cavities in many internal organs.



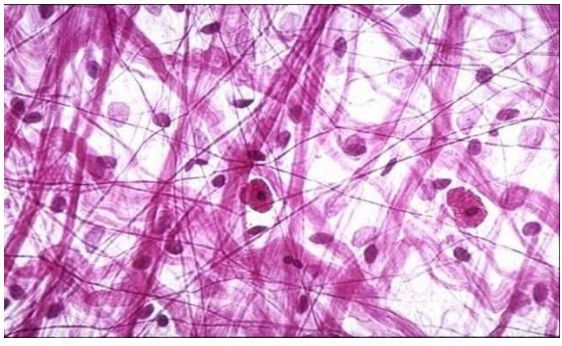
The connective tissues

It include several types of fibrous tissue that vary only in their density and cellularity as well as the more specialized and recognizable variants bone, ligaments, tendons, cartilage, and adipose (fat) tissue.



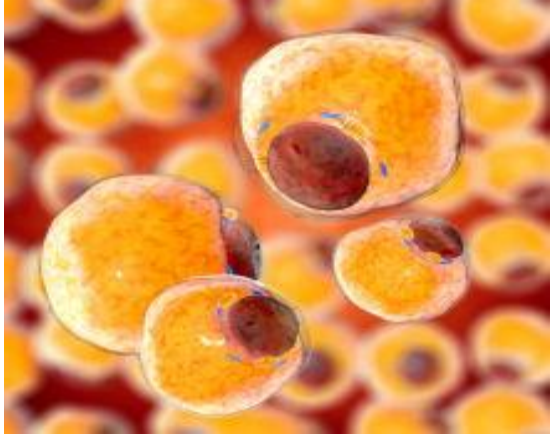
Loose connective tissue

It is a category of connective tissue which includes areolar tissue, reticular tissue, and adipose tissue. Loose connective tissue is the most common type of connective tissue in vertebrates. It holds organs in place and attaches epithelial tissue to other underlying tissues.



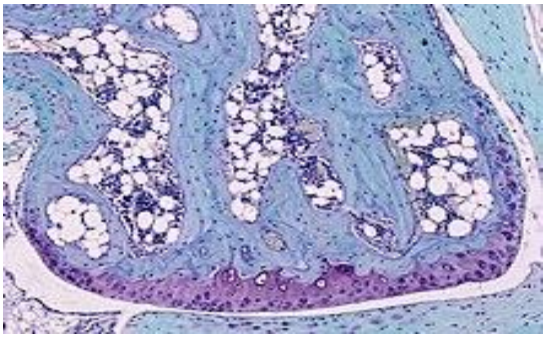
Fibrous connective tissue

It is composed of parallel bundles of collagen fibers. It is found in the dermis, tendons, and ligaments and can also be referred to as dense connective tissue



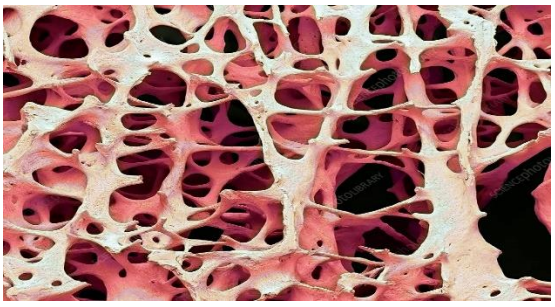
Adipose tissue

Adipose or fat is an anatomical term for loose connective tissue composed of adipocytes. Its main role is to store energy in the form of fat, although it also cushions and insulates the body. Adipose tissue is primarily located beneath the skin, but is also found around internal organs.



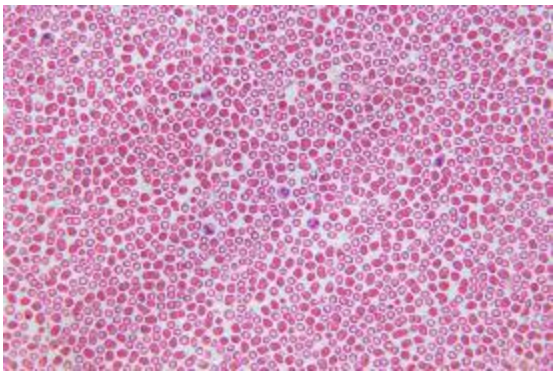
Cartilaginous Tissue

It is an important structural component of the body. It is a firm tissue but is softer and much more flexible than bone. Cartilage is a connective tissue found in various areas of the body comprising joints between bones e.g. the elbows, knees and ankles. Ends of the ribs



Bone tissue

It is a hard tissue and a type of dense connective tissue. Inside it has a honeycomb like matrix, which helps to give the bone rigidity. Bone tissue is made up of different types of bone cells



Blood tissue

Blood is considered a connective tissue because it has a matrix. The living cell types are red blood cells, also called erythrocytes, and white blood cells, also called leukocytes. The fluid portion of whole blood its matrix is commonly called plasma

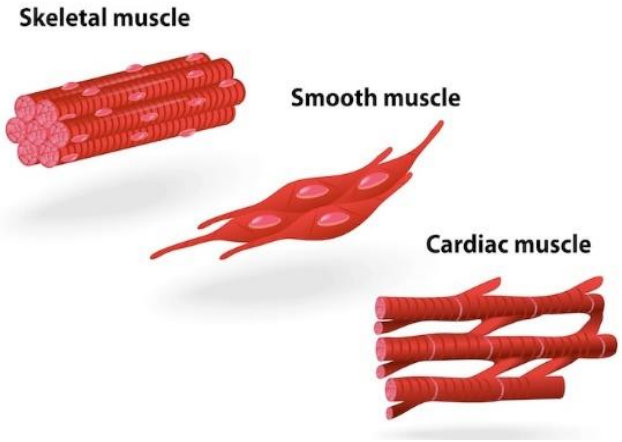
Muscle tissue

It is a soft tissue that composes muscles in animal bodies and gives rise to muscles ability to contract. This is opposed to other components or tissues in muscle such as tendons or perimysium. It is formed during embryonic development through a process known as myogenesis.

Smooth Muscles

They are the type of tissue found in the walls of hollow organs such as the intestines, uterus and stomach. It is also found in arteries and veins of the cardiovascular system.

Skeletal muscle



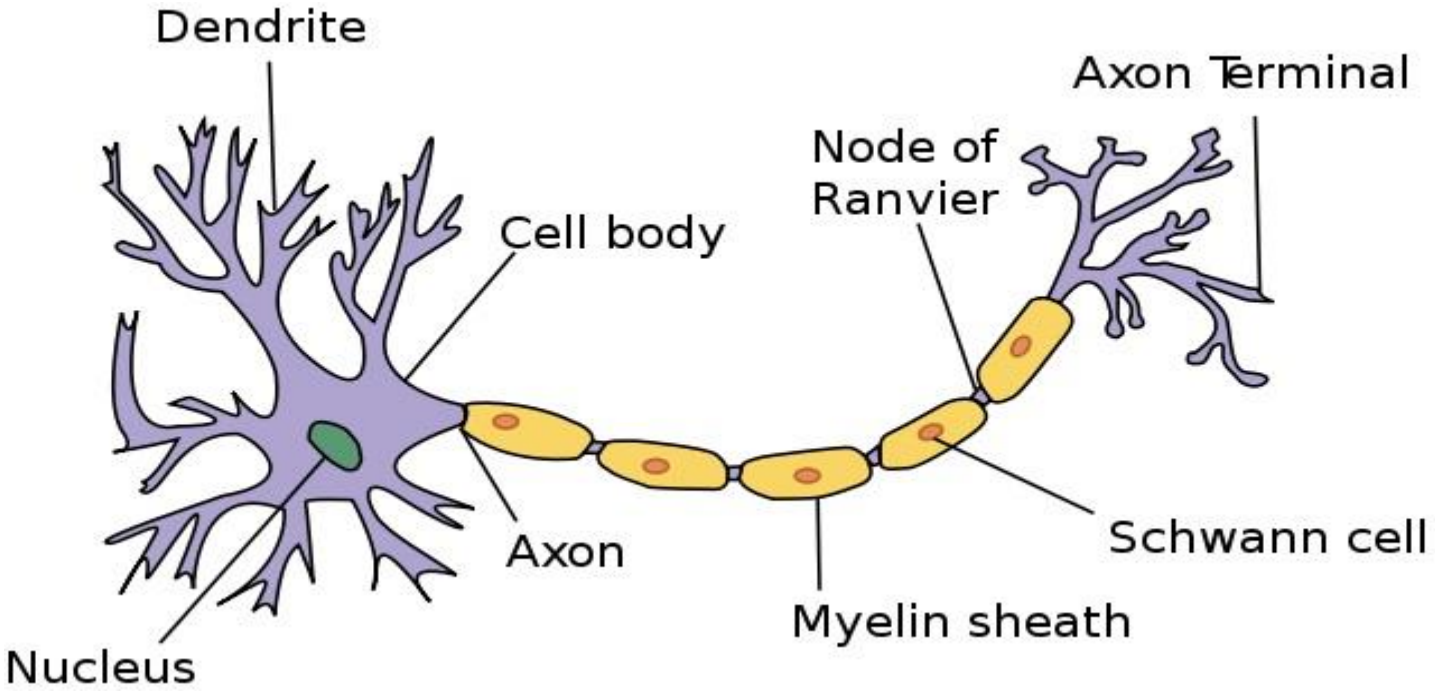
It is a form of striated muscle tissue which is under the voluntary control of the somatic nervous system. Most skeletal muscles are attached to bones by bundles of collagen fibers known as tendons.

Cardiac muscle tissue

It is only found in the heart and it is very coordinated contractions of cardiac muscle pump blood into the vessels of the circulatory system. Similar to skeletal muscle cardiac muscle is striated and organized into sarcomeres having the same banding organization as skeletal muscle.

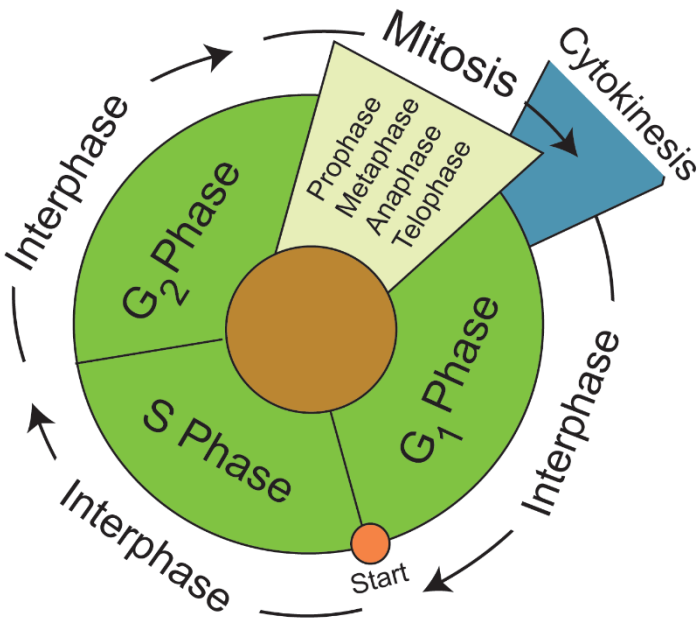
Nervous tissue

Nervous tissue is found in the brain, spinal cord and nerves. It is responsible for coordinating and controlling many body activities. The cells in nervous tissue that generate and conduct impulses are called neurons or nerve cells. These cells have three principal parts (1) the dendrites (2) the cell body (3) one axon



Cell Cycle

A cell cycle is a series of events that takes place in a cell as it grows and divides.



Interphase

It is the phase of the cell cycle in which a typical cell spends most of its life. During interphase, the cell copies its DNA in preparation for mitosis. In interphase the cell gets itself ready for mitosis or meiosis.

Event of Interphase

Interphase is composed of G1 phase (cell growth), followed by S phase (DNA synthesis) and followed by G2 phase (cell growth). At the end of interphase comes the mitotic phase, which is made up of mitosis and cytokinesis and leads to the formation of two daughter cells.

G1-Phase

In this phase takes place in eukaryotic cell division. In this part of interphase, the cell synthesizes mRNA and proteins in preparation for following steps leading to mitosis.

S Phase

During this phase produce two similar daughter cells, the complete DNA instructions in the cell must be replicated. DNA duplication occurs during this S (synthesis) phase.

Gap 2

G2 phase is a period of rapid cell growth and protein synthesis during which the cell prepares itself for mitosis.

Division Phase

During the mitotic phase, the replicated chromosomes, organelles and cytoplasm separate into two new daughter cells.

Mitosis

The first person to observe mitosis in detail was a German biologist, Walther Flemming (1843–1905).

He stated that it is the process in which the nucleus of a eukaryotic cell divides. During this process, sister chromatids separate from each other and move to opposite poles of the cell.

This happens in four phases, called prophase, metaphase, anaphase, and telophase.

Karyokinesis

Division of a cell nucleus during mitosis

Cytokinesis

Division of cytoplasm during mitosis

Karyokinesis is further divided into four phase.

Prophase

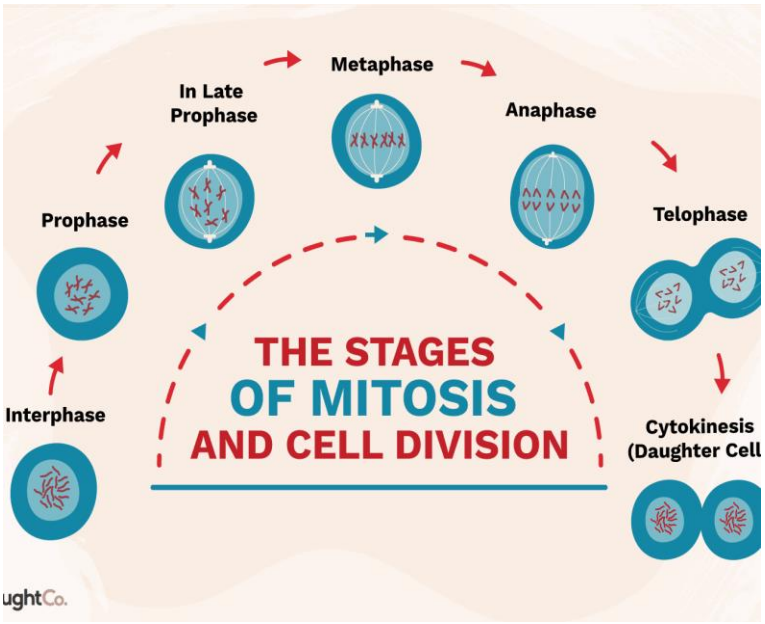
It is the first phase of mitosis, the process that separates the duplicated genetic material carried in the nucleus of a parent cell into two identical daughter cells. Throughout prophase the complex of DNA and proteins contained in the nucleus known as chromatin, condenses.

Metaphase

It is a stage in the cell cycle where all the genetic material is condensing into chromosomes. These chromosomes then become visible. During this stage the nucleus disappears and the chromosomes appear in the cytoplasm of the cell

Anaphase

It is the phase of mitosis after the process of metaphase, when replicated chromosomes are split and the newly-copied chromosomes (daughter chromatids) are moved to opposite poles of the cell.



Telophase

It is the fifth and final phase of mitosis, the process that separates the duplicated genetic material carried in the nucleus of a parent cell into two identical daughter cells. Telophase begins once the replicated, paired chromosomes have been separated and pulled to opposite sides of the cell.

Significance of Mitosis

- Mitosis is important for sexual reproduction indirectly.
- It allows the sexually reproducing organism to grow and develop from a single cell into a sexually mature individual.
- Mitosis permits organisms to continue to reproduce through the generations.
- It is a same division through which identical daughter cells are produced having the same amount and type of genetic constitution as that of the parent cell.
- It is responsible for growth and development of multi-cellular organisms from a single-celled zygote.
- The number of chromosomes remains the same in all the cells produced by this division.
- Thus, the daughter cells retain the same characters as those of the parent cell.
- It helps the cell in maintaining proper size.
- Mitosis helps in repairing wear and tear in body tissues, replacement of damaged or lost part, healing of wounds and regeneration of detached parts (as in tail of a lizards).
- It is a method of multiplication in unicellular organisms.

- If mitosis remains unchecked it may result in uncontrolled growth of cells leading to cancer or tumor.

Meiosis

It is a type of cell division that results in the formation of four daughter cells each with half the number of chromosomes as the parent cell.

Meiosis-I

Separates the pair of homologous chromosomes and reduces the diploid cell to haploid. It is divided into several stages that comprise prophase, metaphase, anaphase and telophase.

Prophase 1

It is basically the crossing over and recombination of genetic material between non sister chromatids this results in the genetically un-identical haploid daughter chromatid cells.

