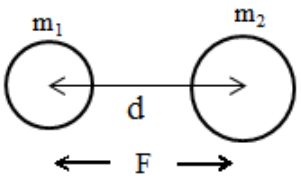
Force

Gravitation: It is defined as the force of attraction between any two bodies in the universe. It is measured in the unit Newton (N).
Gravity: It is defined as the force of attraction between a massive body and any other body in the universe. Gravity is a special case of gravitation. It is measured in the unit Newton (N).
Geocentric theory: It states that, "the earth is in the centre and all the planets and the sun revolve round the earth".
Heliocentric theory: It states that, "the sun is in the center and all the planets including the earth revolve round the sun".
Newton's Universal law of gravitation: It states that, "the gravitational force between any two bodies of the universe is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers." This law is also called universal law because this law is applicable to each and every body of the universe.

Verification of gravitational force, F = $\frac{Gm_1m_2}{d^2}$



Let us consider two bodies having masses 'm_1' and 'm_2' are separated by the distance'd'. Let F be the force of attraction between them. Then,
According to newton's law of gravitation,
Gravitational force is directly proportional to the product of their masses, ie
$F \propto m_1 \times m_2$ ……(i)
Gravitational force is inversely proportional to the square of the distance between their centers, ie

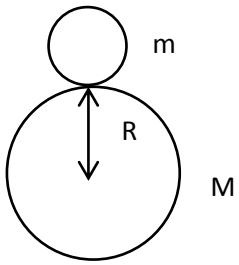
$F \propto \frac{1}{d^2}$……(.ii)

Combining (i) and (ii), we get

$F \propto \frac{Gm_1m_2}{d^2}$ (Where G is a proportionality constant and is known as the universal gravitational constant.)

Or $F = \frac{Gm_1m_2}{d^2}$

Verification of gravity, F = $\frac{Mm}{R^2}$ and F = $\frac{Mm}{(R+h)^2}$



Let us consider a small body having mass 'm' lying nearby the surface of a massive body having mass 'M'. let 'R' be the radius of the massive body. If F be the force of gravity between them. Then,
Gravitational force is directly proportional to the product of their masses, ie

$F \propto M \times m$ ……(i)

Gravitational force is inversely proportional to the square of the distance between their centers.

$F \propto \frac{1}{R^2}$ ……(ii)

By combining (i) and (ii), we get,

$F \propto \frac{GMm}{R^2}$ (Where G is a proportionality constant and is known as the universal gravitational constant.)

$F = \frac{GMm}{R^2}$

if the small body is at maximum height, then,

$F = \frac{Mm}{(R+h)^2}$

Weight of a body varies from place to place on the surface of the earth, why?

Weight of a body is the measure of gravitational force acting on a body and is given by the relation, $F = \frac{GMm}{R^2}$. In this relation if radius of the earth 'R' is more then the weight of a body is less and if radius of the earth 'R' is less then weight of the body is more, since weight of a body is inversely proportional to the square of the radius. The earth is not perfectly round and its equatorial radius is greater and polar radius is smaller. So the weight of a body varies from place to place.

Variation of gravitation force with mass and distance:

1. Change of gravitational force when mass of a body is tripled by keeping the distance between them unchanged;
   Let us consider two bodies having masses 'm_1' and 'm_2'separated by the distance'd', then
   Gravitational force (F_1) = $\frac{Gm_1m_2}{d^2}$ ……..(i)
   If mass of one of the body is tripled keeping the distance unchanged. Then,
   Gravitational force (F_2) = $\frac{G3m_1m_2}{d^2}$
   or $F_2 = 3(\frac{Gm_1m_2}{d^2})$ ……..(ii)

or $F_2 = 3xF_1$ (From (i) and (ii))

∴ The gravitational force increases by 3 times if mass of one of the body is tripled keeping their distance unchanged.

2. Change in gravitational force when the distance between two bodies is doubled by keeping their masses unchanged;

   Let us consider two bodies having masses 'm_1' and 'm_2'separated by the distance'd', then

   Gravitational force (F_1) = $\frac{Gm_1m_2}{d^2}$ ……(i)

   If distance between two bodies is doubled keeping their masses unchanged. Then,

   Gravitational force (F_2) = $\frac{Gm_1m_2}{(2d)^2}$

   or $F_2 = \frac{Gm_1m_2}{4d^2}$ ……..(ii)

   or $F_2 = F_1/4$ (From i and ii)

   ∴ The gravitational force decreases by 4 times if the distance between two bodies is doubled by keeping their masses unchanged.

Factors affecting the gravitational force:

1. The product of masses of the two bodies. ie $F \propto m_1xm_2$
2. The square of the distance between the centers of the two bodies. ie $F \propto \frac{1}{d^2}$

Universal gravitational constant: The force of attraction between two bodies of unit masses separated by unit distance is called universal gravitational constant. Its value is equal to $6.67x10^{-11}Nm^2/kg^2$. Its value was calculated by **Henry Cavendish** by using scientific balance called the torsion balance.

Consequences of gravitational force:

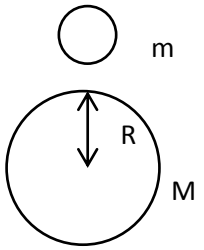
i. Tides in the sea and oceans are due to the gravitational force of the sun and moon.
ii. The planets revolve around the sun due to the presence of gravitational force.
iii. Rainfall and snowfall is only due to gravitational force of the earth.
iv. Natural satellites revolve around the earth due to balance of centripetal and centrifugal force produced by gravitational force.
v. Artificial satellite revolves round the earth due to the balance between the force of gravitation and the outward force due to the velocity of the satellite. Centripetal force is produced by gravitation and the centrifugal force is produced by the velocity of the satellite provided by the solar battery.

Effects of gravity:

1. Acceleration is produced on freely falling body.
2. Everybody has some weight.
3. The earth is surrounded by the atmosphere.
4. We can stand and walk on the surface of the earth.
5. River flows from high level to low level.

Acceleration due to gravity: The acceleration produced on a freely falling body due to the force of gravity of the earth is called acceleration due to gravity. It is denoted by 'g' and its SI unit is m/s^2.

Verification of acceleration due to gravity, $g = \frac{GM}{R^2}$ and $g = \frac{GM}{(R+h)^2}$



Let us consider a small body having mass 'm' is falling from certain height nearer to the surface of a massive body having mass 'M' with acceleration g.

According to Newton's law of gravitation, we have,

$F = \frac{GMm}{R^2}$ ……..(i)

Again we have,

$F = mg$ ……..(ii)

From equation (i) and (ii), we have;

$mg = \frac{GMm}{R^2}$

or $g = \frac{GM}{R^2}$

if the body is falling from maximum height, then,

$g = \frac{GM}{(R+h)^2}$

In the relation $g = \frac{GM}{R^2}$ mass of the falling body 'm' does not affect the value of 'g'. So acceleration due to gravity is independent of the mass of the falling body.

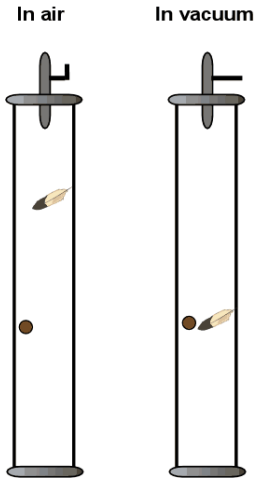
In the relation $g = \frac{GM}{R^2}$, G and M are constant. Therefore,$g \propto \frac{1}{R^2}$

Factors that affect the acceleration due to gravity:

1. Mass of the planet or satellite (M).
2. Radius of the planet or satellite (R).

The value of 'g' remains constant at a certain place but its value changes prom place to place on the surface of the earth. This is due to the fact that the acceleration due to gravity is inversely proportional to the square of radius of the. But the earth is not a perfect sphere and the value of its radius 'R' is not same at all the places on its surface. Its equatorial radius is greater than that of the polar radius. So the value of 'g' varies with altitude. Since the radius of the earth at the poles is minimum, the value of 'g' is maximum ($9.83 m/s^2$) at poles. The radius of the earth is maximum at the equator, the value of 'g' is minimum ($9.78 m/s^2$) at the equator. Therefore the average value of 'g' on the earth's surface is taken as $9.8 m/s^2$.

Coin and feather experiment:



Galileo Galilee dropped a small and a large object simultaneously from the top of the leaning tower of Pisa and both the objects reached the ground at the same time and said that acceleration due to gravity on all the bodies falling towards the earth surface is same. To verify this fact Robert Boyle performed an experiment in a vacuum. In this experiment, a coin and a feather are kept inside a tall glass tube and its ends are closed. The tube is inverted as soon as possible. The coin reaches the bottom earlier as compared to the feather as the tube contains air. Then the tube is made free from air by using vacuum pump. When the tube is quickly inverted, the coin and the feather reach the bottom simultaneously.

When the tube contains air, the feather falls slower than the coin. Because the resistance offered by air on the feather is more as the surface area of the feather is larger than that of the coin. When the tube is vacuum, the coin and the feather falls together, because acceleration due to gravity is independent to the mass of the falling body in absence of air resistance.

Acceleration due to gravity on the surface of the moon: The mass (7.2×10^{22} kg) and radius (1.7×10^{6}m) of the moon are less than that of the earth. So the acceleration due to gravity 'g' of the moon is less than that of the earth. It is about $1/6^{th}$ of the earth, ie $1.67 m/s^2$.

Difference between acceleration due to gravity and gravity:

Acceleration due to gravity	Gravity
• The acceleration produced in a freely falling body due to the force of gravity of the earth is called acceleration due to gravity.	• It is defined as the force of attraction between a massive body and any other body in the universe.
• Its SI unit of measurement is m/s^2.	• Its SI unit of measurement is Newton.
• It is the effect of gravity.	• It is the cause of acceleration due to gravity.

Mass: It is defined as the total quantity of matter contained in a body. It is measured by beam balance. It is measured in the unit kg. Its value remain constant anywhere. Mass of an object depends upon the number of atoms (particles) present in the body.

Weight: It is defined as the measure of gravitational force acting on a body. It is measured by spring balance. It is measured in the unit N. Its value varies from place to place because the gravitational force varies from place to place.

Difference between mass and weight:

Mass	Weight
• It is defined as the total quantity of matter contained in a body.	• It is defined as the measure of gravitational force acting on a body.
• It is measured by beam balance.	• It is measured by spring balance.
• It is measured in the unit kg.	• It is measured in the unit Newton.

Difference between acceleration due to gravity 'g' and gravitational constant 'G".

Acceleration due to gravity 'g'	Gravitational constant 'G'
• The acceleration produced in a freely falling body due to the force of gravity of the earth is called acceleration due to gravity.	• The force of attraction between two bodies of unit masses separated by unit distance is called universal gravitational constant.
• It is variable quantity.	• It is constant quantity.
• Its SI unit of measurement is m/s^2.	• Its SI unit of measurement is Nm^2/kg^2.

Free fall: It is defined as the state at which a body falls freely without any external force. Acceleration produced on a freely falling body is equal to the acceleration due to gravity of that place. There is no perfect free fall of an object on the surface of the earth due to air resistance. Everybody falls on the surface of the moon as a free fall, because there is no atmosphere on the surface of the moon and there is no air resistance.