Metaphase 1

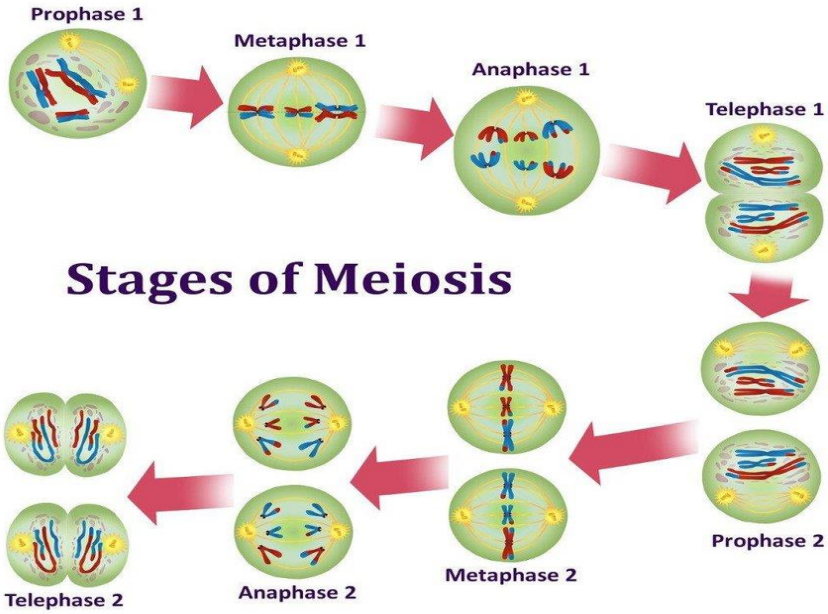
The centrioles are at opposite poles of the cell. The pairs of homologous chromosomes (the bivalents) now as closely coiled and condensed as they will be in meiosis become arranged on a plane central from the poles called the metaphase plat.

Anaphase I

It is the third stage of meiosis-I and follows prophase-I and metaphase-I. This stage is characterized by the movement of chromosomes to both poles of a meiotic cell via a microtubule network known as the spindle apparatus. This mechanism separates homologous chromosomes into two separate groups.

Telophase I

It is that phase when the chromosomes have finished moving to opposite ends of the cell. This will then be followed by cytokinesis producing two daughter cells. After cytokinesis, the two daughter cells would have genetically different chromosomes after meiosis-I.



Meiosis II

In this division the sister chromatids within the two daughter cells distinct and forming four new haploid gametes. The mechanics of meiosis-II is similar to mitosis except that each dividing cell has only one set of homologous chromosomes.

Prophase-II

In prophase II, the nuclear envelope breaks down and the spindle apparatus forms.

Metaphase-II

The chromosomes line up individually along the metaphase plate. In anaphase II, the sister chromatids separate and are pulled towards opposite poles of the cell. In telophase-II, nuclear membranes form around each set of chromosomes, and the chromosomes de-condense.

Anaphase-II

The centromeres separate and the sister chromatids now individual chromosomes move toward the opposite poles of the cell.

Telophase-II

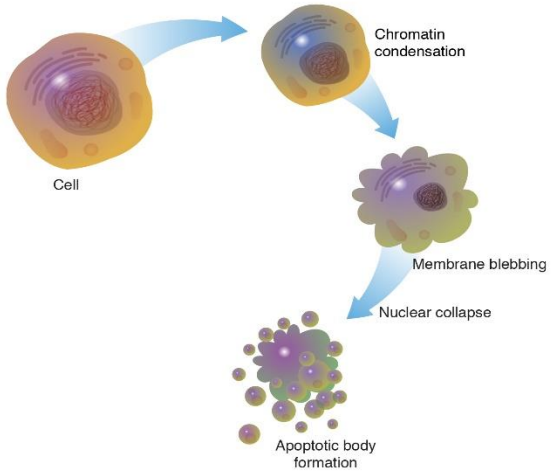
In this phase the chromosomes reach opposite poles and cytokinesis occurs. The two cells produced by meiosis I divide to form four haploid daughter cells, and nuclear envelopes (white in the diagram at right) form.

Significance of Miosis

- Meiosis is responsible for the formation of sex cells or gametes that are responsible for sexual reproduction.
- It activates the genetic information for the development of sex cells and deactivates the sporophytic information.
- It maintains the constant number of chromosomes by halving the same.

Apoptosis

- It is a systematic procedure in which the cells contents are packed into minor packets of membrane for garbage collection by immune cells.
- Apoptosis removes cells during development, removes maybe cancerous and virus infected cells and sustains constancy in the body.



Examples

- The resorption of the tadpole tail at the time of its metamorphosis into a frog occurs by apoptosis. T
- The formation of the fingers and toes of the fetus needs the removed by apoptosis of the tissue between them.

Necrosis

- It is the death of body tissue.
- It happens when too little blood flows to the tissue.
- This can be from injury, radiation, or chemicals.
- Necrosis cannot be reversed.
- When large areas of tissue die due to a lack of blood supply, the condition is called gangrene.

Causes

- Necrosis can be caused by a number of exterior sources comprising injury, infection, cancer, infarction, poisons and inflammation.
- Black necrotic tissue is formed when healthy tissue dies and becomes dehydrated, typically as a result of local ischemia.

Example of necrosis

- When blood flow is cut off to the foot in an accident and the living cells of the foot die.

Who discovered enzyme?

Enzyme was discovered by Winhelm Kuhne in (1878).

What is enzyme?

Enzymes are proteins in nature that act as biological catalysts and accelerate chemical reactions.

What is Substrata?

A reactant in a chemical reaction is called substrate.

What is Product?

The molecules produced in the reaction as known is product.

What is Metabolism?

The quantity of the chemical reactions that take place inside each cell and that provide energy for vital processes and for making new organic material.

What is Anabolism?

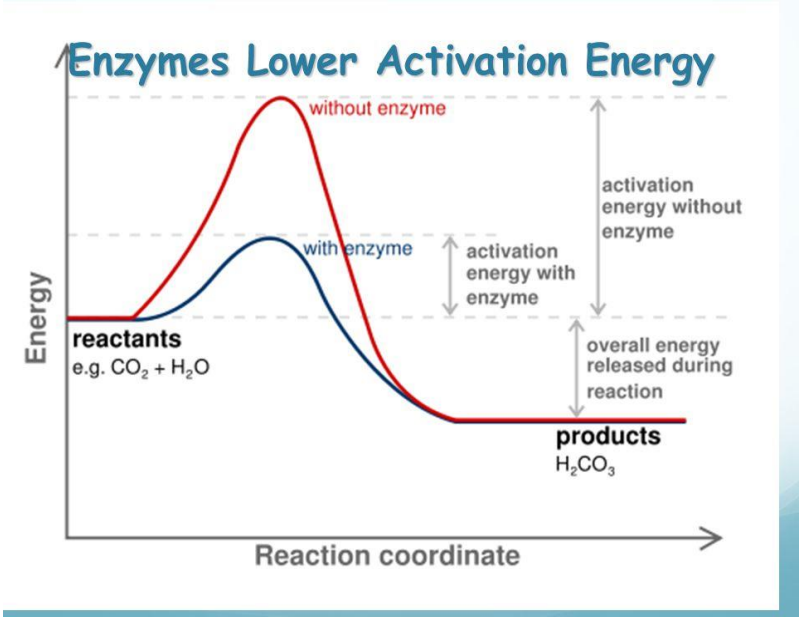
The synthesis of complex molecules from simpler molecules by condensation reactions.

What is Catabolism?

The breaks down of complex molecules and releases energy which is available for the body to use.

Enzyme Lower the Activation Energy

Enzymes are an important class of proteins that help in cellular processes.



Enzymes are particular in their binding and can be allosterically regulated.

In enzyme catalyzed reactions the enzymes lower the activation energy needed for a certain chemical reaction. The free energy of the reactants and products do not change just the threshold energy level needed for the reaction to begin. Enzymes can lower the activation energy of a chemical reaction in three ways. One of the ways the activation energy is lowered is having the enzyme bind two of the substrate molecules and orient them in a precise manner to encourage a reaction. This can be thought of as lining the binding pockets up for the substrates so that it is not left to random chance that they will collide and be oriented in this way. Another way enzymes can lower the activation energy by rearranging the electrons in the substrate so that there are areas that carry partial positive and partial negative charges which favor a reaction to occur. Lastly, the enzyme can strain the bound substrate which forces it to a transition state that favors a reaction. By manipulating the substrates

of the reaction, the enzyme can lower the necessary energy needed to make the reaction occur. The enzyme itself is not a component of the chemical reaction and is the same molecule at the beginning of the reaction as it is at the end.

Characteristic of Enzyme

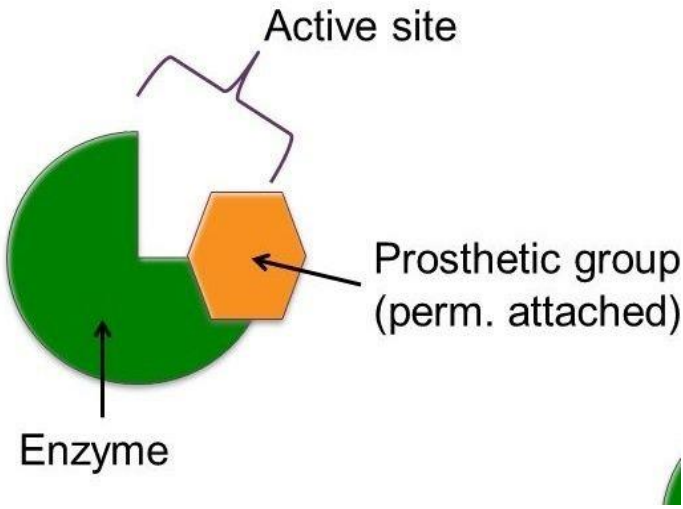
- Chemically enzymes are commonly globular proteins.
- Some RNA molecules called ribozymes can also be enzymes.
- These are generally found in the nuclear region of cells and catalyze the splitting of RNA molecules.
- Enzymes are catalysts that breakdown or synthesize more complex chemical compounds.
- They allow chemical reactions to occur fast enough to support life.
- Enzymes speed up the rate of chemical reactions because they lower the energy of activation, the energy that must be supplied in order for molecules to react with one another.
- Anything that an enzyme normally combines with is called a substrate.
- Enzymes are very effective.
- An enzyme generally catalyze between 1 and 10,000 molecules of substrate per second.
- Enzymes are only present in small amounts in the cell since they are not altered during their reactions.
- They are highly specific for their substrate. Generally there is one specific enzyme for each specific chemical reaction

Prosthetic Group

A prosthetic group is a tightly bound specific non-polypeptide unit required for the biological function of some proteins. The prosthetic group may be organic (such as a vitamin, sugar, or lipid) or inorganic (such as a metal ion), but is not composed of amino acids.

Coenzyme

A coenzyme is an organic non-protein compound that binds with an enzyme to catalyze a reaction



Activator

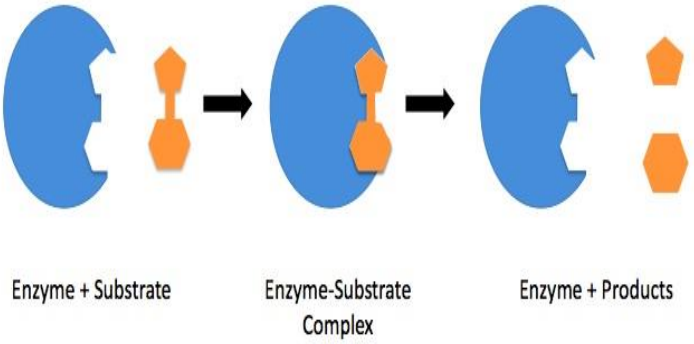
Enzyme activators are molecules that bind to enzymes and increase their activity

Specificity of Enzyme

Specificity is the ability of an enzyme to choose exact substrate from a group of similar chemical molecules. The specificity is actually a molecular recognition mechanism and it operates through the structural and conformational complementarity between enzyme and substrate

Mechanisms of Enzyme Action

An enzyme attracts substrates to its active site, catalyzes the chemical reaction by which products are formed and then allows the products to dissociate (separate from the enzyme surface). The combination formed by an enzyme and its substrates is called the enzyme substrate complex.



Active Site

The active site is the region of an enzyme where substrate molecules bind and undergo a chemical reaction

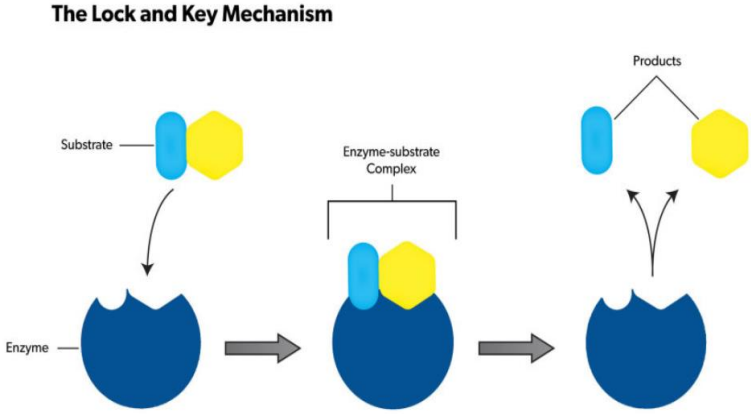
Step of enzyme action

- The enzyme and the substrate are in the same area.
- Some situations have more than one substrate molecule that the enzyme will change.
- The enzyme takes on to the substrate at a special area called the active site.
- A process called catalysis happens.
- The enzyme releases the product

Lock and Key Model

This model was proposed by German chemist Emil Fischer in 1899 and explains one of the most important features of enzymes and their specificity.

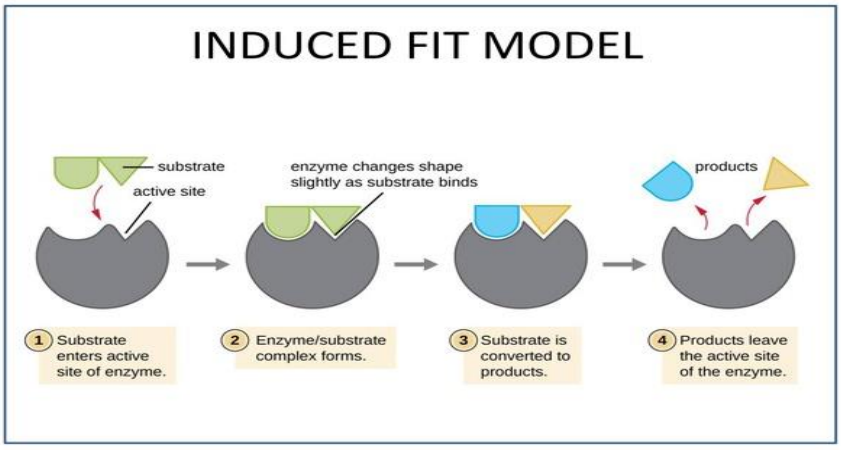
In lock and key model the enzyme substrate interaction suggests that the enzyme and the substrate possess specific complementary geometric shapes that fit exactly into one another.



Induced Fit Model

This model was proposed by Daniel Koshland in 1958

Recent studies do not support lock and key model. The induced fit model is a model for enzyme substrate interaction. It describes that only the proper substrate is capable of inducing the proper alignment of the active site that will enable the enzyme to perform its catalytic function.



Difference between lock and key and induced fit

- Lock and Key states that there is no change needed and that only a certain type will fit however induced fit says the active site will change to help to substrate fit.
- In lock and key the active site has one single entry however in induced fit the active site is made of two components.

Factors that Affect the Rate of Enzyme Action

Enzyme activity can be affected by a variety of factors such as temperature, pH and concentration.

Effect of Temperature on Enzyme Activity

- For most enzyme the optimum temperature about 40 to 45^0c.
- When temperature is rising so usually speeds up a reaction and lowering temperature slows down a reaction.
- However extreme high temperatures can cause an enzyme to lose its shape (denature) and stop working.

Effect of PH on Enzyme Activity

- Enzymes are affected by changes in PH.
- The most favorable PH value the point where the enzyme is most active is known as the optimum PH.
- Extremely high or low PH values generally result in complete loss of activity for most enzymes.
- PH is also a factor in the stability of enzymes

Effect of Concentration of Substrate on enzyme Activity

- Increasing substrate concentration also increases the rate of reaction to a certain point.
- If all of the enzymes in the system bind to the substrate, the additional substrate molecules must wait for the enzyme to become available after the reaction is complete.
- If the enzyme concentration decreases, the reaction rate will decrease.