Weightlessness: It is defined as the state at which the weight of a body becomes zero. A body fells weightlessness during free fall. If the weight of a body is measured in a weighing machine during free fall, it measures zero weight.

Conditions for weightlessness:

1. When a body is falling freely, it becomes weightlessness.
2. When a body is in space, it becomes weightlessness.
3. When a body is in the rocket or artificial satellite, it becomes weightlessness.
4. When a body is at the centre of the earth, it becomes weightlessness. (Hypothetical)

Difference between free fall and weightlessness:

Free fall	Weightlessness
• It is the state at which a body falls freely without any external force.	• It is the state at which weight of a body becomes zero.
• It is the cause of weightlessness.	• It is the effect of free fall.

Difference between weightlessness in free fall and weightlessness in space.

Weightlessness in free fall	Weightlessness in space
• It occurs due to free fall of a body under the influence of the force of gravity.	• It occurs due to zero gravity in the space.
• It is apparent weightlessness.	• It is real weightlessness.

Falling of parachute on the surface of the moon:
Moon does not have atmosphere on its surface, so a body falling on the surface of the moon does not experience any external force and falls as a free fall.

Falling of parachute on the surface of the earth: When a parachute falls on the surface of the earth from certain height, initially its velocity increases and increases but when it reaches to a certain height it falls with constant velocity. So it acceleration becomes equal to zero and the parachutist lands on the earth surface safely.

End

Pressure

Pressure: The force acting perpendicularly per unit area is called pressure.

Pressure (P) = $\frac{\text{Force(F)}}{\text{Area(A)}}$

The SI unit of pressure is N/m^2 or Pascal (Pa).

One Pascal Pressure: The pressure exerted in unit area when 1N of force is applied is called one Pascal pressure.

Properties of liquid pressure:

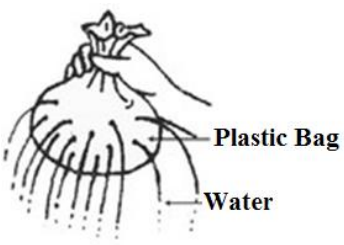
1. Liquid pressure increases with increasing depth.
2. Liquid pressure does not depend upon the volume of it.
3. Liquid pressure is independent of the shape of the vessel in which it is kept.
4. Pressure applied on a liquid is transmitted equally in all direction.

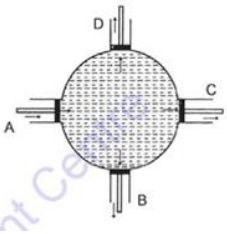
Pascal's Law: Pascal's law states that, "the pressure is equally transmitted perpendicularly to all sides pressure is applied at a place on al liquid contained in a closed container."

Application of Pascal's Law: Pascal's Law is applicable for the construction of hydraulic press, hydraulic brake, hydraulic lift etc.

Verification of Pascal's Law:

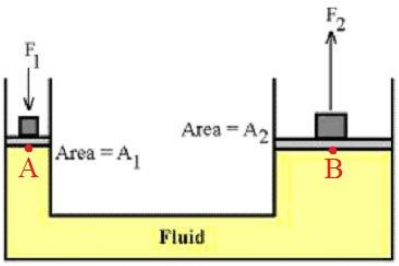
1. Let us take a plastic bag. Let it be filled with water. Let us make a number of holes on the bag with a needle. Let the bag be squeezed from outside. Then it is seen water comes out through all the holes with same pressure.
2. Let us take a spherical glass vessel with four water tight frictionless pistons having same cross sectional area, filled with water. If one of the pistons is pushed inward, then other pistons will come outward with same pressure.





Principal of hydraulic Press: It states that,"a small force applied on a smaller piston is transmitted to produce a large force on the large piston."

Hydraulic press is a U shaped vessel having two pipes one with small cross sectional area and another with large cross sectional area connected with a another horizontal cylinder. Let A_1 and A_2 are the cross sectional area of the small and large cylinder respectively. Let F_1 and F_2 are the forces applied on the pistons respectively. Then,



Pressure on small cylinder (P_1) = $\frac{F_1}{A_1}$

Pressure on large cylinder (P_2) = $\frac{F_2}{A_2}$

According to Pascal's law,

$P_1 = P_2$

$\frac{F_1}{A_1} = \frac{F_2}{A_2}$

$F_2 = \frac{A_2}{A_1} \times F_1$

Since $A_2 > A_1$ then

$F_2 > F_1$

Thus, small force can be used to exert a much larger force.

∴ A hydraulic machine is a force multiplier.

Reasons for using liquid in hydraulic press:

1. Liquid transmits pressure equally and perpendicularly in all directions.
2. Any liquid cannot be compressed. i.e. liquid is incompressible.

Uses of hydraulic press:

1. For pressing cotton bales and goods like quilts, books papers, metal sheets, etc.
2. For extracting juice from sugarcane and other fruits.
3. For squeezing oil out of seeds.

Upthrust: It is defined as the resultant force exerted by a liquid in upward direction. It is measured in the unit Newton (N).

Upthrust (U) = $W_1 - W_2$

Where, W_1 = weight of a body in air

W_2 = weight of the body in liquid.

It can also be calculated by the relation,

U = Vdg

Factors affecting upthrust:

1. The density of the liquid in which the body is immersed.
2. Volume of the body immersed in a liquid.
3. The value of acceleration due to gravity.

Density: The mass per unit volume of a substance is called its density. Its SI unit of measurement is kg/m^3 and CGS unit is gm/cm^3.

$\therefore$ Density (d) = $\frac{\text{mass(m)}}{\text{volume(V)}}$

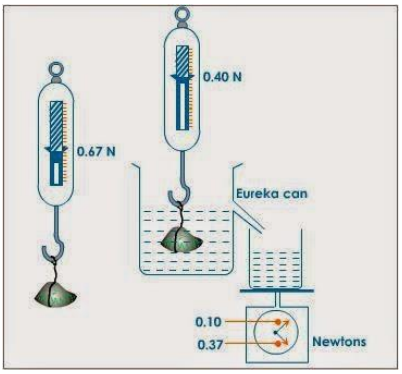
Relative density: Relative density of a substance is defined as the ratio of the mass of a certain volume of the substance to the mass of the equal volume of water at 4℃.

Or relative density of a substance is defined as the ratio of density of a substance to the density of water at 4℃.

$\therefore$ Relative Density (d_r) = $\frac{\text{density of substance}}{\text{density of water at 4℃.}}$

It has no unit of measurement.

Archimedes' principle: It states that," when a body is wholly or partially immersed in a liquid, it experiences an upthrust which is equal to the weight of the liquid displaced by it."



Experimental verification of Archimedes' principle:

Let us take an overflow can completely filled with water. Let us take the weight of an object in air. Let it be measured in water. Let us collect the water overflown out of the overflow can when the object is immersed in it.

Weight of the body in air = W_1

Weight of the body in water = W_2

Weight of the empty beaker = W_3

Weight of the beaker and displaced water = W_4

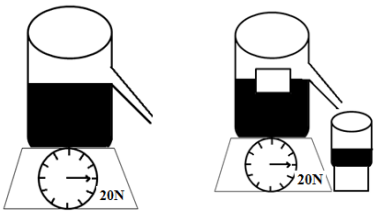
$\therefore$ Upthrust = $W_1 - W_2$ and

Weight of water displaced = $W_3 - W_4$

In this experiment it is seen that;

$W_1 - W_2 = W_3 - W_4$

Law of floatation: It states that, "for a floating body weight of the body is equal to the weight of the liquid displaced,"



Experimental verification of law of floatation:

1. Let us take a small piece of wooden block that floats on water.
2. Let us take an overflow can completely filled with water over a top pan balance.
3. Let the weight of the overflow can with water be, W_1.
4. Let the wooden block be immersed in the water and take the weight of overflow can with water and wooden block. Let it be W_2.
5. From this experiment it is seen that $W_1 = W_2$.

It proves that, "for a floating body weight of the body is equal to the weight of the liquid displaced,"

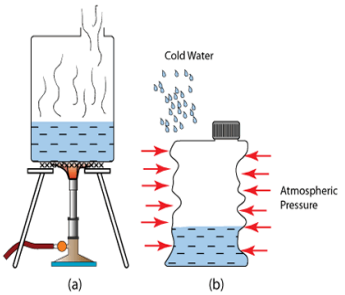
Differences between Archimedes' principle and law of floatation:

Archimedes' principle	Law of floatation
• It states that," when a body is wholly or partially immersed in a liquid, it experiences an upthrust which is equal to the weight of the liquid displaced by it."	• It states that, "for a floating body weight of the body is equal to the weight of the liquid displaced,"
• It is applicable for all the floating or sinking body.	• It is applicable only for floating body.

Atmospheric pressure: The pressure exerted by atmosphere due to its weight is called atmospheric pressure.

The atmospheric pressure varies in different parts of the earth. At the sea level, the atmospheric pressure is about $1x10^5$Pa or 760 mmHg and is maximum which is known as standard atmospheric pressure. That is atmospheric pressure is maximum at the sea level and minimum at the top of Mt. Everest. Barometer is used to measure the atmospheric pressure.

Experiment to show that atmospheric pressure exists: Let us take a tin can. Let its lid be opened and then be heated. The air inside the tin can escape out since it expands on heating. Then its lid is air tight and cold water is poured over it. It gets crushed from outside due to existence of atmospheric pressure.

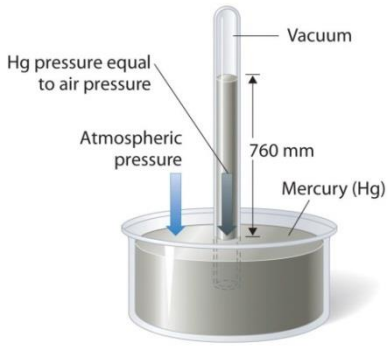


Devices based on the atmospheric pressure;

The working of fountain pen, syringe, water pump, air pump, etc. is based on the atmospheric pressure.

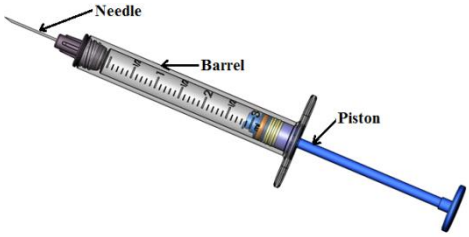
Mercury barometer: The instrument which is used to measure atmospheric pressure is called barometer.

Construction of mercury barometer:



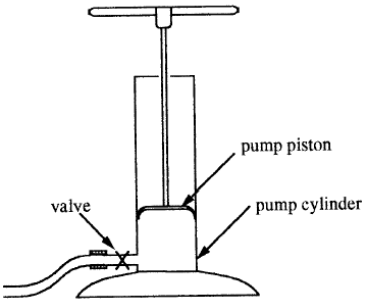
To construct a mercury barometer, a glass tube of about 1m length is taken and it is completely filled with mercury. The open end of the tube is pushed with a thumb and the tube is inverted on a trough filled with mercury. Then the tube is supported with a stand. The mercury level in the tube falls by a few centimeters creating an empty space above the mercury level which is known as Torricellian vacuum. The tube is then graduated to take the reading of atmospheric pressure. It is found that the level of mercury in the tube is 76cm above the level of mercury in the trough at sea level.

Syringe: It is a medical instrument which is used to extract blood from the body of patient and to inject medicines in to the body of the patient.



Working mechanism of syringe: A syringe consists of three parts. They are storage cylinder, piston and needle. In order to fill medicine into the syringe, the needle is inserted in the container of medicine. When piston is pulled out, it creats a partial vacuum inside the storage cylinder. As a result, medicine moves into the storage cylinder in order to fill the vacuum. When the piston if the syringe is pushed in, medicine goes inside the body of patient due to high pressure created into the storage cylinder.

Air pump: It is an instrument which is used to fill air into the tyre of vehicles. Pressure gauze is an instrument which is used to measure the air pressure inside the tyre of vehicles.



Working mechanism of air pump: A manual air pump consists of three parts. They are cylinder, piston and nozzle. When the piston of the air pump is pulled, it creates a partial vacuum in the cylinder and air is filled in the cylinder. When the piston is pushed down, air enters inside the tube of bicycle tyre through the nozzle by opening the valve of the tube. When the piston is pulled, the valve of the tube closes itself and the air inside the tube does not come out. When the process of pulling and pushing of piston is repeated several times, the tube of vehicles is inflated.

Water pump: Water pump is an instrument which is used to lift underground water it is based on the principle of atmospheric pressure. It consists of two parts. They are barrel and piston. It also has two pistons called piston valve and foot valve.

When the handle of the water pump is pushed down, the piston moves upward, this movement is called upstroke.

When the handle of the water pump is pulled upward, the piston moves downward, this movement is called down stroke.

During upstroke a partial vacuum is created between the foot valve and piston valve. In this condition air pressure decreases in the barrel, foot valve opens and piston valve closes and water rises up in the barrel through the foot valve due to atmospheric pressure.

During down stroke the distances between the foot valve and piston valve decreases which increases pressure in the foot valve in the barrel and the foot valve closes. In this condition water in the lower part of the barrel rises to the upper part by opening the piston valve.

If this process is repeated many times water in the upper part of the barrel comes out of the water pump through the outlet.

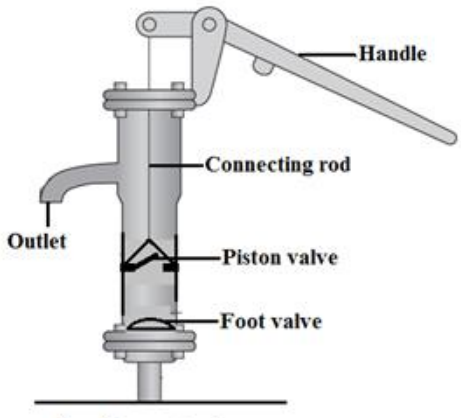


fig. Downstroke

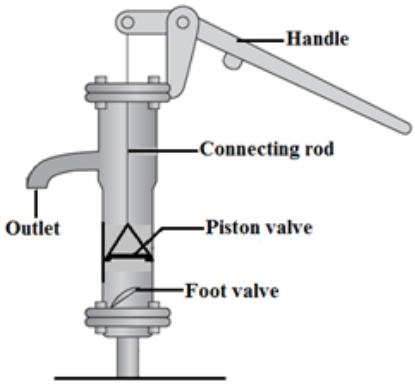


fig. Upstroke

End

Energy

Energy: Energy is defined as the capacity to do work.

Types of energy sources on the basis of form they are used.

Primary sources of energy: The sources of energy that can be used in the same form, as they are available in nature are called primary source of energy. For examples; wood, coal, crude oil, natural gas, dung, solar energy etc.

Secondary sources of energy: Those sources of energy which are derived from primary source of energy are called secondary source of energy. For examples; coal gas, bio gas, kerosene, petrol, diesel, etc.

Types of energy sources on the basis of replacing period:

i. Non-renewable source of energy ii. Renewable source of energy.

Non-renewable source of energy: The energy sources of which get depleted and cannot be replaced quickly when exhausted are called non-renewable source of energy. For example; coal, petrol, diesel, natural gas, etc.

Renewable source of energy: The energy sources that are being produced continuously in nature and are inexhaustible are called renewable sources of energy. For example; solar energy, wind energy, biomass energy, tidal energy, etc.

Differences between renewable and non-renewable sources of energy:

Renewable sources of energy	Non-renewable sources of energy
The energy sources that are being produced continuously in nature and are inexhaustible are called renewable sources of energy.	The energy sources of which get depleted and cannot be replaced quickly when exhausted are called non-renewable source of energy.
These sources of energy are formed in a short period of time.	These sources of energy cannot be formed in short period of time and take millions of years.
They never get exhausted from nature.	They get exhausted from nature after their use.

Solar energy: the heat and light energy given by the sun is called solar energy.

Sun is called the ultimate source of energy. Why?

All the sources of energy existing in the earth are directly or indirectly the outcomes of solar energy. So the sun is called an ultimate source of energy. To verify this statement we can put forward some points as below;

1. Wind energy is the outcome of solar energy. The heat of the sun helps to change the pressure of air at different places. This change in pressure causes the air to blow. In this way, solar energy helps to form wind energy.
2. Fossil fuel is the outcome of solar energy.The solar energy stored by the plants during photosynthesis, changes into fossil and finally into fossil fuels. In this way fossil fuel is the outcome of solar energy.
3. Hydroelectric is the outcome of solar energy. Solar energy evaporates water from oceans and surface of the earth. The water vapour thus formed rises up in the atmosphere to form clouds. When it gets cooled, it falls back to the earth in the form of rain. The water is used to generate hydroelectricity. Thus hydroelectric is the outcome of solar energy.

Some information about the sun and solar energy:

1. Its approximate mass is 1.99×10^{30} kg.
2. Its average diameter is 1.3924×10^{6} km.
3. The distance between the sun and the earth is 1.5×10^{8} km.
4. Its surface temperature is 5700^{0}c.
5. Its core temperature is 1.5×10^{70}c.
6. All types of energy produced by the sun are due to nuclear fusion reaction.
7. The amount of hydrogen present in the sun is about 70% and helium is about 25%.
8. The sun radiates about 2.7×10^{23} kW if energy per second.
9. The earth receives 1.4kWof energy per second, per square meter in average.

How is enormous energy produced by the sun?

The sun provides all other forms of energy due to a reaction called thermonuclear fusion reaction. In the sun, two protons combine to form a deuteron and positron. Then the deuteron thus combines with one more protons and produces a light helium atom and gamma radiation. Finally, two light helium atoms combine to form a stable form of helium along with two protons and energy. During this process a vast amount of energy is produced.

$4\,{}_1H^1 \rightarrow\ 2He^4 + 2\,{}_1e^0 + \gamma$ radiation + energy

Conditions required for nuclear fusion reaction in the sun:

1. Presence of sufficient amount of hydrogen in the sun.
2. Presence of sufficient amount of helium in the sun.
3. Presence of high temperature.
4. Presence of high pressure.

Fossil fuel energy: The fuel obtained from the fossils of organisms is called fossil fuel, and the energy obtained from the fossil fuel is called fossil fuel energy. Coal and mineral oil are formed from fossils of plants and animals in nature. So they are called fossil fuels.

Coal: Coal is the solid and carbon-enriched form of fossil fuel which is obtained in the form of hard black mineral in nature. It is one of the important sources of fuels for iron industries, brick industries, steel industries, cement industries, etc.

There are different types of coal with varying carbon content as given below;

1. Anthracites 2. Bituminous 3. Sub-bituminous 4. Lignite 5. Peat

Among them, anthracite is considered as the coal of high quality. It consists of 90% of carbon.

Mineral oil: It is the liquid form of fossil fuel. The liquid form of fossil fuel, such as petrol, diesel, kerosene, mobile, etc. is called mineral oil.

Mineral oil is obtained from the mines in the earth's crust by drilling. It is obtained in the form of crude oil. The unprocessed mineral oil is called crude oil. Then the crude oil is purified by fractional distillation to get natural gas, petrol, diesel, kerosene, mobile, paraffin, etc. The residue left after fractional distillation is further separated for making tar, raw materials for making plastics, etc.

Advantages of fossil fuels:

1. It is cheaper as compared to other sources.
2. It is multipurpose fuel as it can be used for various purpose.
3. It can be easily transported.
4. It can be used in those industries that require maximum heat energy.

Disadvantages of fossil fuels:

1. It produces harmful gases and smoke which causes environmental pollution.
2. It is non-renewable sources of energy.

Hydropower: hydropower is the form of energy which is produced by rotating turbines with the help of flowing water. Traditionally it has been used to run watermills (Ghatta). Nowadays it is used to generate electricity.

Hydroelectricity: The electricity generated by rotating turbines using water is called hydroelectricity. To generate hydroelectricity, water is collected by constructing dam. Such collected water is allowed to fall on the blades of a water turbine. The kinetic energy of the flowing water rotates the turbine rapidly, which rotates the armature of generator that produces electricity. Our country Nepal is the second richest country in hydroelectric power potential. According to researches, it has been estimated that the hydroelectric power generation capacity of Nepal is about 83000MW.

Advantages of hydroelectricity:

1. It is pollution free source of energy.
2. It is renewable source of energy.
3. It is cheap source of energy in a long term basis.
4. It is easy to transmit.
5. It is easy to use.
6. It can be used to operate various electric and electronic devices.
7. It can be converted into various forms of energy.

Alternative sources of energy: The renewable sources of energy which can be used in place of non-renewable source of energy to preserve them are called alternative sources of energy. Some of them are as below;

A. **Biofuel:** The fuel obtained from the plants of animals waste is called biofuel. It is of two types; biomass and biogas.

   Biomass: Biomass is any organic material that can be converted into energy. It includes wood, dung, weeds, agricultural waste and bagasse. Nepal being an agricultural country, the raw materials for biomass energy are easily available in different parts of the country. Therefore, biofuel is one of the major alternative sources of energy.

   Biogas: The gas which is obtained by the decomposition of organic materials is called biogas. It contains methane, carbon dioxide, hydrogen and hydrogen sulphide.

   Advantages of biofuel:

   1. It is cheaper and can be produced easily.
   2. It burns completely without smoke, and hence it does not cause air pollution.
   3. It produces more heat while burning.
   4. It can be used to generate electricity.
   5. It can used to run engines.

B. **Nuclear energy:**The energy obtained from nuclear fusion and nuclear fission reaction is called nuclear energy. It is obtained from the energy stored in the nucleus atoms.

   Nuclear fusion reaction: The nuclear reaction in which lighter nuclei combine to form a heavy nucleus by releasing a large amount of energy is called nuclear fusion reaction. This reaction produces a tremendous amount of energy in the form of heat and light in the sun.Light nuclei of hydrogen atoms combine to form a heavy nucleus of helium in the sun.

   $4_1H^1 \rightarrow 2He^4 + 2\ {}_1e^0 + \gamma$ radiation + energy

   Nuclear bomb is made on the basis of nuclear fusion reaction. Nuclear fusion reaction has not been controlled so far on the earth.

Nuclear fission reaction: The nuclear reaction in which a heavy nucleus breaks down into two lighter nuclei by releasing a large amount of energy is called nuclear fission reaction. Heavy nuclei of radioactive elements like uranium, plutonium, etc. split into two lighter nuclei when they are hit with free neutrons.