Bioenergetics

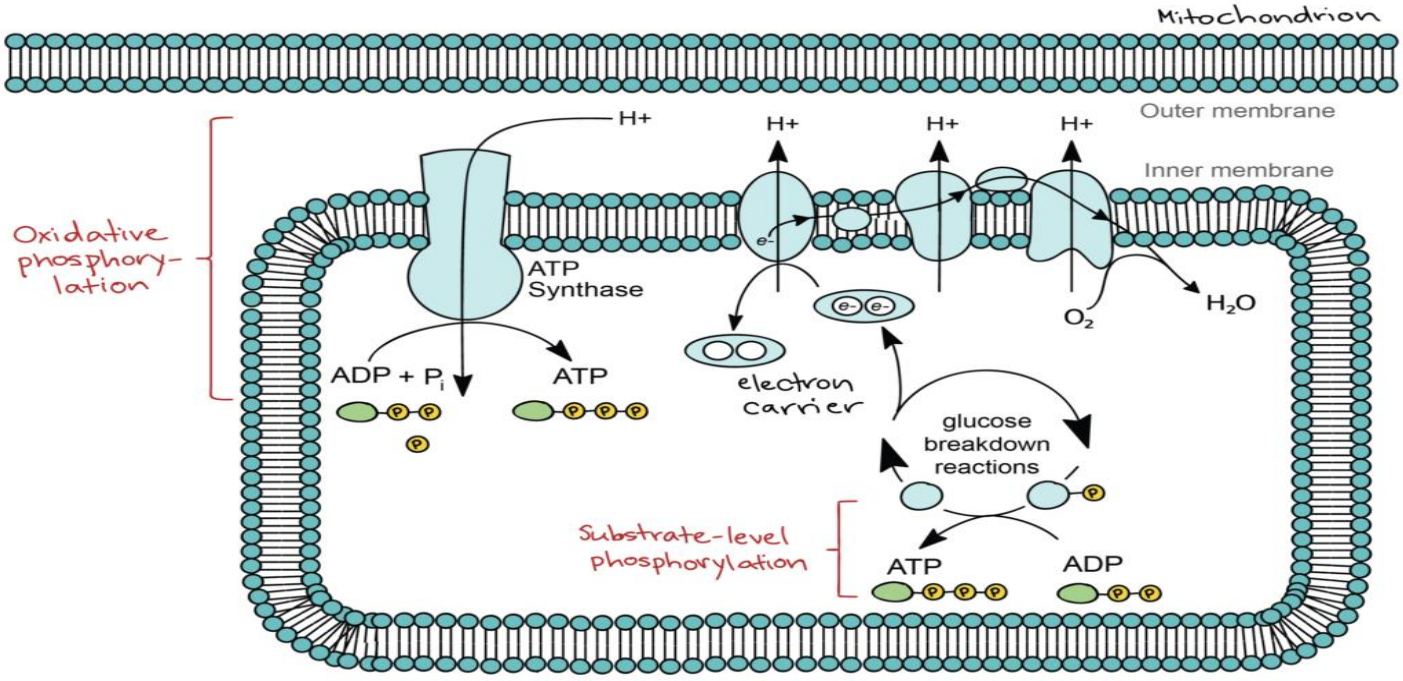
"Bioenergetics is a field in biochemistry and cell biology that concerns energy flow through living systems."

Or

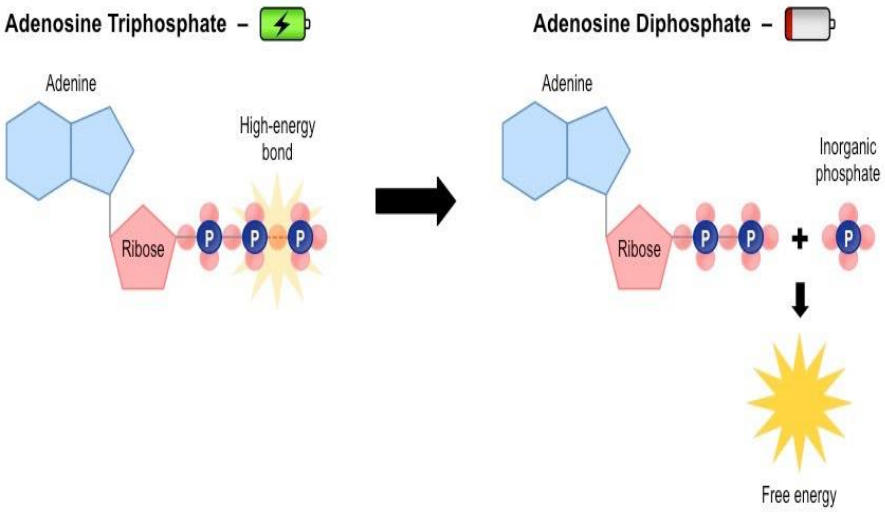
It is the branch of biochemistry that focuses on how cells transform energy frequently by making, storing or consuming adenosine triphosphate (ATP) is called Bioenergetics. Bioenergetics is a processes such as cellular respiration or photosynthesis are vital to most aspects of cellular metabolism therefore to life itself.

Importance of Oxidation Reduction Reaction

Oxidation reduction (redox) reactions are important because they are the principal sources of energy on this planet both natural or biological and artificial. Oxidation of molecules by removal of hydrogen or combination with oxygen normally liberates large quantities of energy.



ATP as the Energy Currency of Cell

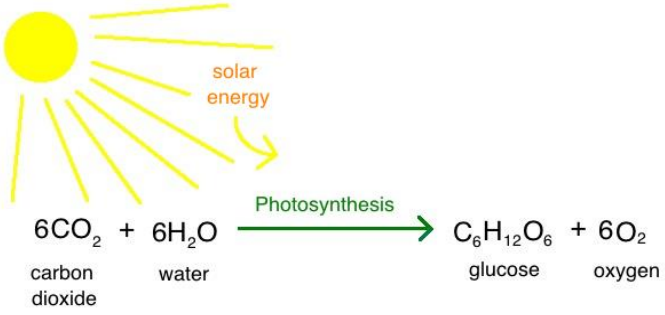


- ATP is known as adenosine triphosphate.
- it is a molecule containing carbon, hydrogen, nitrogen, oxygen and phosphorus.
- ATP is the energy currency of the cell because it is the most preferred energy molecule in the cell.

Its preference is due to the following factors:

- It donates its phosphoryl groups to release energy.
- On hydrolysis it releases a high negative Gibbs free energy which can be used to drive many important biosynthetic reactions in metabolic pathways.
- The presence of adenine and ribosyl groups provide additional features for attachment to enzymes so it is able to regulate enzymatic activities.

Photosynthesis



It is the process by which green plants and certain other organisms transform light energy into chemical energy. During photosynthesis in green plants light energy is captured and used to convert water, carbon dioxide and minerals into oxygen and energy rich organic compounds.

The photosynthesis equation is as follows:

$6CO_2 + 6H_20 + (energy) \rightarrow C_6 H_{12} O_6 + 6O2$ Carbon dioxide + water + energy from light produces glucose and oxygen.

Role of Chlorophyll

Chlorophyll is to absorb light usually sunlight. The energy absorbed from light is transferred to two kinds of energy storing molecules. Through photosynthesis, the plant uses the stored energy to convert carbon dioxide (absorbed from the air) and water into glucose.

Role of Sun Light

Sunlight play very vital role in photosynthesis. The energy captured by chlorophyll can be used in photosynthesis to make sugar. When a plant gets limited sunlight, photosynthesis slows down. This also means that the plant might not be receiving enough sugar.

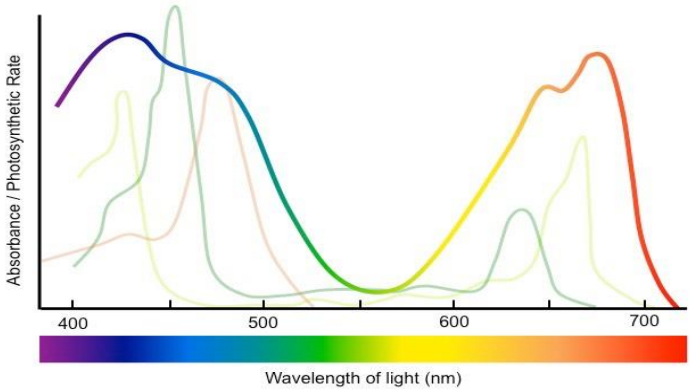
Types of Chlorophyll

There are four types of chlorophyll,

- **Chlorophyll a** found in all higher plants, algae and cyanobacteria.
- **Chlorophyll b** found in higher plants and green algae;
- **Chlorophyll c** found in diatoms, dino-flagellates and brown algae.
- **Chlorophyll d** found only in red algae

Types of Lights that captured by Chlorophyll

- Since the sun gives off a mix of mostly red and blue light, these are the colors that chlorophyll absorbs best.
- On the other hand green light is reflected by chlorophyll that is why most plants have green leaves.
- The energy captured by chlorophyll can be used in photosynthesis to make sugar.



What is Photosystems?

Photosystems are the functional units for photosynthesis defined by a specific pigment organization and association patterns whose work is the absorption and transfer of light energy which implies transfer of electrons. Physically photosystems are found in the thylakoid membranes.

Intake of $C0_2$ and H_2O by Plants

- Carbon dioxide enters through tiny holes in a plant's leaves, flowers, branches, stems, and roots.
- Plants also require water to make their food.
- The energy from light causes a chemical reaction that breaks down the molecules of carbon dioxide, water and reorganizes them to make the sugar (glucose) and oxygen gas.

Mechanisms of Photosynthesis

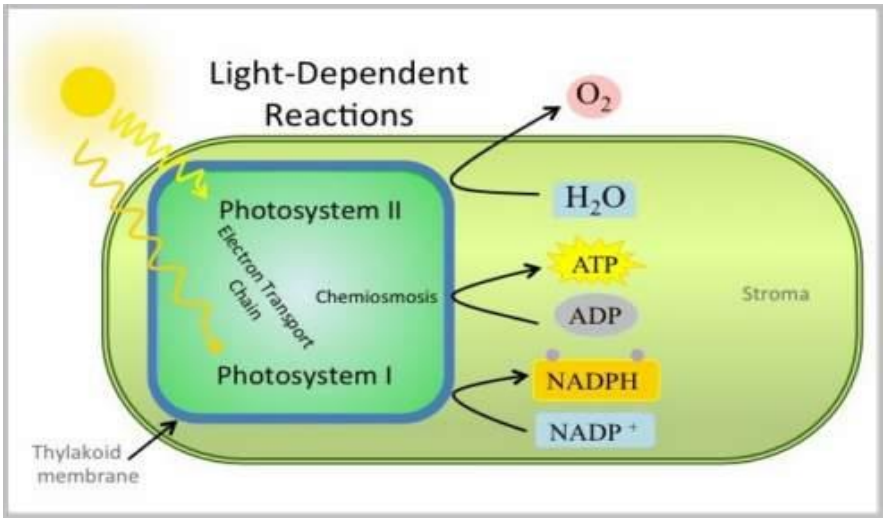
Light Reaction

The energy of light captured by pigment molecules called chlorophylls in chloroplasts is used to generate high energy electrons with great reducing potential. These electrons are used to produce NADPH as well as ATP in a series of reactions called the light reactions because they need light.

Step involve in Light Reaction

- Chlorophyll absorbs the red and blue part of the white light and photosynthesis occurs most capably at these wavelengths.
- When the light falls on the plant the chlorophyll pigment absorbs this light and electrons in it gets excited.
- This process occurs in a complex protein system which is collectively called as a photosystem. There are two closely linked photosystems known as PSI and PSII.
- The chlorophyll pigments which are excited give up their electrons and to compensate for the loss of electrons, water is split to release four H+ ions and four electrons and O2.

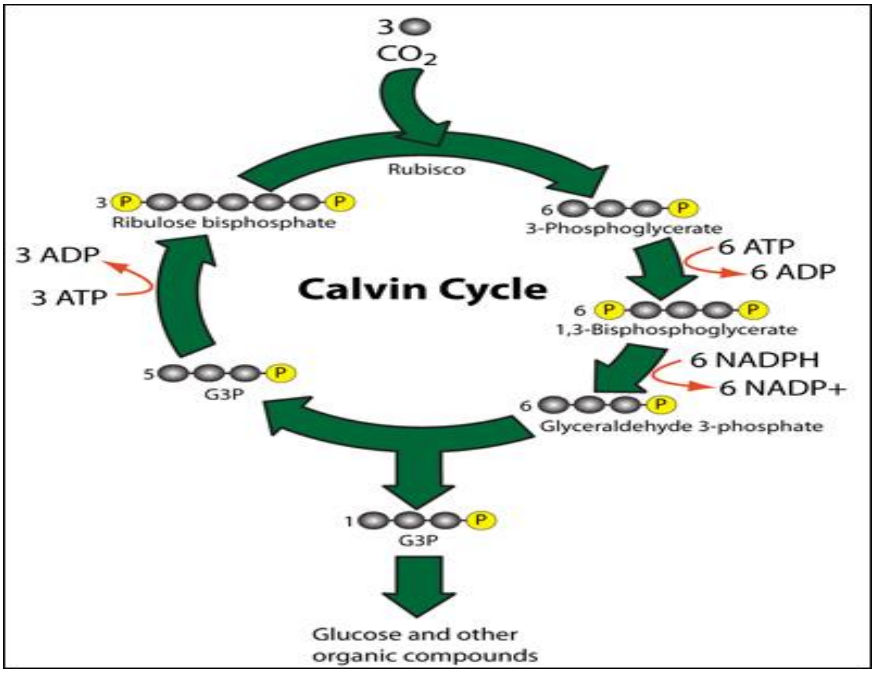
- The electrons that are lost from the PSII enter into an electron transfer chain.
- The electrons finally reach the reaction center where they combine with NADP+ and reduce it to NADPH
- While the electrons are taken care of the built up of H+ ions inside the thylakoid lumen is of equal importance.
- The hydrogen ions building up inside the lumen creates a positive gradient and in the presence of the enzyme ATP synthetize these H+ ions combine with the ADP in the nearby region to form ATP.
- The oxygen that is a waste product is released by the plant into the atmosphere and some of it is used in photorespiration if the plant needs to.



$2H_2O + 2NADP+ + 3ADP + 3Pi \rightarrow O_2 + 2NADPH + 3ATP$

Dark Reaction

The dark reactions occur in the part of the chloroplast known as the stroma. The purpose of the dark reactions is to take the energy from ATP and energized electrons and hydrogen ions from NADPH and add them to CO_2 to make glucose or sugar.



It is (Also referred as Light Independent Reactions of Photosynthesis Carbon Fixation) the high energy molecules ATP and NADPH synthesized in the light dependent reactions of photosynthesis are used to synthesize carbohydrates from carbon dioxide hence the term carbon fixation.

- The carbon fixation cycle also called the Calvin cycle is a 3 phase cycle that occurs in the stroma and that converts CO_2 into carbohydrates using the energy of ATP and the oxidation of NADPH.
- Carbon enters the Calvin cycle in the form of CO2 and leaves in the form of sugar.
- The cycle spends ATP as an energy source and consumes NADPH as reducing power for adding high energy electrons to make the sugar.

- The carbohydrate produced directly from the Calvin cycle is actually not glucose but a three carbon sugar named glyceraldehyde 3phosphate (G3P).
- For the net synthesis of one molecule of this sugar, the cycle must take place three times, fixing three molecules of CO_2.
- As we trace the steps of the cycle, keep in mind that we are following three molecules of CO2 through the reactions

The concept of Limiting Factors in Photosynthesis

Any one of these could become a limiting factor. This means that the factor directly affects the rate of photosynthesis on its own, regardless of the level of the other factors.

The major limiting factors for photosynthesis are light intensity, temperature and carbon dioxide levels.

Effect of Light Intensity

- Without enough light a plant cannot photosynthesis very quickly even if there is plenty of water and carbon dioxide and a suitable temperature.
- Increasing the light intensity increases the rate of photosynthesis until some other factor a limiting factor becomes in short supply.
- At very high light intensities photosynthesis is slowed and then inhibited but these light intensities do not occur in nature.

Effect of CO_2 Concentration

- Carbon dioxide with water is one of the reactants in photosynthesis.
- If the concentration of carbon dioxide is increased, the rate of photosynthesis will therefore increase.
- Again at some point a different factor may become limiting.
- Beyond this concentration, further increases in the concentration of carbon dioxide will not result in a faster rate of photosynthesis and would appear on a graph as a horizontal line.

Temperature

- The chemical reactions that combine carbon dioxide and water to produce glucose are controlled by enzymes.
- As with any other enzyme controlled reaction the rate of photosynthesis is affected by temperature.
- At low temperatures the rate of photosynthesis is limited by the number of molecular collisions between enzymes and substrates.
- At high temperatures, enzymes are denatured.

Respiration

- It is a chemical reaction that happens in all living cells containing plant cells and animal cells.
- It is the way that energy is released from glucose so that all the other chemical processes needed for life can happen.
- Do not confuse respiration with breathing (which is properly called ventilation).

Types of respiration

Anaerobic respiration

- Glucose breaks down without oxygen.
- The chemical reaction transfers energy from glucose to the cell.
- Anaerobic respiration produces lactic acid, rather than carbon dioxide and water.

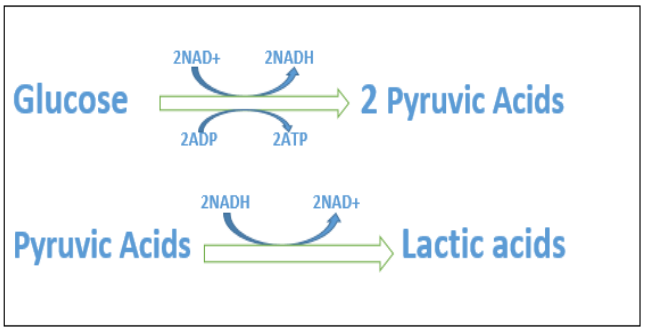
Examples of anaerobic respiration

- Include alcohol fermentation
- Lactic acid fermentation
- Decomposition of organic matter.

The equation is:

- Glucose + enzymes = carbon dioxide + ethanol / lactic acid.
- Though it does not produce as much energy as aerobic respiration.

Lactic Acid Fermentation



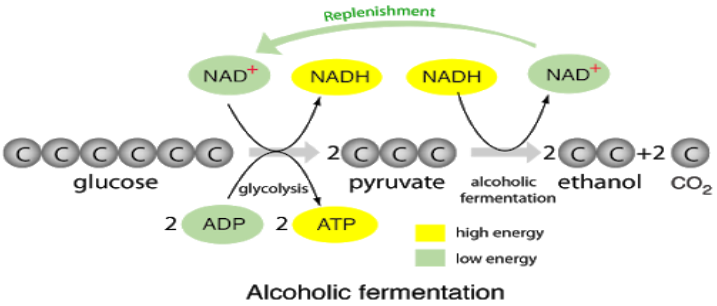
Lactic acid fermentation has two steps:

Glycolysis and NADH regeneration.

- During glycolysis one glucose molecule is converted to two pyruvate molecules producing two net ATP and two NADH.
- Lactic acid fermentation converts the 3-carbon pyruvate to the 3-carbon lactic acid ($C_3H_6O_3$) and regenerates NAD+ in the process allowing glycolysis to continue to make ATP in low oxygen conditions.

Alcoholic fermentation

- It is the process where yeast transforms fructose and glucose in grape juice to mainly ethanol CO_2 and heat.
- A wide range of other compounds are also being produced during this process but this review will only focus on antioxidants.



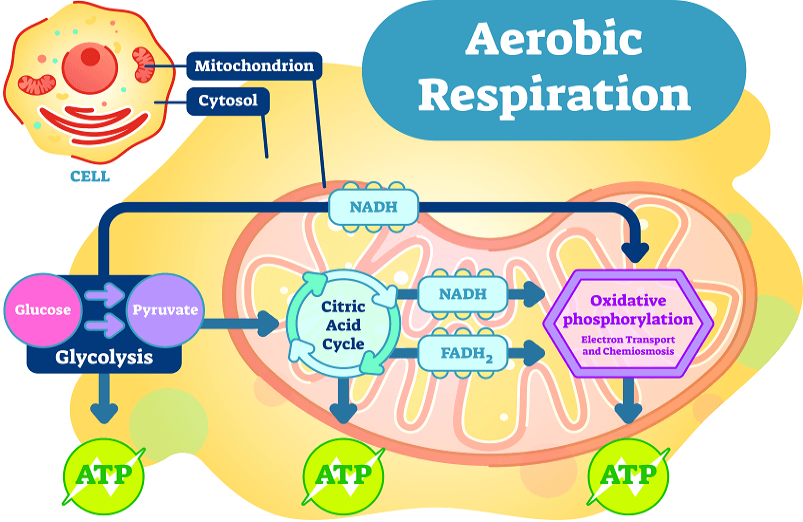
Alcoholic fermentation

- In alcoholic fermentation the pyruvic acid from glycolysis loses one carbon in the form of carbon dioxide to form acetaldehyde which is reduced to ethyl alcohol by NADH.
- When acetaldehyde is reduced to ethyl alcohol, NADH becomes NAD+ (is oxidized). This is the fermentation that commonly occurs in yeast.

Aerobic Respiration

Aerobic respiration is the process by which organisms use oxygen to turn fuel such as fats and sugars into chemical energy.

It complete in three step



Glycolysis

- It is a cytoplasmic pathway which breaks down glucose into two three carbon compounds and generates energy.
- Glucose is trapped by phosphorylation with the help of the enzyme hexokinase.
- Adenosine triphosphate (ATP) is used in this reaction and the product, glucose 6P, inhibits hexokinase.

Krebs cycle

A series of chemical reactions that occur in most aerobic organisms and are part of the process of aerobic cell metabolism, by which glucose and other molecules are broken down in the presence of oxygen into carbon dioxide and water to release chemical energy in the form of ATP.

The electron transport chain

- It is a series of electron transporters embedded in the inner mitochondrial membrane that shuttles electrons from NADH and FADH2 to molecular oxygen.
- In the process protons are pumped from the mitochondrial matrix to the inter-membrane space and oxygen is reduced to form water.

Energy Produced In Respiration

- Cellular respiration is the aerobic process by which living cells break down glucose molecules release energy and form molecules of ATP.
- Overall, this three stage process involves glucose and oxygen reacting to form carbon dioxide and water.

Difference between Photosynthesis and Respiration

Cellular Respiration	Photosynthesis
Occurs in all living organisms.	Occurs only in phototrophs (all green plants, algae, and some bacteria).
The entire process occurs in Mitochondria.	The entire process occurs in Chloroplasts.
Glucose and oxygen are the reactants of this process.	Carbon dioxide, water, and light energy are the reactants of this process.
Carbon dioxide, water, and energy (ATP) are the by-products.	Glucose, oxygen, and water are the by-products.
Undergoes Catabolic Process.	Undergoes Anabolic Process.
Oxygen is taken in and carbon dioxide is liberated out.	Producing food and capturing energy.

In this process, food particles are broken down to release energy.	In this process, food is synthesized by capturing energy.
It is an exergonic reaction as energy is released.	It is an endothermic reaction as it requires energy.
This process does not require sunlight since cellular respiration occurs all the time.	This process requires sunlight since photosynthesis occurs only in the presence of sunlight.
The chemical reaction of cellular Respiration is $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$	The chemical reaction of photosynthesis is $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

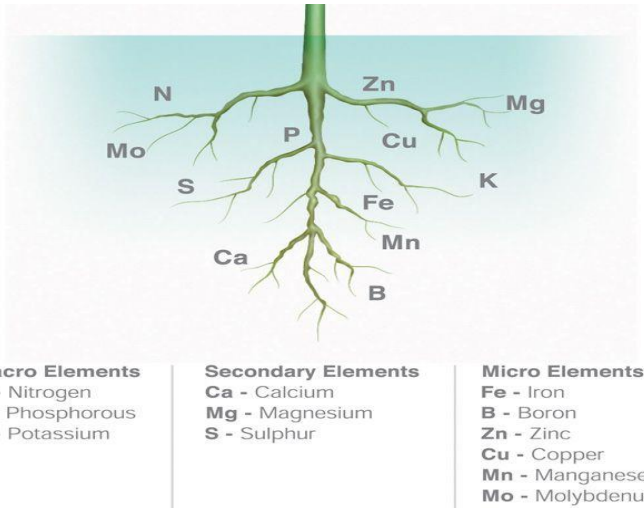
What is Nutrition?

The eating of healthy and balanced diet. Food and drink provide the energy and nutrients that we need to be healthy.

Mineral Nutrition in Plants

Mineral Nutrition is defined as the naturally occurring inorganic nutrient found in the soil and food that is essential for the proper functioning of plant body.

Minerals are vital elements necessary for the body.



Plants require 17 essential elements for growth:

Carbon (C), hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P), potassium (K), sulfur (S), calcium (Ca), magnesium (Mg), boron (B), chlorine (Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni), and zinc (Zn).

Role of Nitrogen

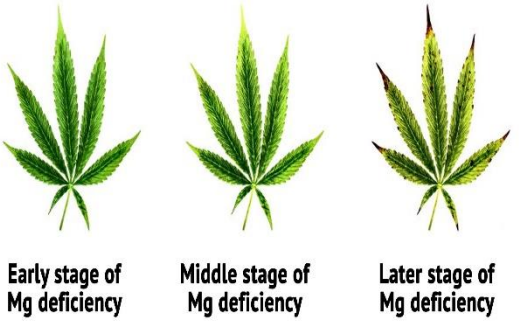
- Nitrogen is the most commonly used mineral nutrient.
- It is important for protein production.
- It plays a pivotal role in many critical functions (such as photosynthesis) in the plant and is a major component of amino acids the critical element constituent component of proteins.

Deficiency Effect of Nitrogen in Plants

- The deficiency of nitrogen influence plants that were stunted and yellow with declined growth and overall poor health.
- However when too much nitrogen is present what tends to result is an explosion of foliar growth but at the expense of flower formation, fruit set and root growth.

Role of Magnesium in Plants

- It fulfills many roles within the plant.
- It is a vital component of chlorophyll which is supporting the function to absorb sunlight during photosynthesis.
- Magnesium acts as a phosphorus carrier in plants and is vital for phosphate metabolism.



Deficiency Effected of Mg in Plants

- Deficiency of Mg Cause degradation the chlorophyll in the old leaves.

- Interveinal chlorosis or yellowing between leaf veins which stay green giving the leaves a marbled appearance.

Importance of Fertilizers

- Fertilizers replace the nutrients that crops remove from the soil.
- Without the addition of fertilizers crop yields and agricultural productivity would be significantly reduced.
- That is why mineral fertilizers are used to supplement the soil nutrient stocks with minerals that can be quickly absorbed and used by crops.

Organic Fertilizer

- They are fertilizers derived from animal matter, animal excreta, human excreta and vegetable matter.

Advantage Organic fertilizers

- In addition to releasing nutrients as organic fertilizers break down they improve the structure of the soil and increase its ability to hold water and nutrients.
- Over time organic fertilizers will make soil and plants healthy and strong.

Inorganic Fertilizer

Inorganic fertilizer also referred to as synthetic fertilizer is manufactured artificially and contains minerals or synthetic chemicals.

- For example synthetic nitrogen fertilizers are typically made from petroleum or natural gas.

Advantage of Inorganic Fertilizer

- Inorganic fertilizers offer is that they are fast acting.
- These nutrient rich salts dissolve quickly and are immediately available to the plants depending on them to provide essential nourishment in the form of nitrogen, phosphorus and potassium.

Environment Hazard Related To Use Chemical Fertilizer

- Some of these impacts include algae blooms causing the reduction of oxygen in surface waters, pathogens and nitrates in drinking water.
- The emission of odors and gases into the air.
- Nutrients from manure and fertilizers enter lakes and streams through runoff and soil erosion.
- Chemical fertilizers affect micro-organisms living in the soil.
- Chemical fertilizers are highly soluble in water hence they leach away into groundwater without fully benefiting the plant.
- Chemical fertilizers encourage plant disease.
- While the fertilizers help a plant to grow, they do not do much for the soil.

Component of Human Food

The seven major classes of nutrients are carbohydrates, fats, fiber, minerals, proteins, vitamins and water.

Carbohydrates

A large group of organic compounds occurring in foods and living tissues including sugars starch and cellulose. They contain hydrogen and oxygen in the same ratio as water (2:1) and typically can be broken down to release energy in the animal body.

Source of Carbohydrates

- Dairy, milk, yogurt, and ice cream.
- Fruits and fruit juice.
- Bread, rice, crackers, and cereal.
- Beans and other plant-based proteins.
- Potatoes and corn.

Importance

- Carbohydrates are our body main source of energy
- They helpful our brain, kidneys, heart muscles and central nervous system.
- For instance, fiber is a carbohydrate that aids in digestion, helps we feel full and keeps blood cholesterol levels in check.

Protein

When many amino acids are combine together by peptide bonds thus making a long chain. Peptide bonds are formed by a biochemical reaction that extracts a water molecule as it joins the amino group of one amino acid to the carboxyl group of an adjacent amino acid.

Found in

- It is generally found in animal products
- It is also present in other sources such as nuts and legumes.

Importance

- Protein is a vital part of a healthy diet.
- It helps to build and repair muscle, organs and bones.
- High protein diets have also been shown to be helpful with reducing fat, losing weight, increasing satiety or a feeling of fullness and retaining muscle.

Fats

A natural oily substance occurring in animal bodies especially when deposited as a layer under the skin or around certain organs.

Source of Fats

Unsaturated fats: They are found in salmon, avocados, olives and walnuts, also in vegetable oils like soybean, corn, canola and olive oil.

Saturated fats: These fats are found in meat and other animal products such as butter and cheese.

Importance

- Dietary fats are essential for body energy and support of cell growth.
- They also help protect our organs and help to keep our body warm.
- Fats help our body absorb some nutrients and produce important hormones too.
- Our body definitely needs fat.

Vitamins

A vitamin is an organic molecule that is an important micronutrient which an organism essentials in small quantities for the right functioning of its metabolism.

- Vitamins help your body grow and work.
- There are 13 vitamins, vitamins A, C, D, E, K, and the B vitamins (thiamine, riboflavin, niacin, pantothenic acid, biotin, B6, B12, and folate).

Vitamin A

Vitamin-A is a group of unsaturated nutritional organic compounds that contains retinol, retinal and several pro-vitamin-A carotenoids.

Source of Vitamin A

- Dairy products
- Liver
- fish
- fortified cereals

Source of Pro-vitamin A

- Carrots,
- Broccoli,
- Cantaloupe
- Squash.

Importance

- They make immune system strong for proper work.
- It also helping vision in dim light.

Vitamin A deficiency

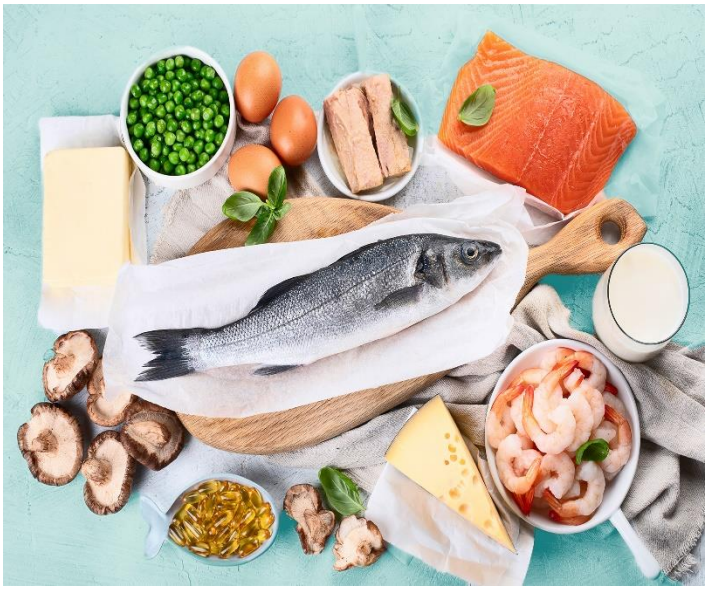
- Fat malabsorption or liver disorders.
- Weakens immunity and hematopoiesis and causes rashes and typical ocular effects e.g. xerophthalmia and night blindness

Vitamin C

It is also called ascorbic acid and water soluble vitamin ($C_6 H_8 O_6$).

Source of Vitamin C

- Broccoli
- Brussels sprouts
- Cauliflower
- Green
- Red peppers
- Spinach
- Cabbage
- Turnip greens
- Sweet and white potatoes.
- Tomatoes
- Winter squash.



Importance

- It is involved in the repair of tissue
- Enzymatic production of certain neurotransmitters.

Deficiency of Vitamin C

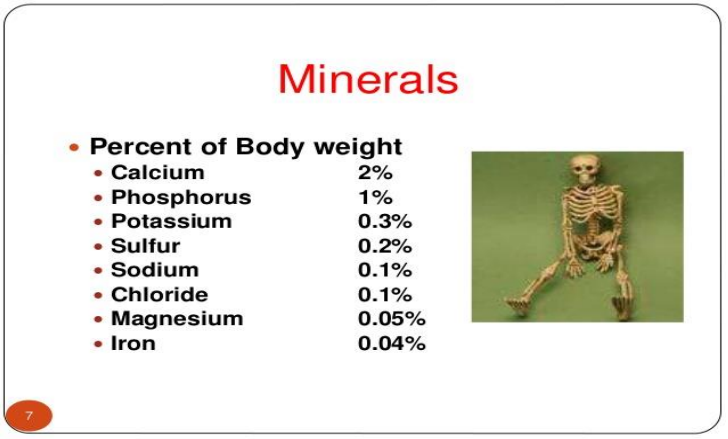
- Severe deficiency causing scurvy
- Comprise fatigue, depression and connective tissue defects (e.g. gingivitis, petechiae, rash, interior bleeding, impaired wound healing).

Vitamin D

It is a group of fat soluble secosteroids responsible. Vitamin D is often referred to as the sunshine vitamin because the sun is one of the best sources of this nutrient.

Source of Vitamin D

- Consume fatty fish and seafood.
- Eat more mushrooms.
- Include egg yolks in your diet.
- Eat fortified foods.
- Take a supplement.
- Try a UV lamp.



Importance

- It helps to regulate the amount of calcium and phosphate in the body.
- These nutrients are needed to keep bones, teeth and muscles healthy.

Vitamin D deficiency

- It can lead to a loss of bone density which can contribute to osteoporosis and fractures (broken bones).
- Severe vitamin D deficiency can also lead to other diseases.
- In children it can cause rickets.

Mineral

A mineral is a naturally occurring inorganic element or compound having an orderly internal structure and characteristic chemical composition.