$_{92}U^{235} +_{0}n^{1} \rightarrow_{56}Ba^{141} + _{36}Kr^{92} + 3_{0}n^{1} + Q$

During this process some mass gets lost which changes into large amount of energy. The amount of energy produced during nuclear fission reaction can be calculated by the Eienstein's mass energy relation which is as given below.

$E = mc^2$

Where, E = Energy generated

m = Loss in mass

c = Speed of light

Nuclear fission reaction is carried out in nuclear power plants to produce heat. The heat used to produce steam for operating steam engines. Steam engines are used to rotate turbines for generating electricity.

Difference between nuclear fusion and nuclear fission reaction:

Nuclear fusion reaction	Nuclear fission reaction
The nuclear reaction in which lighter nuclei combine to form a heavy nucleus by releasing a large amount of energy is called nuclear fusion reaction.	The nuclear reaction in which a heavy nucleus breaks down into two lighter nuclei by releasing a large amount of energy is called nuclear fission reaction.
It cannot be controlled.	It can be controlled.
In this reaction comparatively more energy is produced.	In this reaction, comparatively less energy is produced.
A nuclear bomb (hydrogen bomb) is made on the basis of this reaction.	An atom bomb is made on the basis of this reaction.

Tidal energy: The energy that can be obtained from the tides of seas and oceans is called tidal energy. Water of tides is collected in dams is collected in large dams. The water collected in dams is sent through pipes to rotate turbines for generating electricity.

Wind energy: The energy obtained from strongly moving wind is called wind energy. Traditionally, wind energy has been used to separate husk from grains, to drive windmills, to propel sailboats etc. Nowadays it is used for generating electricity. There are so many high wind blowing regions in Nepal, especially in Mahabharata region. So it is one of the best alternative sources of energy for our country.

Geo-thermal energy: The energy that can be obtained from the heat present inside the earth is called geothermal energy. In the places where earthquake and volcano are active, the temperature increases by 80℃ while going about 1km deep in the earth's crust. In other places, the temperature increases by 30℃. Water is sent to the hot rock through pipes by drilling. The hot water is brought to the surface through other pipes. The steam produced by hot water is used to rotate turbines for generating electricity.

Energy crisis: The shortage of sources of energy that we are going to face in nearby future is called energy crisis.The present stock of fossil fuels is limited. According to the survey conducted in1984, the present stock will last only for 25 years, in case energy demand will not increase. But energy demand is increasing every year by 2.3%. If the demand of energy grows by the same rate the stock will lasts only upto 2037. So we will surely face energy crisis in future.

Present status of use of different sources of energy: According to the present status of energy use different sources of energy is fulfilling the energy demand as below;

Mineral oil: 35 percent. Coal: 27 percent. Biomass: 13 percent. Hydropower: 5 percent.
Nuclear reaction: 3 percent.

The main causes of energy crisis:

1. High demand of energy sources as a result of population growth and industrialization.
2. Overuse of non-renewable sources of energy.
3. Lack of reliable alternative sources of energy.
4. Improper use of misuse of energy.
5. Consumption of more fuel by less efficient machines or devices.
6. Lack of concrete plans about the conservation of present sources of energy.

Methods for solving energy crisis:

1. Developing and using alternative sources of energy.
2. Developing and using devices which can be operated by renewable sources of energy.
3. Using existing sources of energy wisely and economically.
4. Conserving available sources of energy and avoiding unnecessary use of fossil fuels.

Heat

Heat: Heat is defined as the total sum of kinetic energy of all the molecules. It flows from a body at higher temperature to a body at lower temperature.

Quantity of heat present in an object depends on:

1. The number of atoms of the matter, i.e. its mass. 2. The average kinetic energy of the molecules.

Unit of heat energy: Heat is measured in joule in SI system. But in CGS system, heat is measured in calorie. The relation between SI and CGS unit is 1 calorie=4.2 joule.

One calorie heat: It is defined as the amount of heat energy required for 1 gram pure water to increase its temperature by $1\ ^0$c.

One joule heat energy: It is defined as the amount of heat energy required to raise the temperature 1 kg substance having specific heat capacity 1 j/kg^{0}c by 1^0c.

Effects of Heat

1. Heat changes the volume of a body.
2. Heat changes the physical state of a body.
3. Heat changes the temperature of a body.
4. Heat changes the solubility of a substance.
5. Heat brings chemical changes in the body.

Importance of heat:

1. It is used for cooking food, drying grains, wet clothes.
2. It is used for running vehicles, machines in industries and water cycle.
3. It causes blowing wind.
4. It is necessary to run different life processes normally in human body, animals and plants.

Temperature: It is defined as the average of kinetic energy possessed by each molecules of a body. It is measured in Kelvin (K) in SI unit. It is measure by using a thermometer. The normal temperature of the human body is 37^0c or 98.6^0F.

Relationship between temperature and kinetic energy of the molecules of a body: temperature of a body is directly proportional to the average kinetic of each molecule.

Difference between heat and temperature:

Heat	Temperature
• It is the sum of kinetic energy of all the molecules.	• It is the average kinetic energy of each molecule.
• It is the cause of temperature.	• It is the effect of heat.
• It is measured by calorimeter.	• It is measured by thermometer.
• Its SI unit is Joule.	• Its SI unit is Kelvin.

Thermometer: A device which is used for measuring the temperature of a body is called thermometer. Generally mercury or colored alcohol is used as thermometric liquid.

Principle of thermometer: It states that, "increase in the volume of a thermometric liquid is directly proportional to the raise in temperature."

Advantages of mercury as a thermometric liquid:

1. It has uniform rate of expansion and contraction.
2. It does not stick to the inner wall of the capillary tube.
3. It is silvery white in colour. So it can be seen easily in the capillary tube and easy to read.
4. Its freezing point is -39^0c and boiling point is 357^0c. So it remains in liquid state over a large range.

Disadvantages of mercury as a thermometric liquid:

1. Its freezing point is -39^0c. So mercury thermometer cannot be used to measure low temperature.
2. Its rate of expansion is low. So mercury thermometer is less sensitive than alcohol thermometer.

Advantages of alcohol as a thermometric liquid:

1. Its freezing point is -117^0c. So it can measure very low temperature.
2. It is cheaper than mercury thermometer.
3. Its expansion rate is six times more than that of mercury. So it is highly sensitive.

Disadvantages of alcohol as a thermometric liquid:

1. Its rate of expansion and contraction is not uniform.
2. Its boiling point is 78^0c. So it cannot measure the temperature above ta 78^0c.
3. It sticks the inner wall of capillary tube. So it is difficult to take accurate reading.

Disadvantage of water as a thermometric liquid:

Water cannot be used as a thermometric liquid because;

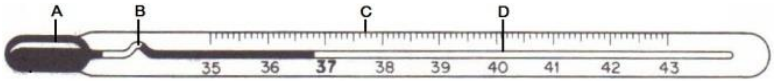
1. Pure water is a bad conductor of heat.
2. It sticks the inner wall of capillary tube.
3. Its expansion rate is not uniform.

It vaporizes easily.

Types of thermometer:

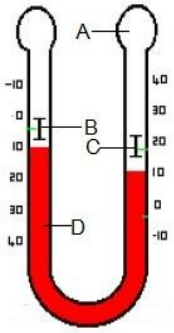
4. Clinical thermometer.2. Digital thermometer.3. Maximum and minimum thermometer.4.Laboratory thermometer.

Clinical thermometer: The thermometer which is used to measure human body temperature is called clinical thermometer. They are available in both Celsius and Fahrenheit scales. In this thermometer scale ranges from 35^0c to 42^0c. or 94^0F to 108^0F. In this thermometer mercury is used as thermometric liquid.

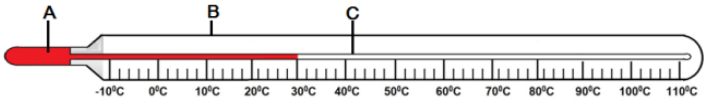


Digital thermometer: A digital thermometer is a modern thermometer which shows the temperature in digits. It does not have any calibration on it. It neither contains alcohol nor mercury.

Maximum minimum thermometer: The thermometer that is used to measure the maximum and minimum temperature of the surrounding of 24 hours of a particular place is called maximum and minimum thermometer. In this thermometer both alcohol and mercury are used. It consists of U shaped parallel tubes of glass. It is filled with mercury at its lower part and upper parts of the two tubes are filled with alcohol. There are two metal index separating the two liquid mercury and alcohol. In this thermometer mercury tube shows the maximum temperature and alcohol tube shows minimum temperature. The reading indicated by lower ends of the index shows the maximum and minimum temperature of a certain place. A magnet is used to reset the metallic index in its original position.



Laboratory thermometer: A thermometer which is used to measure the temperature of different bodies of the laboratory is called laboratory thermometer. Mercury or alcohol is used as a thermometric liquid. The temperature scale has a wide range from -10^0c to 110^0c.



Difference between clinical and laboratory thermometer:

Clinical thermometer	Laboratory thermometer
• It is used to measure the temperature of human body.	• It is used to measure the temperature of different objects in the laboratory.
• It is short with prismatic structure.	• It is ling with a round and cylindrical structure.
• The temperature scale ranges between 35^0c to 42^0c.	• The temperature scale ranges between -10^0c to 110^0c.
• It has narrow constriction near the bulb.	• It does not have narrow constriction.

Specific heat capacity: The amount of heat energy required to raise the temperature e of 1 kg substance of temperature by 1^0c (or 1 kelvin) is called specific heat capacity of the substance. Its SI unit of measurement is J/kg^{0}c.

Specific heat capacity of some substances is as below:

Substances	Specific heat capacity (J/kg^{0}c)	Substances	Specific heat capacity (J/kg^{0}c)
Lead	130	Aluminium	900
Mercury	140	Petrol	1670
Silver	234	Cooking oil	2000
Brass	380	Ice	2100
Copper	400	Kerosene	2200
Steel	447	Alcohol	2400
Iron	460	Water	4200
Glass	670		
Sand	800		

Advantages of highest specific heat capacity of water:

1. Hot water bag is used during injury or cold.

Water has high specific heat capacity, because of which it remain hot for long time and supply heat energy continuously to our body. So water is used in hot water bag.

2. Water is used to cool the hot engine of vehicles.

Water has high specific heat capacity, because of which it can absorb heat energy from the hot engine for long time. So it is used to cool the hot engine of vehicles.

3. During high fever a cloth soaked with water is used on forehead.

Water has high specific heat capacity, because of which it can absorb heat energy from our body for long time. So a loth soaked with water is used on forehead during high fever.

Specific heat capacity of sand in desert is low so it gets heated very fast and gets cooled very fast so the day of desert is very hot and night is very cold.

Heat equation: The quantity of heat lost of gained by the object is equal to the product of its mass, specific heat capacity and change in temperature. This relation is called heat equation. Mathematically it can be expressed as;

$Q = msdt$ Where Q=quantity of heat, m= mass, s= specific heat capacity and dt =change in temperature.

Principal of calorimetry: It states that, "the quantity of heat lost by an object is equal to the quantity of heat gained by another object if they are brought in thermal contact.