Mineral in Human Body

The five major minerals in the human body are calcium, phosphorus, magnesium, sodium, potassium, chloride and sulfur. We only need small amounts of trace minerals. They include iron, manganese, copper, iodine, zinc, cobalt, fluoride and selenium. Most people get the amount of minerals they need by eating a wide variety of foods.

Role of Calcium

Calcium is one of the most important minerals for the human body. It helps form and maintain healthy teeth and bones. A proper level of calcium in the body over a lifetime can help prevent osteoporosis.

Sources of calcium

- Milk, cheese and other dairy foods.
- Green leafy vegetables such as curly kale, okra and spinach.
- Soya drinks with added calcium.
- Bread and anything made with fortified flour.
- fish where you eat the bones – such as sardines and pilchards

Role of iron

Iron is a vital element for blood production. About 70 percent of our body having iron in the red blood cells of blood called hemoglobin and in muscle cells called myoglobin. Hemoglobin is important for transferring oxygen in blood from the lungs to the tissues.

Sources of iron

- liver (but avoid this during pregnancy)
- Red meat.
- Beans, such as red kidney beans, edamame beans and chickpeas.

- Nuts.
- Dried fruit – such as dried apricots.
- Fortified breakfast cereals.
- Soybean flour

Dietary fiber

Also known as roughage or bulk includes the parts of plant foods our body cannot digest or absorb.

Source of Dietary food

- Apples, bananas, oranges, strawberries all have around 3 to 4 grams of fiber.
- Raspberries have most fibers almost 8 grams per cup.
- Exotic fruits are also good sources of fiber such as a mango has 5 grams, a persimmon has 6, and 1 cup of guava has about 9.
- Dark colored vegetables.
- Potatoes.

Soluble Fibers

This type of fiber dissolves in water to form a gel like material. It can help lower blood cholesterol and glucose levels.

Source

- Oats
- Peas
- Beans
- Apples
- Citrus fruits
- Carrots
- Barley
- Psyllium

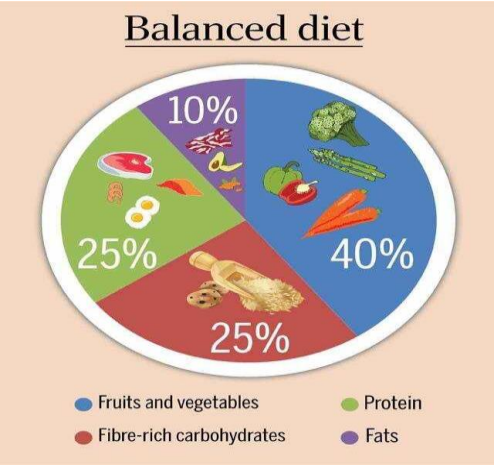
Insoluble Fibers

Insoluble fiber does not dissolve in water. It comprises plant cellulose and hemicellulose.

Source

- Wheat bran

- Vegetables
- Whole grains.



Water in Human Body

60% of the human adult body is water. According to H.H. Mitchell the brain and heart are composed of 73% water and the lungs are about 83% water. The skin comprises 64% water, muscles and kidneys are 79% and even the bones are watery 31%.

Function of Water in Human Body

- It helps create saliva.
- It regulates your body temperature.
- It protects your tissues, spinal cord and joints.
- It helps excrete waste through perspiration, urination and defecation.
- It helps maximize physical performance.
- It helps prevent constipation

Balance Diet

A balanced diet contains the proper quantities and proportions of the needed nutrients to maintain good health. It must have balanced amounts in proper proportions of carbohydrates, fats, proteins, vitamins, minerals, and water intake.

Common food in their composition

Food	Carbohydrate	Fat	Protein
Bread	52%	52%	9%
Rice	23%	0.1%	2.2%
Banana	20%	0.5%	1%
Potato	19%	0.1%	2%
Peas	16.7%	0.5%	5.2%
Apple	12.8%	0.5%	0.3%
Cabbage	5.5%	0.3%	1.2%

Relationship of Energy Requirements with Age

As you get older, the number of calories needed is usually less than when you were younger. This is because basic body processes require less energy when there is a decline in physical activity and loss of muscles. However, contrary to popular belief, basic nutrient needs do not decrease with age

Relationship of Energy Requirements with Gender

Although the recommended breakdown of carbohydrate, protein, and fat are the same for both genders, because men generally need more calories, they also require higher total intake of each of the macronutrients. Women need fewer calories than men, but in many cases, they have higher vitamin and mineral needs.

Relationship of Energy Requirements with Activity

There is a wealth of data proving that physical activity generates cardiovascular and metabolic benefits beyond what can be explained by related energy expenditure. Regular physical activity can increase resting metabolic rate (RMR), which increases total daily energy expenditure

	% of daily diet	**Male (80 kg) Sedentary**	**Male (80 kg) Active**	**Female (65 kg) Inactive**	**Female (65) active**
Carbohydrates	45-65%	264 to 382 g	344 to 500 g	215 to 310 g	280 to 404 g
Protein	10-15%	58 to 88 g	76 to 115 g	48 to 72 g	62 to 93 g
Fats	20-35%	54 to 95 g	70 to 123 g	44 to 77 g	57 to 100 g

Malnutrition

It is a condition that results from eating a food which does not supply a healthy quantity of one or more nutrients.

Effect of Malnutrition

The effects of malnutrition include:

- Changes in body mass
- Poor wound healing
- Severe weight loss (cachexia)
- Organ failure
- Loss of lean body mass, which normally starts after age 40.

Over Nutrition

It is a form of malnutrition in which the consumption of nutrients is oversupplied. The quantity of nutrients surpasses the quantity essential for normal growth, development and metabolism.

Effect of Over Nutrition

Obesity which increases the risk of serious health conditions, including cardiovascular disease, hypertension, cancer, and type-2 diabetes.

Protein energy malnutrition (PEM)

It is also called protein energy under nutrition (PEU). It is a form of malnutrition that is defined as a range of pathological disorders arising from corresponding deficiency of nutritional protein in variable amounts.

Effect Protein energy malnutrition

- Increased overall mortality rate
- Increased hospitalization rates
- Poor wound healing
- Enlarged vulnerability to contagion.

Marasmus

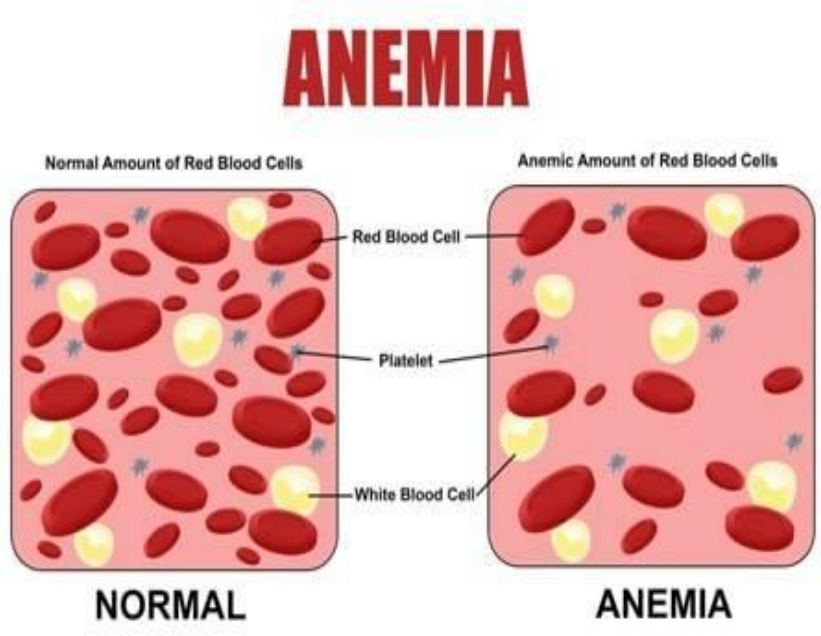
Nutrient insufficiency is the key cause of marasmus. It happens in children that do not consume sufficient protein, calories, carbohydrates and other essential nutrients. This is generally due to poverty and a shortage of food.

The symptoms of marasmus include:

- Weight loss.
- Dehydration.
- Chronic diarrhea.
- Stomach shrinkage

Kwashiorkor

It is a severe form of malnutrition. It's most common in some developing regions where babies and children do not get enough protein or other essential nutrients in their diet. The main sign of kwashiorkor is too much fluid in the body's tissues, which causes swelling under the skin (oedema).



Kwashiorkor and Its Symptoms

- Kwashiorkor is an ailment resulting from insufficient protein consumption.
- Initial signs comprise fatigue, irritability and weariness.
- As protein deficiency continues, one sees growth failure, loss of muscle mass, generalized swelling (edema) and decreased immunity.
- A large protuberant belly is common.

Mineral Deficiency Diseases

Lack of mineral cause many disorders including anemia, rickets, osteoporosis and goiter.

Anemia

Anemia is a disease in which the body lack enough healthy red blood cells to carry sufficient oxygen to body’s tissues. Anemia can be temporary or long term and it can range from mild to severe.

Symptoms

- Fatigue.
- Weakness.
- Pale or yellowish skin.
- Irregular heartbeats.
- Shortness of breath.
- Dizziness or lightheadedness.
- Chest pain.
- Cold hands and feet

Anemia affect the body

- If a person have anemia so his body does not get enough oxygen rich blood.
- A person to feel tired or weak.

- Also cause shortness of breath, dizziness, headaches or an irregular heartbeat.

Osteoporosis

It is a bone disease that occurs when the body loses too much bone and makes too little bone or both. As a result bones become weak and may break from a fall or in serious cases from sneezing or slight accidents.

Symptom

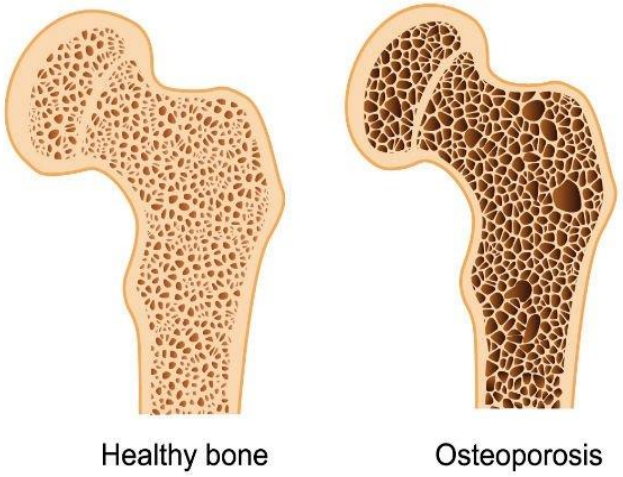
- Back pain caused by a fractured or collapsed vertebra.
- Loss of height over time.
- A bent posture.
- A bone that breaks much more easily than expected

Main cause of osteoporosis

- A constant deficiency of calcium plays a role in the development of osteoporosis.
- Low calcium intake contributes to reduced bone density early bone loss and an increased risk of fractures.
- Severely restricting food intake and being underweight weakens bone in both men and women.

Goiter

It is an abnormal enlargement of thyroid gland. Thyroid is a butterfly formed gland found at the base of neck just below Adam's apple. Although goiters are generally painless, a large goiter can cause a cough and make it difficult to swallow or breathe.

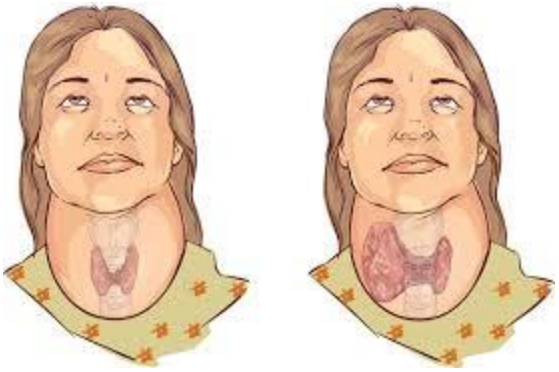


Causes of Malnutrition

- Malnutrition is caused by having an inadequate diet or a problem absorbing nutrients from food.
- There are many reasons including having reduced mobility, a long term health condition or a low income.

Human Digestive System

As food passes through the GI tract, it mixes with digestive juices, causing large molecules of food to break down into smaller molecules. The body then absorbs these smaller molecules through the walls of the small intestine into the bloodstream, which delivers them to the rest of the body.



Alimentary Canal

The organs of the alimentary canal are the mouth, pharynx, esophagus, stomach, small intestine and large intestine.

Oral cavity

It contains the lips the lining inside the cheeks and lips. the front two thirds of the tongue, the upper and lower gums, the floor of the mouth under the tongue, the bony roof of the mouth and the small area behind the wisdom teeth.

Teeth

Mouth is the beginning of digestive system. The teeth in mouth are very important because they help prepare food to travel through the rest of your digestive system.

Incisors: The four front teeth in both the upper and lower jaws are called incisors.

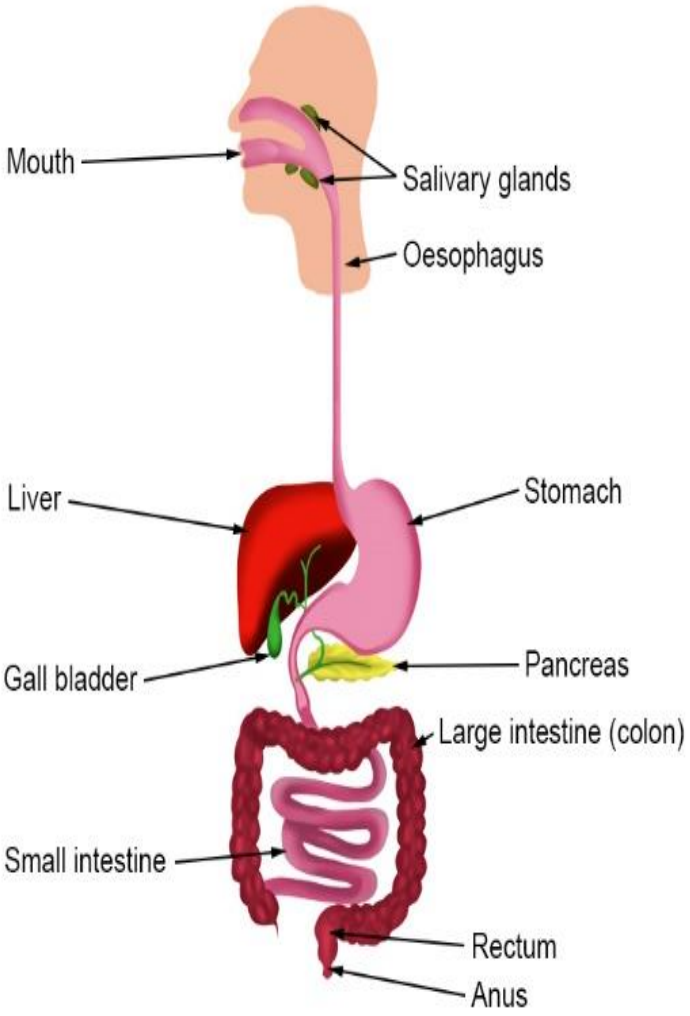
Canines: There are four canines in the oral cavity.

Premolars (Bicuspids): These teeth are located behind and adjacent to the canines and are designed to crush food.

Molars: The most posterior teeth in the mouth are the molars

Tongue

Tongue helps out, pushing the food around while we chew with teeth. When we ready to swallow the tongue pushes a tiny bit of mushed up food called a bolus toward the back of the throat and into the opening of esophagus.



Slivery Glands

The salivary glands produce saliva which keeps the mouth and other parts of the digestive system moist. It also helps break down in carbohydrates (with salivary amylase, formerly known as ptyalin).

The pharynx

It is the part of the throat behind the mouth and nasal cavity, and above the esophagus and larynx.

Esophagus

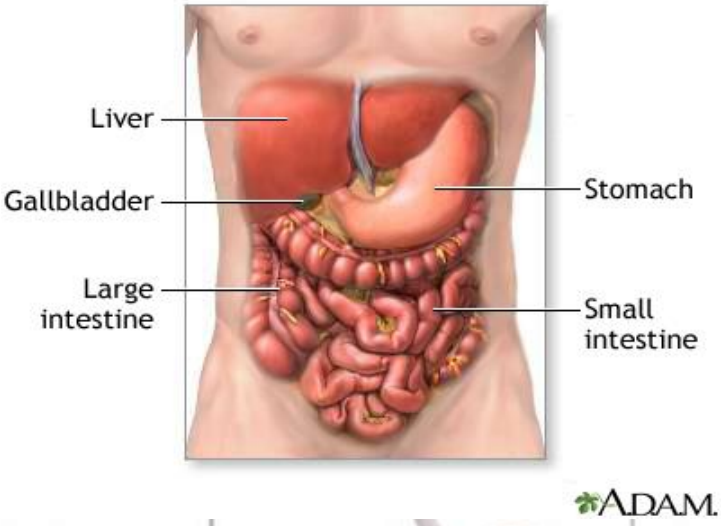
Anatomically and functionally, the esophagus is the least complex section of the digestive tube. Its role in digestion is simple: to convey boluses of food from the pharynx to the stomach. The esophagus begins as an extension of the pharynx in the back of the oral cavity.

Peristalsis

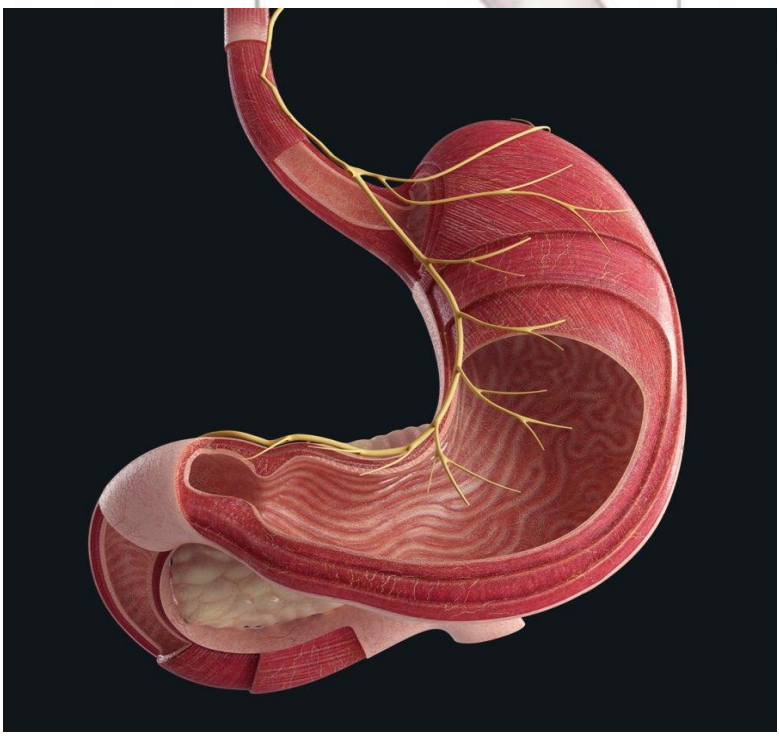
It is a series of wave-like muscle contractions that moves food to different processing stations in the digestive tract. The process of peristalsis begins in the esophagus when a bolus of food is swallowed.

Stomach

The stomach secretes acid and enzymes that digest food. Ridges of muscle tissue called rugae line the stomach. The stomach muscles contract periodically, churning food to enhance digestion. The pyloric sphincter is a muscular valve that opens to allow food to pass from the stomach to the small intestine.



In the stomach, food undergoes chemical and mechanical digestion. Here, peristaltic contractions (mechanical digestion) churn the bolus, which mixes with strong digestive juices that the stomach lining cells secrete (chemical digestion).



Gastric juice is made up of digestive enzymes, hydrochloric acid and other substances that are important for absorbing nutrients – about 3 to 4 liters of gastric juice are produced per day. The hydrochloric acid in the gastric juice breaks down the food and the digestive enzymes split up the proteins.

Small Intestine

The small intestine or small bowel is an organ in the gastrointestinal tract where most of the end absorption of nutrients and minerals from food takes place. It lies between the stomach and large intestine, and receives bile and pancreatic juice through the pancreatic duct to aid in digestion.

Duodenum

The duodenum is the first part of the small intestine. It is located between the stomach and the middle part of the small intestine, or jejunum. After foods mix with stomach acid, they move into the duodenum, where they mix with bile from the gallbladder and digestive juices from the pancreas.

Livers as Digestive Gland

As an exocrine gland the liver secretes bile into a system of canaliculated and ducts convey their content to the gall bladder, where it is stored and concentrated, before release into the digestive tract.

Pancreases as Digestive Gland

The pancreas is a glandular organ in the upper abdomen, but really it serves as two glands in one: a digestive exocrine gland and a hormone-producing endocrine gland. Functioning as an exocrine gland, the pancreas excretes enzymes to break down the proteins, lipids, carbohydrates, and nucleic acids in food.

Jejunum

The jejunum is the second part of the small intestine in humans and higher vertebrates, including mammals, reptiles, and birds. Its lining is specialized for the absorption by enterocytes of small nutrient molecules which have been previously digested by enzymes in the duodenum.

Ileum

It is the final section of the small intestine in higher vertebrates, including mammals, reptiles, and birds. In fish, the divisions of the small intestine are not as clear and the terms posterior intestine or distal intestine may be used instead of ileum.

Absorption of Food

Digested food molecules are absorbed in the small intestine. This means that they pass through the wall of the small intestine and into our bloodstream. Once there, the digested food molecules are carried around the body to where they are needed.

Large Intestine

The large intestine, also known as the large bowel, is the last part of the gastrointestinal tract and of the digestive system in vertebrates. Water is absorbed here and the remaining waste material is stored as feces before being removed by defecation.

Caecum

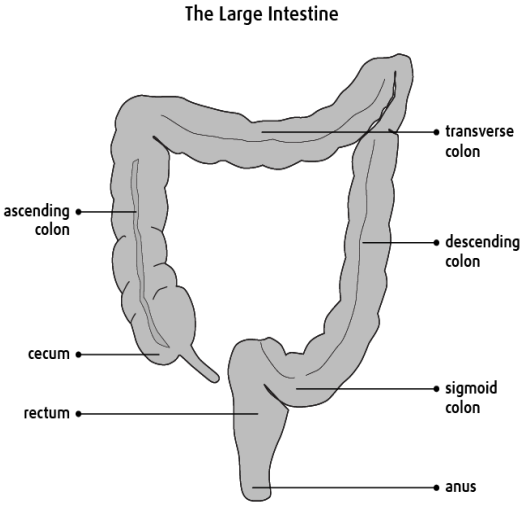
The main functions of the cecum are to absorb fluids and salts that remain after completion of intestinal digestion and absorption and to mix its contents with a lubricating substance, mucus. The internal wall of the cecum is composed of a thick mucous membrane, through which water and salts are absorbed.

Colon

The colon is part of the large intestine, the final part of the digestive system. Its function is to reabsorb fluids and process waste products from the body and prepare for its elimination. The colon consists of four parts: descending colon, ascending colon, transverse colon, and sigmoid colon.

Other Roles of the Liver

- The liver's main job is to filter the blood coming from the digestive tract, before passing it to the rest of the body.
- The liver also detoxifies chemicals and metabolizes drugs.
- As the largest organ in our body, our liver has 3 vital functions, essential to our body: detoxification, synthesis and storage.
- Real filter, the liver recovers and eliminates many toxins. Those toxins can be naturally



present in the waste generated by organism, like ammonia, or in the ones we eat or drink like alcohol.

- Our liver assures the metabolism of the carbohydrates, the fat and the proteins while producing bile, essential element for our digestion.
- Our liver also avoids hemorrhages via the coagulation process.
- The liver stores vitamins (A, D, E, and K) and glycogens (carbohydrates) meaning it stores energy like sugar and makes it available to our organism when needed

Constipation

It occurs when bowel movements become less frequent and stools become difficult to pass.

Causes of Constipation

- Eating foods low in fiber.
- Not drinking enough water (dehydration).
- Not getting enough exercise.
- Changes in your regular routine, such as traveling or eating or going to bed at different times.

Treatments

- Drink more water.
- Eat more fiber, especially soluble, non-fermentable fiber.
- Exercise more.
- Drink coffee, especially caffeinated coffee.
- Take Senna, an herbal laxative.
- Eat probiotic foods or take probiotic supplements.
- Over-the-counter or prescription laxatives.

Diarrhea

Diarrhea is passing loose or watery bowel movements three or more times in a day.

Causes of Diarrhea

- Viruses (viral gastroenteritis).
- In children are rotavirus
- In adults are norovirus (this is sometimes called cruise ship diarrhea due to well publicized epidemics).
- Bacteria are a common cause of traveler's diarrhea.

Treatment

- Plenty of fluids to prevent dehydration.
- Oral rehydration drinks to replace lost salts and minerals. ...
- Intravenous replacement of fluids in severe cases.
- Medications such as antibiotics and anti-nausea drugs

Ulcers

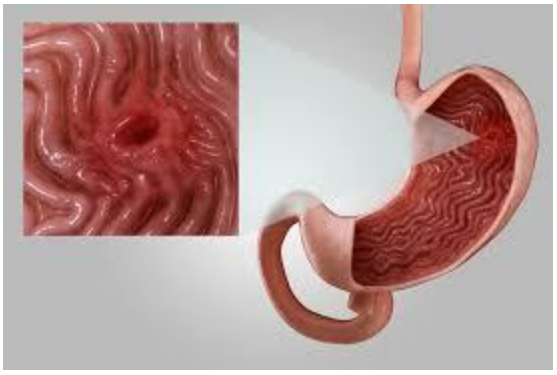
A peptic ulcer is a sore on the lining of stomach, small intestine or esophagus. A peptic ulcer in the stomach is called a gastric ulcer. A duodenal ulcer is a peptic ulcer that develops in the first part of the small intestine (duodenum).

Causes of Ulcer

- Its Infection caused by bacterium Helicobacter pylori (H. pylori).
- Long term use of non-steroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen (Advil, Motrin IB and others) and naproxen sodium (Aleve).
- Stress and spicy foods do not cause peptic ulcers.

Treatment

Proton pump inhibitors reduce stomach acid by blocking the action of the parts of cells that produce acid. These drugs include the prescription and over-the-counter medications omeprazole (Prilosec), lansoprazole (Prevacid), rabeprazole (Aciphex), esomeprazole (Nexium) and pantoprazole (Protonix).



TRANSPORT
CHAPTER 9

Transportation

Transport refers to the act or the means by which a molecule or ion is moved across the cell membrane or via the bloodstream.

Transport in Plants

Plants have tissues to transport water, nutrients and minerals.

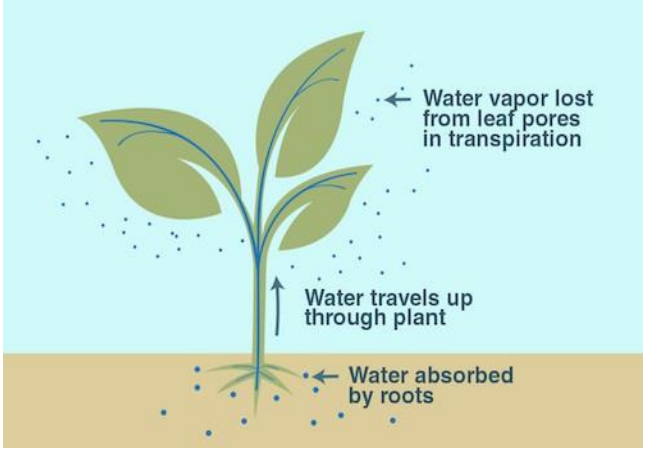
Xylem Tissue

Xylem tissue transports water and mineral salts from the roots up to other parts of the plant.

Phloem Tissue

Phloem tissue transports sugar and protein between the leaves and other parts of the plant.

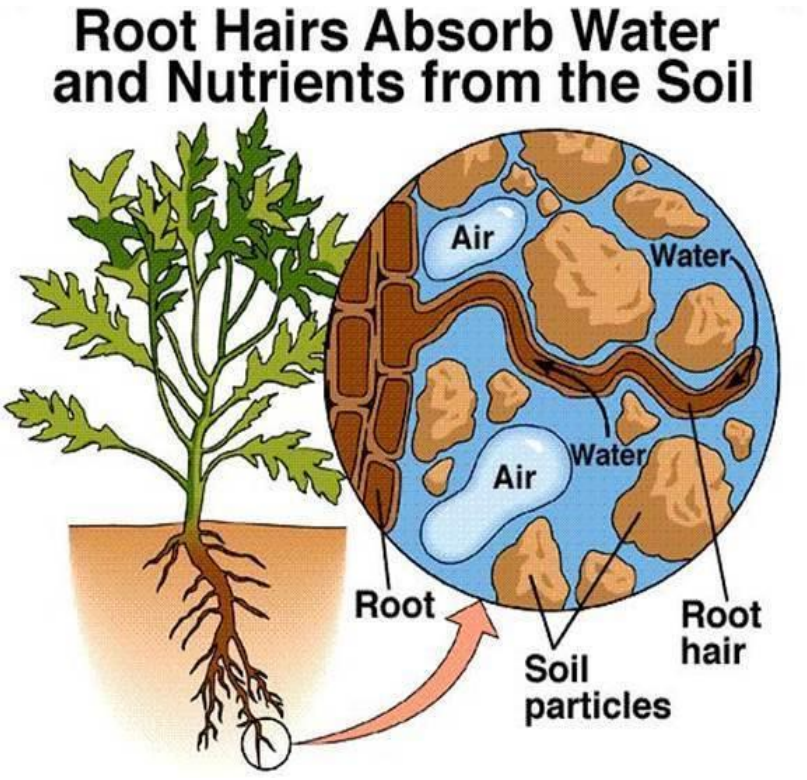
Absorption of Water in Plants



In higher plants water is absorbed through root hairs which are in contact with soil water and form a root hair region a little behind the root tips. Root hairs are tubular hair like prolongations of the cells of the epidermal layer (when epidermis bears root hairs it is also known as piliferous layer) of the roots. The walls of root hairs are permeable and consist of pectic substances and cellulose which are strongly hydrophilic (water loving) in nature. Root hairs contain vacuoles filled with cell sap. When roots elongate, the older hairs die and new root hairs are developed so that they are in contact with fresh supplies of water in the soil.

Absorption of salt in Plants

Mineral salts are absorbed from the soil solution in the form of ions. They are mainly absorbed through the meristematic regions of the roots near the tips. However some mineral salts may also be absorbed at other locations on the root surface or over the entire root surface including region of elongation and root hairs that depends upon the high availability of such minerals around them and or strong tissue demand at such locations.



Transpiration

It is the process of water movement through a plant and its evaporation from aerial parts such as leaves, stems and flowers. Water is necessary for plants but only a small amount of water taken up by the roots is used for growth and metabolism.

Stomata

Stomata are tiny pores in plant tissue which take place gas exchange. Stomata are typically found in plant leaves but can also be found in some stems. Specialized cells known as guard cells surround stomata and function to open and close stomata pores.

Stomata Control of Transpiration

Stomata are pores in the leaf that allow gas exchange where water vapor leaves the plant and carbon dioxide enters. Special cells called guard cells control each pore opening or closing. When stomata are open, transpiration rates increase when they are closed transpiration rates decrease.

Factor that effecting rate of transpiration

Light

Light increases the rate of water absorption and the resulting increased turgidity of the two guard cells which form the boundary of each stoma, brings about the opening of the stomata increasing transpiration rate.

Temperature

As temperature increases, the rate of evapotranspiration increases. Evaporation increases because there is a higher amount of energy available to convert the liquid water to water vapor. Transpiration increases because at warmer temperatures plants open up their stomata and release more water vapor.

Humidity

As the relative humidity of the air surrounding the plant rises the transpiration rate falls. It is easier for water to evaporate into dryer air than into more saturated air. Wind and air movement: Increased movement of the air around a plant will result in a higher transpiration rate.

Soil Moisture

The results suggest that once plants wilt, the transpiration rate should be roughly proportional to the available water content of the soil. The lower limit of water available for transpiration occurs at a suction well above 15 bars. Time the actual transpiration rate falls behind the potential evapotranspiration.

Wind

Relative humidity: As the relative humidity of the air surrounding the plant rises the transpiration rate falls. It is easier for water to evaporate into dryer air than into more saturated air. Wind and air movement: Increased movement of the air around a plant will result in a higher transpiration rate

Number of Stomata

Stomata – Stomata are pores in the leaf that allow gas exchange where water vapor leaves the plant and carbon dioxide enters. Special cells called guard cells control each pore's opening or closing. When stomata are open, transpiration rates increase; when they are closed, transpiration rates decrease.