I.e. Heat lost = Heat gained

End

Light

Lens: lens is a transparent medium bounded by two refracting surfaces out of which at least one is spherical.
Types of lens:

1. Concave lens 2. Convex lens

Convex lens: The lens which is thick in the middle and thin at the edges is called convex lens. It is also called converging lens because it converges the parallel light rays at a single point.

Types of convex lens:

1. Biconvex lens 2. Plano convex lens 3. Concavo convex lens

Concave lens: The lens which is thin in the middle and thick at the edges is called concave lens. It is also called diverging lens because parallel rays are appeared to be diverged from a single point.

Types of concave lens:

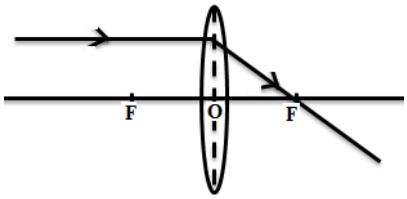
1. Biconcave lens 2. Plano concave lens 3. Concavo concave lens

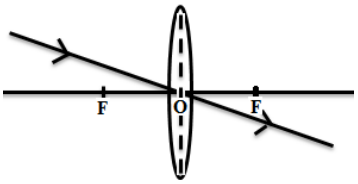
Some terms related to lens:

i. **Centre of curvature:** The centre of the sphere of which a lens forms its part is called centre of curvature. There are two centers of curvature. They are denoted by C_1 and C_2.
ii. **Principle axis:** The imaginary lines joining the two centers of curvature is called principle axis.
iii. **Optical centre:** The point on the principle axis, which is equidistant from the two centers of curvature is called optical centre. It is the geometrical centre of the lens. It is denoted by O.
iv. **Principle focus:** The point on the principle axis, where the parallel rays of light are converged in convex lens or appear to be diverged in concave lens is called principle focus.
v. **Focal length:** The distance between the principle focus and optical centre of a lens is called focal length. It is denoted by 'f'.
vi. **Focusing:** The process of adjusting the distance between the lens and the screen in order to produce a clear and distinct image is called focusing.

Rules for drawing ray diagram for convex lens:

1. A light ray parallel to principle axis goes through principle focus.
2. A light ray passing through optical centre goes without bending (undeviated).





Rules for drawing ray diagram for concave lens:

1. A light ray parallel to the principle axis appears to be diverged from the principle focus.
2. A light rays passing through optical centre goes without bending.

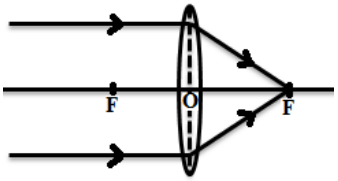
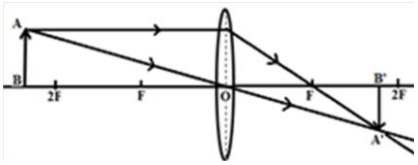


Image formed by convex lens:

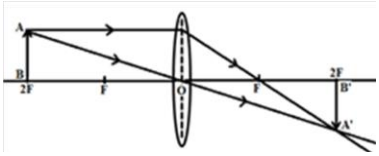
1. When object is at infinity:

Nature of image:
1. Real 2. Highly diminished 3. Inverted 4. Image is formed at F.



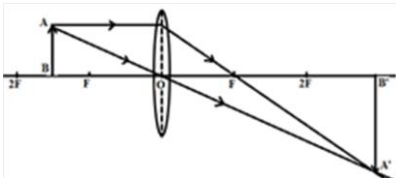
2. When object is placed beyond 2F:

Nature of image:
1. Real 2. Inverted 3. Diminished 4. Image is formed in between F and 2F.



3. When object placed at 2F:

Nature of image:
1. Real 2. Inverted 3. Equal to the size of object4. Image is formed at 2F.

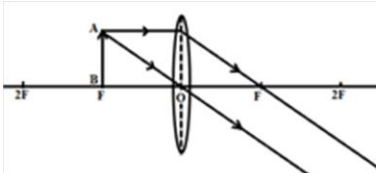


4. When object is in between F and 2F:

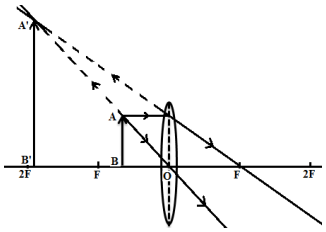
Nature of image:
1. Real 2. Inverted 3. Magnified 4. Image is formed beyond 2F.

5. When object is placed at F:

Nature of image formed:
1. Real 2. Inverted 3. Highly magnified4. Image is formed at infinity



6. When object is in between O and F:



Nature of image formed:

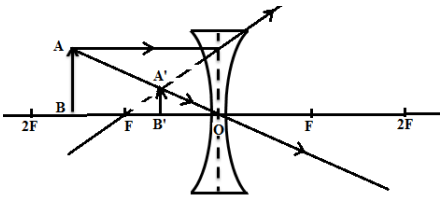
1. Virtual 2. Erect
3. Highly magnified 4. Image is formed to the same side of the object.

Image formed by concave lens:

1. Concave lens always forms same nature of image wherever the object is kept.

Nature of image formed:

1. Virtual 2. Erect 3. Diminished



Power of lens: Capacity of a lens to converge or diverge the parallel rays of light is called power of lens. It can also be defined as the reciprocal of focal length. Mathematically,

Power (P) = $\frac{1}{F}$ (where focal length of a lens is measure in the unit meter).

Its SI unit of measurement is Dioptre (D). Power of a concave lens is negative (-ve) and power of convex lens is positive (+ve).

One dioptre: Power of a lens is said to be one dioptre if its focal length is 1 meter.

Uses of lens:

1. Convex lens is used to form image on the film of a camera.
2. Convex lens is used in an astronomical telescope to see the heavenly bodies like moon, stars, galaxies, etc.
3. Convex lens is used in terrestrial telescope to see the objects like trees, houses, persons, vehicles, etc on the earth.
4. Convex lens is used in microscope.
5. Convex lens is used to correct hypermetropia or long sightedness defect of an eye.
6. Concave lens is used to correct myopia or short-sightedness defect of an eye.

Magnification of a lens: It is defined as the ratio of the height of image to the height of object. It can also be defined as the ratio of image distance to the object distance. It is denoted by the letter 'M' or μ. It has no unit. Mathematically,

$$\mu = \frac{height\ of\ image\ (I)}{height\ of\ object(O)} \quad \text{or}$$

$$\mu = \frac{image\ distance\ (v)}{object\ distance\ (u)}$$

Magnification of a lens is less than 1, means image is smaller than object. Magnification is equal to 1, means height of image is equal to the height of object. Magnification is greater than 1, means image is magnified.

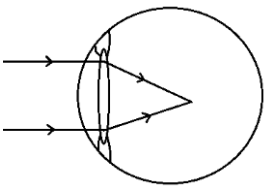
Distance of distinct vision: The maximum or minimum distance up to where a normal eye can see an object without difficulty is called the distance of distinct vision ***or range of vision.***

Far point: The farthest point that can be focused distinctly by a normal eye is called the far point. For a normal eye the far point is at infinity.

Near point: The nearest point that can be focused distinctly by a normal eye is called the near point. For a normal eye the near point is at 25cm.

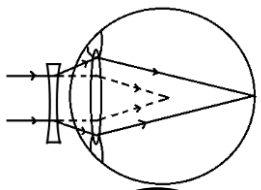
Power of accommodation of human eye: It is defined as the ability of an eye to focus the image of the object at different distances, on the retina by changing its focal length.

Defects of vision: If an eye cannot see nearby objects clearly but can see distant objects clearly or cannot see distant object clearly but can see nearby object clearly is called defect of vision.



Types of defects of vision:

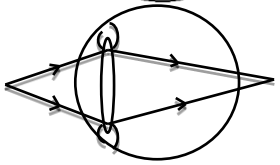
1. Short- sightedness or myopia
2. Long-sightedness or hypermetropia.



Short-sightedness: The defect of vision, in which an eye can see nearby objects but cannot see distant objects clearly is called short-sightedness. In this type of defect image of the distant object is formed in front of the retina.

Causes of short-sightedness:

1. Thickening of eye lens or shortening of the focal length of the eye lens.
2. Elongation of eye ball.

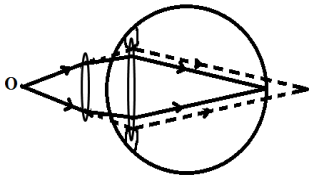


Correction of short-sightedness: Shot-sightedness defect of an eye can be corrected by using concave lens of suitable power.

Long-sightedness: The defect of vision, in which an eye can see distant objects clearly but cannot see nearby objects clearly is called long-sightedness. In this type of defect image of the nearby object is formed behind the retina.

Causes of long-sightedness:

1. Increase in focal length of eye lens or decrease in thickness of the eye lens.
2. Shortnening of eye ball or contraction of eye ball.



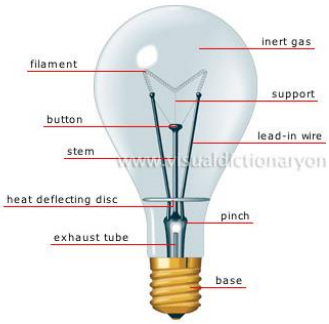
Correction of long-sightedness: Long-sightedness defect can be corrected by using convex lens of suitable power.

Current Electricity and Magnetism

Effects of current electricity: Electrical energy can be converted into other different forms of energy, which is known as effects of current electricity. There are four main effects of current electricity; they are

a. Lighting effect b. heating effect c. magnetic effect d. chemical effect

Lighting effect of current electricity: Electrical energy can be converted into light energy by the use of different lighting devices, which is known as lighting effects of current electricity. Some lighting devices are; filament lamp, fluorescent lamp, CFL **(compact fluorescent lamp)**.



Filament lamp: An electric lamp in which filament is used to get light is called filament lamp. It converts 10% of electrical energy into light energy. Remaining 90% of the energy is wasted in the form of heat and radiation. Its life span is about 1000 hours. It is filled with inert gases like Nitrogen or argon in order to prevent the oxidation of filament.

Filament: A thin wire in the form of coil used inside an electric bulb which converts electrical energy into light energy is called filament. It is made up of tungsten metal. It has high melting point (3400^0c) and high resistance.

Fluorescent lamp: It is a tubular electric lamp having a coating of fluorescent material on its inner surface and containing mercury vapour. When electric current is passed with the help of two electrodes electrons start to flow through the mercury vapour. UV rays are produced because of collision of electrons with mercury vapour molecules. When the UV rays strikes with fluorescent powder coated in the inner surface of the tube, it produces visible rays.

It converts 30% of electrical energy into light energy. Its life span is about 3000 hours.

Differences between filament lamp and fluorescent lamp:

Filament lamp	Fluorescent lamp
• Tungsten filament emits light.	• Fluorescent powder emits light.
• It converts 10% of electrical energy into light.	• It converts 30% of electrical energy into light.
• It is filled with inert gases like nitrogen or argon.	• It is filled with mercury vapour.
• Its average life span is about 1000 hours.	• Its average life span is about 3000 hours.

Heating effects of current electricity: Electrical energy can be converted into heat energy by the use of heating devices, which is known as heating effect of current electricity. Electric iron, immersion rod, kettle are some examples of heating devices.

Heating element: The wire used is the electrical heating appliances to convert electrical energy into heat energy is called heating element. Nichrome is an example of heating element which is an alloy of nickel (60%) and chromium (40%) metals.

Characteristics of nichrome wire:

1. It has high resistance.
2. It has high melting point (900 ^{0}c).
3. It does not get oxidized.

Magnetic effect of current electricity: When electric current is passed through a conductor, it behaves like a magnet, which is called magnetic effect of current electricity.

Electromagnet: The magnet made by passing electricity through a solenoid is called electromagnet. It is used in loudspeaker, microphone, radio, television, electric bell etc.

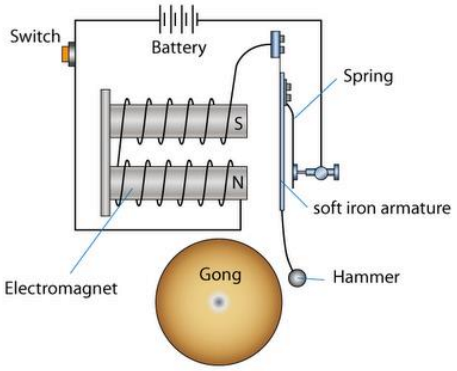
Solenoid: The cylindrical form of insulated copper coil having large number of closed turns used to make electromagnet is called solenoid.

Characteristics of electromagnet:

1. It is a temporary magnet.
2. Its strength can be changed according to the requirement.
3. Its shape and size can be changed according to the requirement.

Strength of electromagnet can be changed by:

1. By increasing the number of turns of the coil.
2. By increasing the magnitude of current electricity passing through the coil.
3. Inserting a soft iron core.



Electric bell: When switch is made on circuit becomes complete and the soft iron body kept inside the solenoid changes into electromagnet, which attracts the soft iron armature towards it, as a result the hammer strikes the bell gong. But at this moment screw nail does not come in contact with the soft iron armature as result circuit becomes incomplete and solenoid does not become electromagnet. So the iron armature goes back to its own position and again circuit becomes complete and the process is repeated.

Electromagnetic induction: The phenomenon in which current is induced in a conducting wire by the change in magnetic flux by the wire is called electromagnetic induction.

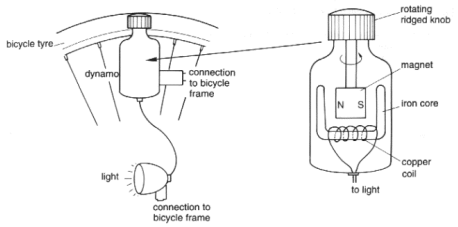
Laws of electromagnetic induction:

1. When there is a change in magnetic flux linked with a closed coil, an emf is induced in the coil.
2. The magnitude of induced emf is directly proportional to the rate of change of magnetic flux.
3. The induced emf last as long as there is change in magnetic flux.

Difference between AC and DC:

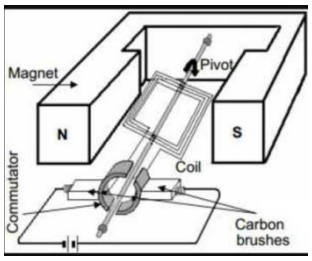
AC	DC
Its magnitude changes frequently.	Its magnitude does not change.
Its direction changes frequently.	Its direction does not change.

Magnetic flux: The total number of magnetic lines of force passing perpendicularly from an area is called magnetic flux.
Generator or Dynamo: The machines used to convert mechanical energy (kinetic energy) into electrical energy are called generator or dynamo. They are based on the principle of electromagnetic induction. Usually dynamo is used to induce current in less amount and generator is used to induce large amount of current.
The magnitude of electric current can be increased by:
1. Increasing the number of turns of the coil. 2. Increasing the strength of magnetic field.
3. Increasing the speed of magnet or coil. 4. Decreasing the distance between the coil and the magnet.



Bicycle Dynamo: inside a dynamo, a permanent magnet and a coil of enamel coated wire are used. When tyre of the bicycle comes in motion knob at the head of the dynamo rotates and the magnet also rotates. The magnetic flux linked to the coil changes due to the motion of the magnet and the current is induced in the coil.

Electric motor: It is a device which converts electrical energy into mechanical energy. It is used in fans, tape recorders, computers, washing machines, CD players, etc. It works on the principle of motor effect.



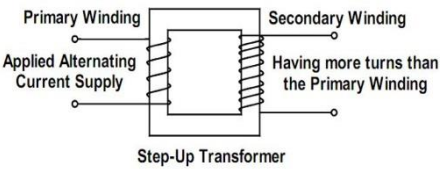
Motor effect: When a current carrying wire is kept inside a magnetic field, a movement is developed on the wire, which is called motor effect or the principle of motor.

Differences between generator and motor:

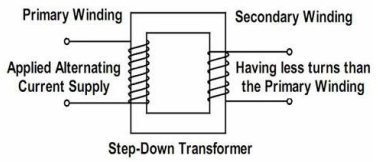
Generator	Motor
It converts mechanical energy into electrical energy.	It converts electrical energy into mechanical energy.
It works on the principle of electromagnetic induction.	It works on the principle of motor effect.
An electromagnet is used in it.	A permanent magnet is used in it.

Inverter: Inverter is an electrical devices which changes alternating current (AC) into direct current (DC) and direct current into alternating current. An inverter is used as a source of electricity during load shedding or when main supply of electricity is cut off.
Battery charger: A battery charger is an electrical appliance, which is used to supply energy into a secondary cell or rechargeable cell by forcing an electric current through it. It is commonly used to recharge the battery of mobile phone, laptop, automobile, etc.
Solar battery: It is a device which changes light energy into electrical energy. It is also called solar panel. A solar panel is a group of solar cells.
Transformer: A transformer is a device which converts low A.C. voltage to high A.C. voltage and vice versa. Or a transformer is a device used for increasing or decreasing the magnitude of A.C. voltage. It works on the principle of electromagnetic induction. In a transformer;
1. Input energy is equal to output energy. i.e. $I_1V_1 = I_2V_2$
2. Voltage is directly proportional to the number of turns of coils.

Types of transformer:
a. Step up transformer: The transformer which converts low A.C. voltage to high A.C. voltage is called step up transformer. In this type of transformer number of turns of secondary coil is more than that of the primary coil and output voltage is more than that of the input voltage. This type of transformer is used in hydro power station, in order to increase the A.C. voltage so that it can be transmitted up to long distance.



b. Step down transformer: The transformer which converts high A.C. voltage to low A.C. voltage is called step down transformer. In this type of transformer number of turns of secondary coil is less than that of the primary coil and output voltage is less than that of the input voltage. This type of transformer is used in radio, television, cassette player, etc.



Structure of transformer: Number of U-shaped iron sheets are combined each other facing in opposite direction. These plates are laminated with the help of **varnish** in order to prevent the loss of electric current in the form of heat. Number of turns of enameled copper wire is wrapped on the two opposite arms of the core with different numbers.
Following formula shows the relationship between the input voltage (V_1), output voltage(V_2), number of turns of primary coil (N_1) and number of turns of secondary coil (N_2) :

$$\frac{\text{Secondary voltage}(V_2)}{\text{Primary voltage}(V_1)} = \frac{\text{No.of turns of secondary coil}(N_2)}{\text{No.of turns of primary coil}(N_1)}$$

Safety measures in using electricity:

1. Naked and connected wires should be covered properly with insulating tape.
2. Wiring should be done only in dry places.
3. Wires of high quality, proper amperage and good insulating material should be used.
4. Naked wires and joints should be covered with insulating tape.
5. Defective plugs, switches and sockets should be replaced.
6. Fuse of proper rating and proper material should be used.
7. All electrical appliances must be properly earthed.
8. In case of fire due to electricity water should not be used as a fire extinguisher.
9. Fuse and switch should be used in live wire only.

Reason behind making covers of wire colorful (advantages of colour code of wire):

1. It makes us easy to identify the phase, neutral and earthing wires in underground wiring.
2. It makes us easy for maintenance of old wiring.

Earthing: It is the process of connecting the metallic body of an electric appliance to the earth through a conducting wire.

Electric power consumption: Electric energy consumed in our domestic circuit is measure by the electric meter box in the unit Kilowatt hour. That is 1 unit is equal to 1 kilowatt hour. It is calculated by the following relation;

Electricity consumed (EC) = P N T

Relation between 1 kilowatt-hour and joule:

1KWh = 1 KW x1h
1KWh = 1000 W x3600 sec.
1KWh = 1000 J/sec x3600 sec.
1KWh = 3600000 J.
1KWh = 3.6×10^6 J.

One kilowatt hour: One kilowatt hour is the energy consumed by an electrical device of power 1KW for one hour.

Classification of Elements

Classification of elements: The grouping of elements on the basis of their similarities and dissimilarities of their properties is called classification of elements.

Periodic table: The systematic arrangement of elements in different groups and period on the basis of their similarities and dissimilarities of physical and chemical properties is called periodic table.

Importance and uses of periodic table;

1. It makes easy for comparative study of elements.
2. It helps for the prediction of neighboring elements.
3. It helps to find out the correct position of elements.
4. It helps to find out the valency of elements.

Groups: The vertical columns in the periodic table are called groups.

Periods: The horizontal rows in the periodic table are called periods.

Difference between group and period:

Group	Period
The vertical column in the periodic table is called group.	The horizontal row in the periodic table is called period.
The valance electrons of the elements in the same group are same.	The valance electrons of the elements in the same period are different.
The valency of all the elements in the same group is same.	The valency of the elements in the same periods is different.
Reactivity of metals increases but the reactivity of non-metals decreases from top to bottom in a group.	The reactivity of elements decreases first and then increases from left to right in a period.

Mendeleev's periodic table: It is a table in which the elements have been arranged in increasing order of atomic weights so that the elements having similar properties occur in the same vertical column.

Mendeleev's periodic law: It states that, "the physical and chemical properties of elements are the periodic functions of their atomic weights".

Merits of Mendeleev's period table:

1. It is the first scientific and systematic table of elements.
2. It helped in the correction of wrong atomic weights.
3. The gap left in the table helped to discover new elements.

Demerits of Mendeleev's periodic table:

1. Alkali metals and other metals like copper, gold, silver were put in the same group.
2. In group VIII, three elements were placed in the same cell, even though they have different atomic weights.
3. There were no places for isotopes.
4. There were no suitable places for lanthanides and actinides.
5. Separation of chemically similar elements and grouping of chemically dissimilar elements.
6. Elements having more atomic weights were kept before the elements having less atomic weight.

Modern periodic table: It is a table in which the elements are arranged in increasing order of their atomic numbers so that the elements having similar properties occur in the same vertical column. Henery Moseley prepared this table.

Modern periodic law: It states that, "the physical and chemical properties of elements are the periodic functions of their atomic numbers".

Characteristics of modern periodic table:

1. Elements are arranged in increasing order of their atomic numbers.
2. There are 18 groups in the modern periodic table.
3. There are 7 periods in the modern periodic table.
4. The elements present in a group have same number of valence electrons in this table.
5. The elements present in a group have same valency.
6. The elements present in a group have similar chemical properties.
7. Atomic size of the elements in a group increases from top to bottom.
8. Atomic size of the elements in a period decreases from left to right.
9. Lanthanides and actinides have been placed separately below the main table.
10. It has been divided into four block; they are s- block, p- block, d- block and f- block.
11. Inert gases have been placed in group 18.