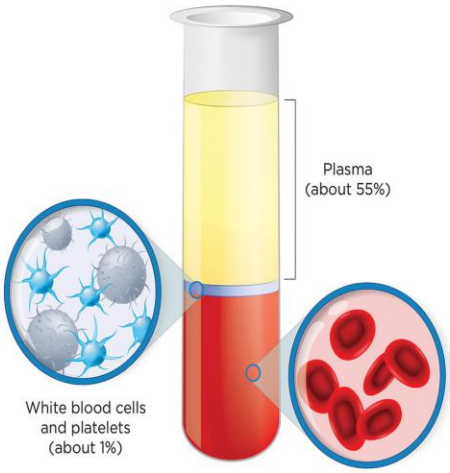
Significance of Transpiration

The Significance of Transpiration in plants includes:

- Keeps the cell turgid.
- Cools the surface of the leaves.
- Helps in growth and development.
- It controls the temperature of the plants.
- Allows the movement of minerals from the soil to different parts of the plant

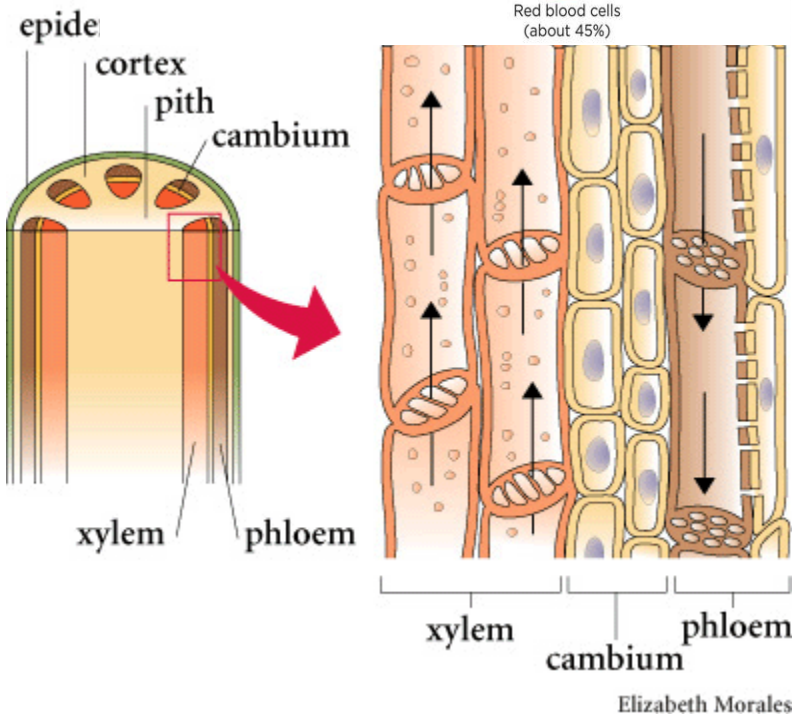
Transportation of Water

Overall, water is transported in the plant through the combined efforts of individual cells and the conductive tissues of the vascular system. ... It is carried upward through the xylem by transpiration, and then passed into the leaves along another water potential gradient.



Translocation of Food in Plants

Transport of soluble product of photosynthesis or food from leaves to other parts of plants is called translocation. For translocation, food molecules enter the part of the phloem called the sieve tubes where they can be transported upwards or downwards to all the parts of the plant including roots. The food is manufactured in the leaves. From the mesophyll cells of the leaves, the food enters the phloem cells. They are then transported along the phloem to the different parts of the plant (stem, roots, etc.). From the phloem, the cells draw the food as per their requirement.



Transport in Human

The main transport system of human is the circulatory system, a system of tubes (blood vessels) with a pump (the heart) and valves to ensure one way flow of blood.

Functions

- To transport nutrients and oxygen to the cells.
- To remove waste and carbon dioxide from the cells.

Blood

Blood circulates through our body and delivers essential substances like oxygen and nutrients to the body's cells. It also transports metabolic waste products away from those same cells

Composition of Blood

Blood cells consist of erythrocytes (red blood cells), leukocytes (white blood cells) and thrombocytes (platelets). By volume, the red blood cells constitute about 45% of whole blood, the plasma about 54%, and white cells about 1%

Plasma

Plasma is the clear, straw-colored liquid portion of blood that remains after red blood cells, white blood cells, platelets and other cellular components are removed. It is the single largest component of human blood comprising about 55 percent and contains water, salts, enzymes, antibodies and other proteins.

Function

- Plasma carries water, salts and enzymes.
- The main role of plasma is to take nutrients, hormones, and proteins to the parts of the body that need it.
- Cells also put their waste products into the plasma.
- The plasma then helps remove this waste from the body.

Red Blood Cell

Human blood is red because of the hemoglobin protein which contains a red colored compound called heme. The cell is flexible and assumes a bell shape as it passes through extremely small blood vessels. It is covered with a membrane composed of lipids and proteins, lacks a nucleus and contains hemoglobin a red iron rich protein that binds oxygen.

Function

The main function of RBCs is to transport oxygen from the lungs to the tissues, where it is used as a source of electrons and ATP synthesis in the mitochondria.

White Blood Cell

A type of blood cell that is made in the bone marrow and found in the blood and lymph tissue. White blood cells are part of the body's immune system. White blood cell, also called leukocyte or white corpuscle, a cellular component of the blood that lacks hemoglobin, has a nucleus, is capable of motility.

Function

- They flow through your bloodstream to fight viruses, bacteria and other foreign invaders that threaten your health.
- When your body is in distress and a particular area is under attack, white blood cells rush in to help destroy the harmful substance and prevent illness.

Platelets

Platelets are the small colorless cell fragments in blood. Platelets are produced from very large bone marrow cells called megakaryocytes. A normal platelet count ranges from 150,000 to 450,000 platelets per microliter of blood. Having more than 450,000 platelets is a condition called thrombocytosis and having less than 150,000 is known as thrombocytopenia.

Function

The principal function of platelets is to prevent bleeding.

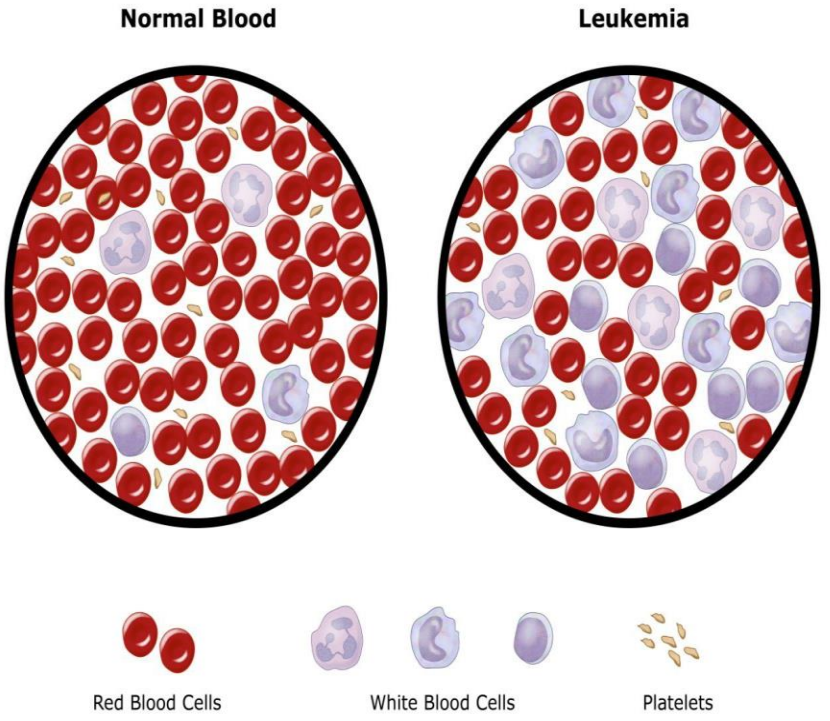
Blood Disorder

Thalassemia

It is a blood disorder passed down through families (inherited) in which the body makes an abnormal form or inadequate amount of hemoglobin. Hemoglobin is the protein in red blood cells that carries oxygen. The disorder results in large numbers of red blood cells being destroyed, which leads to anemia.

Causes

Thalassemia is caused by mutations in the DNA of cells that make hemoglobin — the substance in red blood cells that carries oxygen throughout your body. The mutations associated with thalassemia are passed from parents to children.



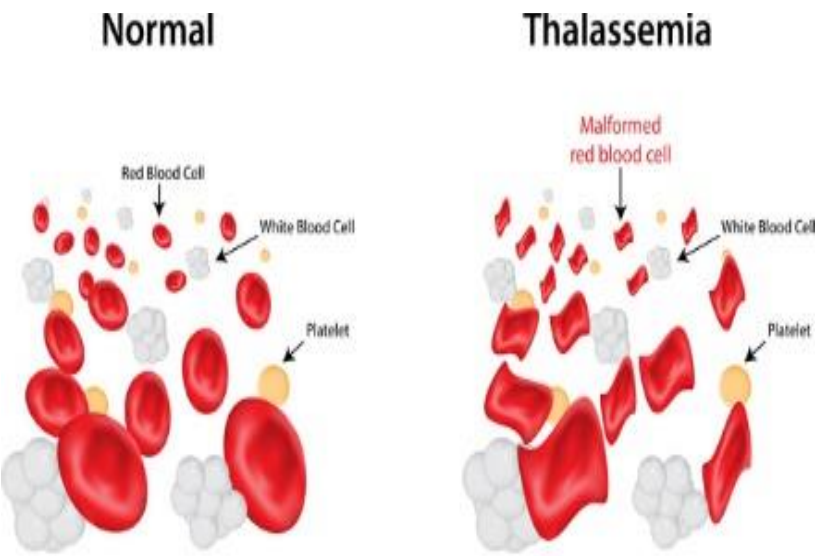
Symptoms

Fatigue.

- Weakness.
- Pale or yellowish skin.
- Facial bone deformities.
- Slow growth.
- Abdominal swelling.
- Dark urine

Treatment

- Frequent blood transfusions possibly every few weeks.
- Treatment to remove excess iron from your blood.
- Stem cell transplant.
- To rid your body of the extra iron, you might need to take an oral medication, such as deferasirox (Exjade, Jadenu) or deferiprone (Ferriprox).
- Another drug, deferoxamine (Desferal), is given by needle.



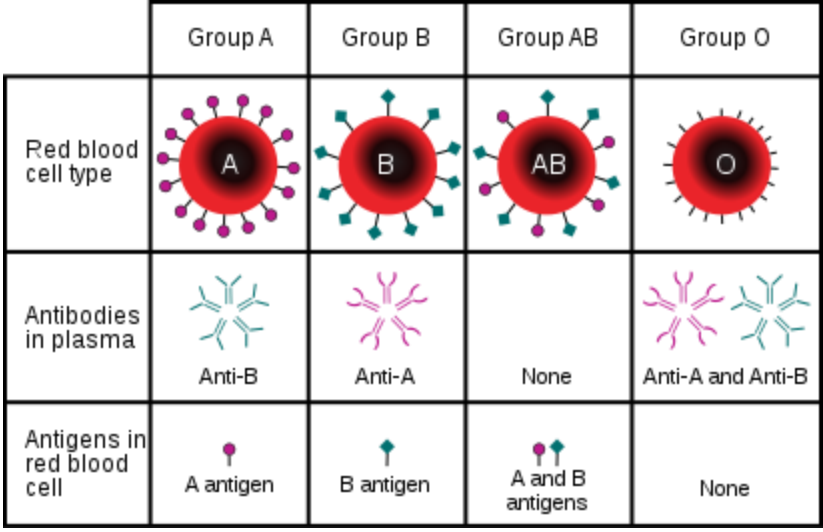
Leukaemia

It is a cancer which starts in blood forming tissue usually the bone marrow. It leads to the over production of abnormal white blood cells the part of the immune system which defends the body against infection.

Causes

Exact cause of leukemia is not known.

Risk factors have been known containing radiation exposure, certain chemotherapy for cancer, smoking, family history of leukemia and exposure to certain chemicals such as benzene.



Symptom

- Fever or chills.
- Persistent fatigue or weakness.
- Frequent or severe infections.
- Losing weight without trying.
- Swollen lymph nodes, enlarged liver or spleen.
- Easy bleeding or bruising.
- Recurrent nosebleeds.
- Tiny red spots in skin (petechiae)

Treatments

- Chemotherapy (major treatment modality for leukemia)
- Radiation therapy,
- Biological therapy,
- Targeted therapy
- Stem cell transplant.

Blood Group System

The ABO blood group system classifies blood types according to the different types of antigens in the red blood cells and antibodies in the plasma. They use the ABO system alongside the RhD antigen status to determine which blood type or types will match for a safe red blood cell transfusion.

ABO Blood Group System

It was not until the year 1900, when Karl Landsteiner at the University of Vienna, discovered why some blood transfusions were successful while others could be deadly. Landsteiner discovered the ABO blood group system by mixing the red cells and serum of each of his staff.

Your ABO blood type is based on the presence or absence of the A and B antigens on your red blood cells. The A blood type has only the A antigen and the B blood type has only the B antigen. The AB blood type has both A and B antigens, and the O blood type has neither A nor B antigen.

Blood Transfusion in ABO system

If ABO incompatible red cells are transfused so red cell hemolysis can occur. For example if group A red cells are infused into a recipient who is group O, the recipient's anti-A antibodies bind to the transfused cells.

Rh Blood Group System

It is the second most significant blood group system after the ABO blood group system. The Rh blood group system consists of 49 defined blood group antigens among which the five antigens D, C, c, E, and e are the most important. There is no d antigen.

Blood Transfusion in Rh System

The term "Rh" was originally an abbreviation of "Rhesus factor." It was discovered in 1937 by Karl Landsteiner and Alexander.

Antibodies to Rh antigens can be involved in hemolytic transfusion reactions and antibodies to the Rh (D) and Rh antigens confer significant risk of hemolytic disease of the fetus and new born. But people with Rh-negative blood should only get Rh-negative red blood cells except in extreme emergencies. This is because an Rh-positive blood transfusion can cause a person with Rh negative blood to make antibodies against the Rh factor, causing a transfusion reaction

Parent 2 (Rh +) \ Parent 1 (Rh+)	D	d
D	DD (Rh +)	Dd (Rh +)
d	Dd (Rh +)	dd (Rh -)

Recipient	Donor							
My Blood Type	O-	O+	A-	A+	B-	B+	AB-	AB+
O-	●							
O+	●	●						
A-	●		●					
A+	●	●	●	●				
B-	●				●			
B+	●	●			●	●		
AB-	●		●		●		●	
AB+	●	●	●	●	●	●	●	●

Human Heart

The human heart is an organ that pumps blood throughout the body via the circulatory system, supplying oxygen and nutrients to the tissues and removing carbon dioxide and other wastes.

Structure of Human Heart

The human heart is about the size of a human bunch and is divided into four chambers, two ventricles and two atria.

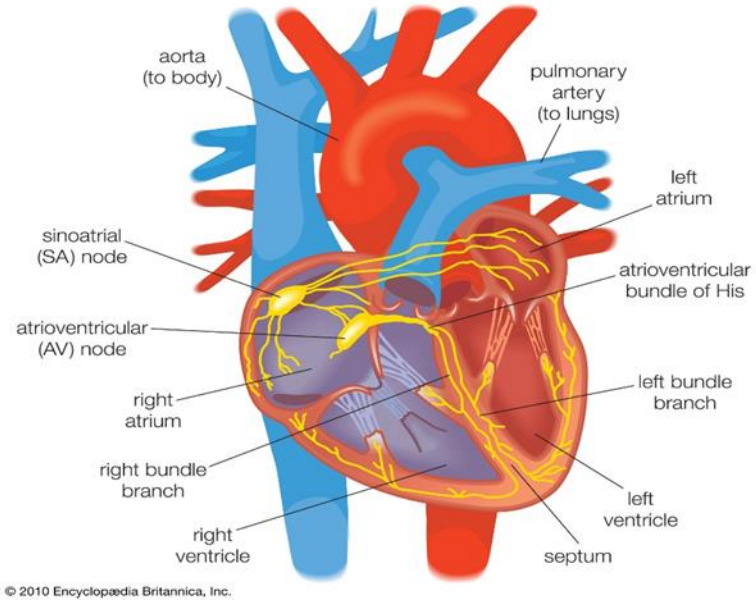
Ventricles

They are the chambers that pump blood.

Atrium

They are the chambers that receive blood.

- Right atrium and right ventricle make up the right heart.
- The left atrium and ventricle make up the left heart.
- The structure of the heart also houses the biggest artery in the body the aorta.



Septum

The right and the left region of the heart are separated by a wall of muscle called the septum.

Function

- The right ventricle pumps the blood to the lungs for re-oxygenation through the pulmonary arteries.
- The right semilunar valves close and prevent the blood from flowing back into the heart.
- The oxygenated blood is received by the left atrium from the lungs via the pulmonary veins.

Circulation of Blood in Heart Chambers

Blood arrives the right atrium and passes through the right ventricle. The right ventricle pumps the blood to the lungs where it becomes oxygenated. The oxygenated blood is brought back to the heart by the pulmonary veins which enter the left atrium. From the left atrium blood flows into the left ventricle.

Heart Beat

A single complete pulsation of the heart is call heartbeat.

- One cycle takes 0.8 second.
- Average rate of heart beat in healthy man is 72 times per minute.

Each single heartbeat comprises three main steps: atrial systole, ventricular systole, and complete cardiac diastole.

Arterial Systole

As blood flows into the atria, the pressure will rise, so the blood will initially move passively from the atria into the ventricles. When the action potential triggers the muscles in the atria to contract (atrial systole), the pressure within the atria rises further, pumping blood into the ventricles

Ventricle Systole

The cardiac cycle at the point of start a ventricular systole or contraction

- newly oxygenated blood (red arrow) in the left ventricle begins pulsing through the aortic valve to supply all body systems
- Oxygen depleted blood (blue arrow) in the right ventricle initiates pulsing through the pulmonic (pulmonary).

Cardiac Diastole

It is the period during which the two ventricles are relaxing from the contortions or wringing of contraction then opening and filling; atrial diastole is the period during which the two atria likewise are relaxing under suction, dilating and filling.

Pules

The rhythmic dilation of an artery that results from beating of the heart. Pulse is often measured by feeling the arteries of the wrist or neck.