Merits of modern periodic table:

1. The similar elements are grouped together and dissimilar elements have been separated, in this table.
2. There is a clear demarcation between active metals, non-metals, metalloids, transition elements, inert gases, lanthanides and actinides.
3. As the classification is based upon atomic number, the problem of position of isotopes got justified.
4. Lanthanides and actinides have been placed separately below the main table in order to avoid unnecessary expansion of the table.

Difference between Mendeleev's periodic table and modern periodic table:

Mendeleev's periodic table	Modern periodic table
• In this table elements are arranged in increasing order of their atomic weights.	• In this table elements are arranged in increasing order of their atomic numbers.
• It consists of only five periods.	• It consists of seven periods.
• There are no places for isotopes.	• Isotopes are placed together with main elements.
• There is no place for noble gases.	• Noble gases are placed in zero group or group 18.
• There was no suitable place for the lanthanides and actinides.	• Lanthanides and actinides are placed at the bottom of the table separately.

Classification of periods on the basis of number of elements:

1. Very short period: Period 1 (two elements)
2. Short periods: Period 2 and 3 (8 elements in each)
3. Long periods: Period 4 and 5 (18 elements in each)
4. Very long period: period 6 (32 elements)
5. Incomplete period: Period 7 (26 elements)

Position of different types of elements in the modern periodic table:

a. **Metal:** The electropositive elements are called metals. They contain one to three electrons in their outermost shell. They lose their electrons while taking part in chemical reactions. They are placed at the left hand side of the period table.

b. **Alkali metals:** The elements of group 1 are called alkali metal. They are called so because they react with water and form strong alkalis.

c. **Alkaline earth metals:** The elements of group 2 are called alkaline earth metals. They are called so because they are found inside the earth crust and form alkalis when dissolved with water.

Group IA (1)
H
Li
Na
K

Group IIA(2)
Be
Mg
Ca

d. **Non-metals:** The electronegative elements are called non-metals. They contain four to eight electrons in their outer most shells. They gain electrons while taking part in the chemical reactions. They are placed at the right hand side of the periodic table.

e. **Metalloids:** The elements which show the properties of both metals and non- metals are called metalloids.

f. **Halogens:** The elements of group 17 are called halogens. They are called so because they form salts with group 1 elements.

g. **Inert gases:** The elements of group 18 (zero group) are called inert gases. They are called so because they do not take part in chemical reaction and remain inactive. They have zero valency.

Group VIIA(17)
F
Cl
Br
I

Group 0 (18)
He
Ne
Ar
Kr

h. **Transition elements:** The elements of group 3 to 12 are called transition elements. Or the d- block elements are called transition elements. They lie in between s- block and p- block elements.

i. **Lanthanides:** The 14 elements from Cerium to Lutetium having atomic number 58 to 71 are called lanthanides. They are f- block elements. They are also called inner transition elements.

j. **Actinides:** The 14 elements from Thorium to Lawrencium having atomic number 90 to 103 are called actinides. They are f- block elements. They are also called inner transition elements.

k. **Inner transition elements:** lanthanides and actinides are called inner transition elements.

Electronic configuration of elements on the basis of sub-shell: Aufbau principle gives us a sequence in which various sub-shells are filled with electrons. According to this principle, the electrons are filled up in the sub-shells in the order of their increasing order of energy level. i.e. subshells of lower energy is filled first. This can be expressed in sub-shells are as follows;

$1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$, $3d^{10}$, $4p^6$, $5s^2$, $4d^{10}$, $5p^6$, $6s^2$, $4f^{14}$,……..

Electronic configuration of first twenty elements:

1. Hydrogen $1s^1$
2. Helium $1s^2$
3. Lithium $1s^2, 2s^1$
4. Beryllium $1s^2, 2s^2$
5. Boron $1s^2, 2s^2, 2p^1$
6. Carbon $1s^2, 2s^2, 2p^2$
7. Nitrogen $1s^2, 2s^2, 2p^3$
8. Oxygen $1s^2, 2s^2, 2p^4$
9. Fluorine $1s^2, 2s^2, 2p^5$
10. Neon $1s^2, 2s^2, 2p^6$
11. Sodium $1s^2, 2s^2, 2p^6, 3s^1$
12. Magnesium $1s^2, 2s^2, 2p^6, 3s^2$
13. Aluminium $1s^2, 2s^2, 2p^6, 3s^2, 3p^1$
14. Silicon $1s^2, 2s^2, 2p^6, 3s^2, 3p^2$
15. Phosphorous $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$
16. Sulphur $1s^2, 2s^2, 2p^6, 3s^2, 3p^4$
17. Chlorine $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$
18. Argon $1s^2, 2s^2, 2p^6, 3s^2, 3p^6$
19. Potassium $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$
20. Calcium $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$

Classification of elements on the basis of sub- shells:

a. **s- block elements:** The elements whose final electron enters into s- sub shell of their outermost shell are called s- block elements. Elements of group 1 and 2 are s- block elements.

b. **p- block elements:** The elements whose final electron enters into p- sub shell of their outermost shell are called p- block elements. Elements of group 13 to 18 are p- block elements.

c. **d- block elements:** The elements whose final electron enters into d- sub shell of their outermost shell are called d- block elements. Elements of group 3 to 12 are d- block elements.
d. **f- block elements:** The elements of lanthanide and actinide series placed at bottom of the periodic table in two horizontal rows are called f- block elements. They are also called inner transition elements.

Reactivity of elements: The tendency of an element to loose or gain electrons in order to take part in chemical reaction is called reactivity of elements. It depends upon the following factors;

1. Size of atom 2. Nuclear force of attraction

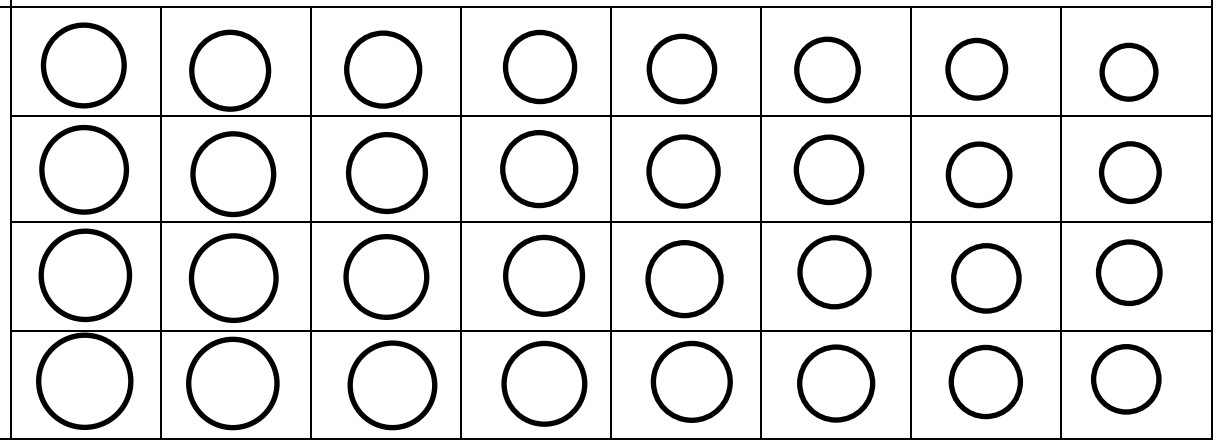
Reactivity of elements in a group:

1. **For metals:** As we move from top to bottom, size of atoms increases, nuclear force of attraction decreases and tendency of losing electrons increases. So the reactivity of metals increases from top to bottom.
2. **For non- metals:** As we move from top to bottom size of atoms increases, nuclear force of attraction decreases and tendency of gaining electrons decreases. So the reactivity of non-metals decreases from top to bottom.

Reactivity of elements in a period:

1. **For metals:** As we move from left to right in a period, size of atoms decreases, nuclear force of attraction increases and tendency of losing electrons decreases. So the reactivity of metals decreases from left to right.
2. **For non- metals:** As we move from left to right in a period, size of atoms decreases, nuclear force of attraction increases and tendency of gaining electrons increases. So the reactivity of non-metals increases from left to right.

Variation of size of atoms in groups and periods:

	Groups							
Periods								

Chemical Reaction

Chemical reaction: The combination, decomposition of displacement that occurred in the molecules of matter during a chemical change is called a chemical reaction.

Reactant: The elements or compounds that take part in a chemical reaction are called reactant. Reactants are written on the left hand side of a chemical reaction.

Product: The elements or compounds that are formed as a result of chemical reaction are called product. Products are written on the right hand side of a chemical reaction.

Word equation: A chemical reaction expressed by writing the full names of reactants and products is called word equation.

Carbon + Oxygen $\longrightarrow$ Carbon dioxide

Reactants Product

Chemical equation (formula equation): A chemical reaction expressed by writing the symbols and molecular formulae of reactants and products is called a chemical equation.

$2Na + Cl_2 \longrightarrow 2NaCl$

Balanced chemical equation: A chemical equation written by balancing the total number of atoms of each element on the reactant side and product side is called a balanced chemical equation.

$Na + Cl_2 \longrightarrow NaCl$

$2Na + Cl_2 \longrightarrow 2NaCl$

Types of chemical reaction:

1. **Combination or addition or synthesis reaction:** A chemical reaction in which two or more reactants combine together to give a single product is called addition reaction.

   $2Na + Cl_2 \longrightarrow 2NaCl$

   $N_2 + 3H_2 \xrightarrow[Fe/Mo]{450^0c/200atm} 2NH_3$

   $2Al + N_2 \longrightarrow 2AlN$

2. **Decomposition or dissociation reaction:** A chemical reaction in which a single reactant is broken down into two or more products is called decomposition reaction.

   $2KClO_3 \xrightarrow{\Delta} 2KCl + 3O_2$

   $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

   $2H_2O \xrightarrow{Electricity} 2H_2 + O_2$

   $2AgBr \xrightarrow{Light} 2Ag + Br_2$

   $2H_2O_2 \xrightarrow{Catalyst} 2H_2O + O_2$

3. **Displacement or replacement reaction:** A chemical reaction in which an atom or a radical of a compound is displaced by another element is called displacement or replacement reaction.
   a. **Single displacement reaction:** A chemical reaction in which one atom or one radical is displaced by another element is called single displacement reaction.

      $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

      $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$

   b. **Double displacement reaction:** A chemical reaction in which an element or a radical of a compound is mutually displaced by an element or a radical is called double displacement reaction.

      $CaCl_2 + 2AgNO_3 \longrightarrow Ca(NO_3)_2 + 2AgCl$

4. **Acid base reaction (neutralization reaction):** A chemical reaction in which an acid and a base react together to give salt and water is called acid- base reaction. It is also called neutralization reaction because neutral substances salt and water are formed by this reaction.