A pulse in signal processing is a rapid, transient change in the amplitude of a signal from a baseline value to a higher or lower value, followed by a rapid return to the baseline value

Blood Vessel

Blood vessel, a vessel in the human or animal body in which blood circulates.

Arteries

Each artery is a muscular tube lined by smooth tissue and has three layers:

The intima: the inner layer lined by a smooth tissue called endothelium.

The media: a layer of muscle that lets arteries handle the high pressures from the heart.

The adventitia: connective tissue anchoring arteries to nearby tissues.

Function

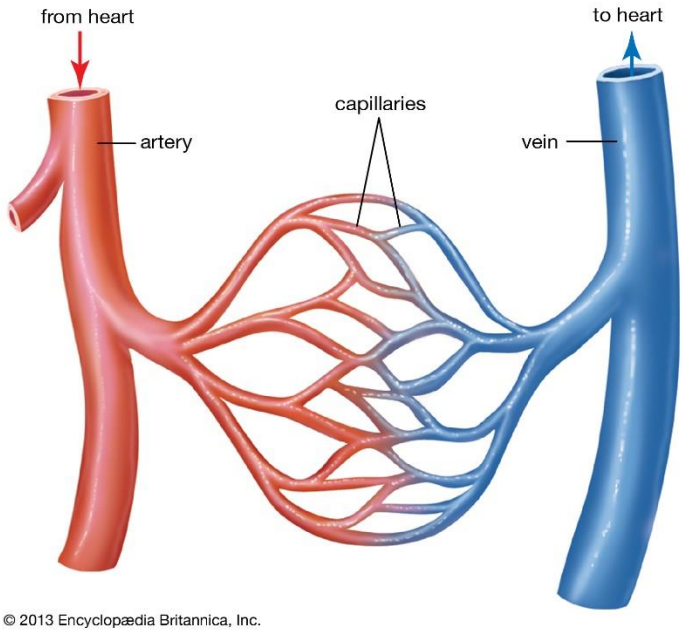
Arteries are the blood vessels of the body that transport blood away from the heart and to the organs and tissues of the body. The aorta is the largest artery in the body that exits the left ventricle of the heart.

Capillaries

Capillaries are very thin approximately 5 micrometers in diameter and are composed of only two layers of cells;

Endothelial cells: it made inner layer of capillaries

Epithelial cells: it made outer layer of capillaries



Function

It the smallest and most numerous of the blood vessels, form the connection between the vessels that carry blood away from the heart (arteries) and the vessels that return blood to the heart (veins). The primary function of capillaries is the exchange of materials between the blood and tissue cells.

Veins

They consists of three main layers.

- The outer layer is connective tissue, called tunica adventitia or tunica externa;
- A middle layer of smooth muscle called the tunica media.
- The inner layer lined with endothelial cells called the tunica intima

Function

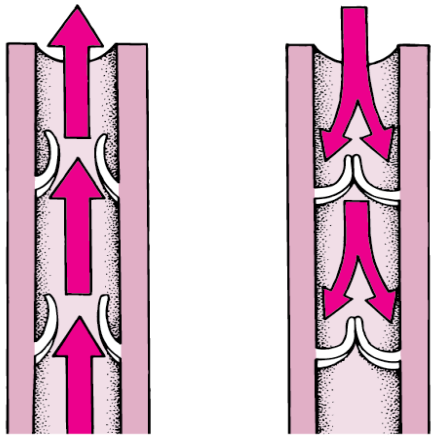
Veins are vessels of the circulatory system that support circulation by conveying blood to the heart. Blood flowing through the circulatory system transports nutrients, oxygen, and water to cells throughout the body.

Valves

Valves in veins are bicuspid, meaning they have two flap-like structures that regulate blood flow. These flaps are made of elastic tissue. The valves' main job is to keep the blood moving in one direction – back up towards the heart

General Plan of Human Blood Circulatory System

Arties make the arterial system while veins make the venous system.



Arterial System

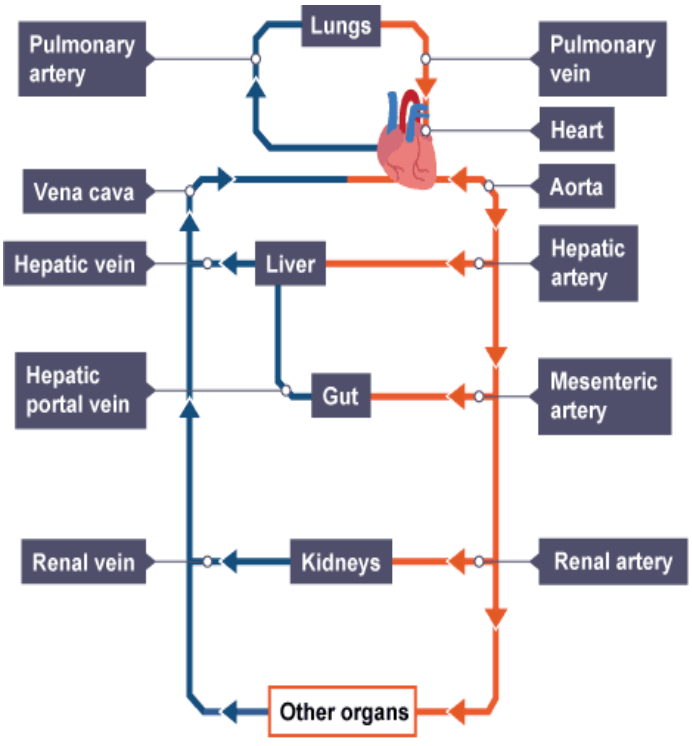
The blood circulatory system (cardiovascular system) delivers nutrients and oxygen to all cells in the body. It consists of the heart and the blood vessels running through the entire body. The arteries carry blood away from the heart.

Coronary Arteries

Corona arteries are the arterial blood vessels of coronary circulation, which transport oxygenated blood to the heart muscle. The heart requires a continuous supply of oxygen to function and survive, much like any other tissue or organ of the body. The coronary arteries wrap around the entire heart.

Dorsal Aorta

The dorsal aorta is a blood vessel in a single-pass circulatory system that carries oxygenated blood from the gills to the rest of the body. In a single-pass circulatory system blood passes once through the heart to supply the body once. Dorsal lateral plate region. Dorsal longitudinal anastomotic vessel.



Coeliac Trunk

It is a major artery that supplies the foregut of the gastrointestinal tract. It arises from the abdominal aorta at the level of the twelfth thoracic vertebrae. It gives off three major branches called left gastric, common hepatic and splenic arteries.

Hepatic Artery

The common hepatic artery is a short blood vessel that supplies oxygenated blood to the liver, pylorus of the stomach, duodenum, pancreas, and gallbladder.

Renal Arteries

They usually arise off the left interior side of the abdominal aorta, immediately below the superior mesenteric artery and supply the kidneys with blood. Each is directed across the crus of the diaphragm so as to form nearly a right angle.

Iliac Artery

Primarily, the common iliac arteries supply blood to the bones, organs, muscles and other structures in the abdomen and pelvis. These arteries play an important role in lower limb circulation.

Pulmonary Arteries

They are responsible for carrying the oxygenated blood to the heart from the lungs and carrying the deoxygenated blood from the heart to the lungs.

Venus system

The venous system refers to the network of veins that work to deliver deoxygenated blood back to your heart.

It has two type

Superior Vena Cava

The superior vena cava is formed by the left and right brachiocephalic or innominate veins, which receive blood from the upper limbs, eyes and neck, behind the lower border of the first right costal cartilage.

Function

Superior vena cava coursing towards the right atrium of the heart, returning deoxygenated blood from the body. The SVC is one of the 2 large veins by which blood is returned from the body to the right side of the heart.

The inferior vena cava

The inferior vena cava is formed by the coming together of the two major veins from the legs, the common iliac veins, at the level of the fifth lumbar vertebra, just below the small of the back.

Function

It is a large vein that carries the deoxygenated blood from the lower and middle body into the right atrium of the heart.

Femoral vein

It is a direct continuation of the popliteal vein just proximal to the knee. The vein ascends to the inguinal region, where it passes posterior to the inguinal ligament as the external iliac vein to enter the abdomen. The main function of the femoral vein is to drain the lower limb.

The Portal Vein

It is a blood vessel that carries blood from the gastrointestinal tract, gallbladder, pancreas and spleen to the liver. This blood contains nutrients and toxins extracted from digested contents.

Hepatic Veins

They are the veins that drain de-oxygenated blood from the liver into the inferior vena cava. There are usually three upper hepatic veins draining from the left, middle, and right parts of the liver. These are larger than the group of lower hepatic veins that can number from six to twenty.

Pulmonary Veins

They are the veins that transfer oxygenated blood from the lungs to the heart. The largest pulmonary veins are the four main pulmonary veins, two from each lung that drain into the left atrium of the heart. The pulmonary veins are part of the pulmonary circulation.

Discovery of Blood Circulation

Ibn-Al-Nafess

he was born in 1213, Damascus. He posited that the "pores" of the heart are closed, that there is no passage between the two chambers, and the substance of the heart is thick. Instead, Ibn al-Nafis hypothesized that blood rose into the lungs via the arterial vein and then circulated into the left cavity of the heart.

Works written: Theologus Autodidactus, Kitab a...

Profession: Physician, Polymath, Physiologist.

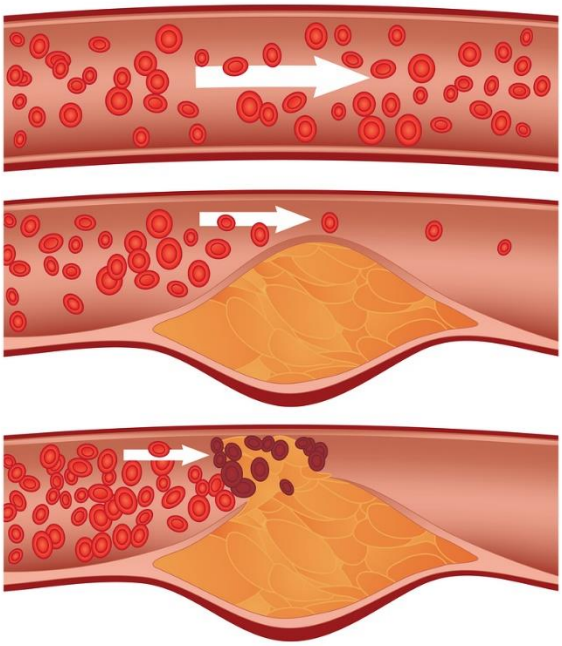
William Harvey

William Harvey was born on 1 April 1578. ... Harvey also proved that blood flows in two separate loops, the pulmonary circulation and the systemic circulation. He then tied a ligature on the upper arm of a person, which distended the veins in the forearm and made the valves of the forearm clearly visible.

Cardiovascular Disorder

The term "heart disease" is often used interchangeably with the term "cardiovascular disease." Cardiovascular disease generally refers to conditions that involve narrowed or blocked blood vessels that can lead to a heart attack, chest pain (angina) or stroke.

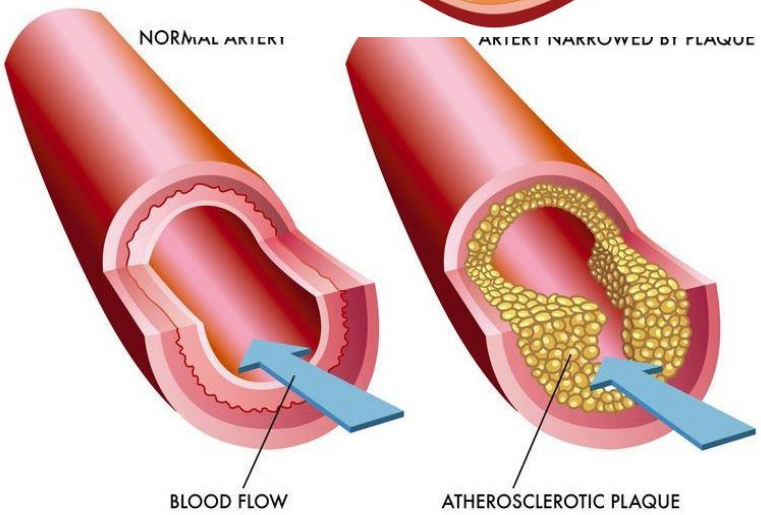
Atherosclerosis



It refers to the buildup of fats, cholesterol and other substances in and on your artery walls (plaque), which can restrict blood flow.

Causing Agents

- High blood pressure.
- High cholesterol.
- Diabetes.
- Obesity.
- Smoking and other tobacco use.
- A family history of early heart disease.
- Lack of exercise.
- An unhealthy diet



Symptom

- Chest pain or angina.
- Pain in your leg, arm, and anywhere else that has a blocked artery.
- Shortness of breath.
- Fatigue.
- Confusion, which occurs if the blockage affects circulation to your brain.
- Muscle weakness in your legs from lack of circulation

Diagnose

Doctors have an arsenal of diagnostic tests and tools they can access to confirm the presence of Atherosclerosis - these include an angiogram (Arteriogram), cholesterol tests, a chest x-ray, a CT (computed tomography) scan, Duplex scanning, an echocardiogram, an electrocardiogram (ECG or EKG), an exercise stress test.

Treatment

- Cholesterol-lowering medications, including statins and fibrates.
- Angiotensin-converting enzyme (ACE) inhibitors, which may help prevent narrowing of your arteries.
- Beta-blockers or calcium channel blockers to lower your blood pressure

Arteriosclerosis

It is the thickening, hardening, and loss of elasticity of the walls of arteries.

Causes

Smoking, High blood pressure

Diagnostic method

Blood test, EKG

Symptoms

Sudden weakness

Treatment

Treatment of underlying condition.

Myocardial Infarction (MI)

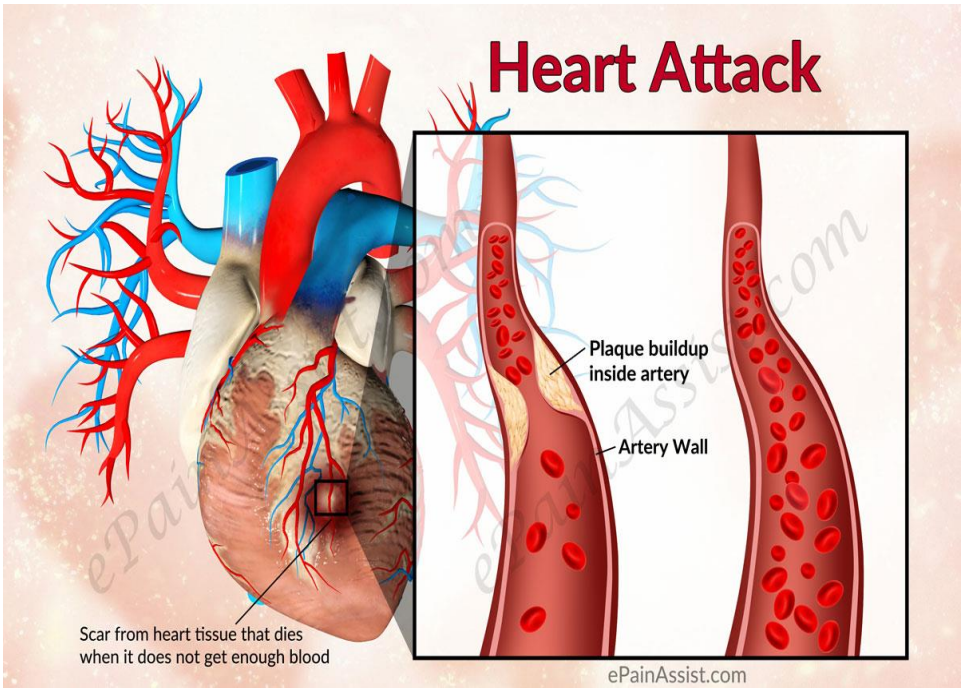
It also known as a heart attack, occurs when blood flow decreases or stops to a part of the heart.

Causes

The causes of myocardial infarction, or a heart attack, all involve some kind of blockage of one or more of the coronary arteries. The coronary arteries provide the heart with oxygenated blood, and if they become blocked, the heart will become oxygen starved, killing heart tissue and causing a heart attack.

Symptoms

- Pressure, tightness, pain, or a squeezing or aching sensation in your chest or arms that may spread to your neck, jaw or back.
- Nausea, indigestion, heartburn or abdominal pain.
- Shortness of breath.
- Cold sweat.
- Fatigue.
- Lightheadedness or sudden dizziness



Diagnoses

An electrocardiogram (EKG) may be done to measure your heart's electrical activity. Blood tests can also be used to check for proteins that are associated with heart damage, such as troponin. Other diagnostic tests include: a stress test to see how your heart responds to certain situations, such as exercise.

Treatments

Antiplatelet drugs, such as clopidogrel, can be used to prevent new clots from forming and existing clots from growing. Nitroglycerin can be used to widen your blood vessels. Beta-blockers lower your blood pressure and relax your heart muscle. This can help limit the severity of damage to your heart.