   $HCl + NaOH \rightarrow NaCl + H_2O$

   $H_2SO_4 + KOH \rightarrow K_2SO_4 + H_2O$

   $2HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + 2H_2O$

Factors which affect a chemical reaction:

1. **Heat:** Some of the chemical reactions are carried out by heat. Some examples are;

   $2KClO_3 \xrightarrow{\Delta} 2KCl + 3O_2$

   $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

2. **Light:** Certain chemical reactions occur in the presence of sunlight. Some examples are;

   $2AgBr \xrightarrow{Light} 2Ag + Br_2$

   $6CO_2 + 6H_2O \xrightarrow{Light} C_6H_{12}O_6 + 6O_2$

3. **Pressure:** Some of the chemical reactions which takes place in presence of pressure are;

$$N_2 + 3H_2 \xrightarrow[Fe/Mo]{450^0c/200atm} 2NH_3$$

4. **Catalyst:** A catalyst is chemical substances which actually do not take part in chemical reaction but increases or decreases the rate of chemical reaction.
   Characteristics of catalysts:
   i. A catalyst remains unchanged in its mass and chemical composition in the chemical reaction.
   ii. A catalyst does not initiate the chemical reaction but it alters the rate of the reaction.
   a. **Positive catalyst:** A catalyst which increases the rate of chemical reaction is called positive catalyst.

$$2KClO_3 \xrightarrow{MnO_2} 2KCl + 3O_2$$

$$2H_2O_2 \xrightarrow{MnO_2} 2H_2O + O_2$$

   b. **Negative catalyst:** A catalyst which decreases the rate of chemical reaction is called negative catalyst.

$$2H_2O_2 \xrightarrow{C_3H_5(OH)_3} 2H_2O + O_2$$

5. **Solution:** Some of the chemical reactions take place only in solution form. Some examples are;

$$CaCl_2 + 2AgNO_3 \longrightarrow Ca(NO_3)_2 + 2AgCl$$

$$NaCl + AgNO_3 \longrightarrow NaNO_3 + AgCl$$

6. **Direct contact:** Some active substances react on simple contact. Some examples are;

$$2Na + Cl_2 \longrightarrow 2NaCl$$

7. **Electricity:** Some of the chemical reactions take place by the passage of electricity. Some examples are;

$$2H_2O \xrightarrow{Electricity} 2H_2 + O_2$$

Types of chemical reactions on the basis of liberation of heat:

1. **Exothermic reaction:** The chemical reaction in which heat energy is released is called exothermic reaction. Some examples are;

$$C + O_2 \longrightarrow CO_2 + Heat$$

$$Zn + 2HCl \longrightarrow ZnCl_2 + H_2 + Heat$$

2. **Endothermic reaction:** The chemical reaction in which heat energy is absorbed is called endothermic reaction. Some examples are;

$$N_2 + O_2 + Heat \longrightarrow 2NO$$

$$2NaCl + Heat \longrightarrow 2Na + Cl_2$$

Rate of chemical reaction: The change in concentration of the reactant or product per unit time is called the rate of chemical reaction.

Factors affecting the rate of chemical reactions:

1. **Temperature:** Increase in temperature increases the rate of a chemical reaction whereas decrease in temperature decreases the rate of chemical reaction. The kinetic energy of the reacting molecules increases on increasing the temperature of the reactants. Due to increased energy, the frequency of collision increases, and finally the rate of chemical reaction increases.
   Two beakers are filled with crystals of oxalic acid. 10 ml of dilute sulphuric acid is added with both of the beakers and 5ml of potassium permagnet is added to the beakers. After stirring for some time both the solution turn into pink. If one of the beakers is heated till 60^0c to 80^0c it becomes colourless whereas other remains as it is. It proves that reaction completes faster in the beaker which is heated.
2. **Concentration:** The rate of chemical reaction increases on increasing the concentration of reactants. By increasing the concentration of the reactants effective collision between the reacting molecules increases and hence the rate of chemical reaction increases.
3. **Surface area:** Rate of chemical reaction increases on increasing the surface area of the reactants. On increasing the surface area of the reactants effective collision between the reactants molecules increases and hence the rate of chemical reaction increases. Two beakers are filled with 20 ml of dilute sulphuric acid. 2 gm of zinc pieces are kept in both of the beakers but one with large pieces and another with granulated. The chemical reaction completes faster in the beaker containing granulated zinc and the zinc pieces are lost in the beaker fast. It proves that the chemical reaction takes place faster if the surface area is more.
4. **Pressure:** Rate of chemical reaction increases on increasing the pressure of the reactants. On increasing the pressure of the reactants effective collision between the reactants molecules increases and hence the rate of chemical reaction increases.

Acid, Base and Salt

Acid: Acid are those chemical substances which gives hydrogen ions when dissolved in water. According to modern concept acids are those chemical substances which give hydronium (H_3O^+)

Some examples of acids; Hydrochloric acid (HCl), Sulphuric acid(H_2SO_4), Nitric acid(HNO_3), Carbonic acid(H_2CO_3), Acetic acid(CH_3COOH) etc.

Classification of acids on the basis of source; 1.Organic acid 2.Inorganic acid

Organic acid; Acids which are obtained from living organisms and have carbon atom in their molecular composition are called organic acids.

Examples; Acetic acid (CH_3COOH)-Vinegar, Mallic acid- Apple, Lactic acid- Sour milk, Tartaric acid-Lime and grapes, Citric acid-Lemon, Oxalic acid-Tomatoes.

Inorganic acids: The acids which are obtained from minerals are called inorganic acids. They are also called mineral acids.

Examples; Hydrochloric acid (HCl), Sulphuric acid (H_2SO_4), Nitric acid(HNO_3), Carbonic acids(H_2CO_3).

Differences between organic and inorganic acids:

Organic acids	Inorganic acids
• They are obtained from living beings.	• They are prepared from minerals.
• They are weak acids.	• Most of them are strong acids.
• They are poor conductor of electricity.	• They are good conductor of electricity.

Classification of acids on the basis of strength; 1.Strong acids 2.Weak acids

Strong acids: The acid which produces high concentration of hydrogen ions when dissolved in water is called strong acids. They are more corrosive in nature. Most of the inorganic acids are strong acids. They have low P^H value. Some examples of strong acids are; Hydrochloric acid (HCl), Sulphuric acid(H_2SO_4), Nitric acid(HNO_3).

Weak acids: The acid which produces low concentration of hydrogen ions when dissolved in water is called weak acids. They are less corrosive in nature. All the organic acids are weak in nature. They have high P^H value. Some examples of weak acids are; Acetic acid (CH_3COOH), Carbonic acids(H_2CO_3).

Differentiate between strong acid and weak acid:

Strong acid	Weak acid
• It gives more concentration of hydrogen ions when dissolved in water.	• It gives less concentration of hydrogen ions when dissolved in water.
• Most of the inorganic acids are strong acids.	• All the organic acids are weak acids.
• They are more corrosive in nature.	• They are less corrosive in nature.

Physical properties of acids:

1. Most of the acids are sour in taste.
2. They change the colour of blue litmus paper into red, methyl orange into red and no change in the colour of phenolphthalein.
3. They are corrosive in nature and burn our skin.

Chemical properties of acids:

1. Acids reacts with metals to give salt and hydrogen gas.

   $2HCl + Zn \rightarrow ZnCl_2 + H_2$ $H_2SO_4 + Mg \rightarrow MgSO_4 + H_2$

   $2HNO_3 + Ca \rightarrow Ca(NO_3)_2 + H_2$

2. Acids react with bases to give salt and water.

   $HCl + NaOH \rightarrow NaCl + H_2O$ $H_2SO_4 + KOH \rightarrow K_2SO_4 + H_2O$

   $2HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + 2H_2O$

3. Acids react with metal carbonates and metal bicarbonates to give respective salts, water and carbon dioxide gas.

   $HCl + Na_2CO_3 \rightarrow 2NaCl + H_2O + CO_2$ $H_2SO_4 + MgCO_3 \rightarrow MgSO_4 + H_2O + CO_2$

   $2HCl + Ca(HCO_3) \rightarrow CaCl_2 + 2H_2O + 2CO_2$

4. Acids dissolve in water to give hydrogen ions (H^+).

   $HCl \xrightarrow{water} H^+ + Cl^-$ $H_2SO_4 \xrightarrow{water} 2H^+ + SO_4^{--}$ $HNO_3 \xrightarrow{water} H^+ + NO_3^-$

Uses of acids:

1. $H_2SO_4 \rightarrow$it is used for making chemical fertilizers, drugs and detergents.
2. $HCl \rightarrow$It is used in tanning and printing industries.
3. $HNO_3 \rightarrow$It is used for making plastics, dyes and explosives.
4. $H_2CO_3 \rightarrow$It is used in soft drinks like coca-cola, soda water, beer, etc.
5. $CH_3COOH \rightarrow$It is used in pickles.
6. Carbolic acids →It is used to kill germs.
7. Citric acids →It is used as a source of vitamin C.

Bases: The metallic oxides or hydroxides which react with acids to give salt and water are called bases. They are bitter in taste andsoapy in touch.

Some examples of bases are; Sodium oxide (Na_2O), potassium oxide (K_2O), magnesium oxide (MgO), calcium oxide (CaO), sodium hydroxide (NaOH), potassium hydroxide (KOH), magnesium hydroxide ($Mg(OH)_2$), calcium hydroxide ($Ca(OH)_2$), etc.

Types of bases: on the basis of strength bases are of two types;

1. Strong bases 2. Weak bases

Strong bases: The bases which produce high concentration of hydroxyl ions (OH^-), when dissolved in water are called strong bases. Eg. sodium hydroxide (NaOH), potassium hydroxide (KOH), magnesium hydroxide ($Mg(OH)_2$), calcium hydroxide ($Ca(OH)_2$), etc.

Weak bases: The bases which produce low concentration of hydroxyl ions (OH^-), when dissolved in water are called weak bases. Eg. Ammonium hydroxide (NH_4OH), copper hydroxide ($Cu(OH)_2$), iron hydroxide ($Fe(OH)_2$), etc.

Alkalis: The bases which dissolve in water to produce OH^- ions are called alkalis.

(*Bases are those substances that may or may not dissolve in water but alkalis are the bases that dissolve in water. Insoluble bases are not alkalis. Therefore we can say that all alkalis are bases, but all bases are not alkalis.)*

Physical properties of bases or alkalis:

1. Bases are bitter in taste and soapy in touch.
2. Bases turn red litmus paper to blue, methyl orange to yellow and phenolphthalein to pink.
3. Strong bases or alkalis burn our skin.

Chemical properties of bases or alkalis:

1. Bases react with acids to form salt and water.

   $HCl + NaOH \rightarrow NaCl + H_2O$ $H_2SO_4 + KOH \rightarrow K_2SO_4 + H_2O$

   $2HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + 2H_2O$
2. Bases or alkalis reacts with ammonium salts to give salts, water and ammonia gas.

   $NaOH + NH_4Cl \rightarrow NaCl + H_2O + NH_3$ $Ca(OH)_2 + 2NH_4Cl \rightarrow CaCl_2 + 2H_2O + 2NH_3$

   $Ca(OH)_2 + (NH_4)_2CO_3 \rightarrow CaCO_3 + 2H_2O + 2NH_3$
3. Bases or alkalis react with carbon dioxide and form corresponding carbonates and water.

   $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$ $2KOH + CO_2 \rightarrow K_2CO_3 + H_2O$

   $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

Uses of bases:

1. NaOH→to make soaps, detergents, paper, etc.
2. KOH →to make soaps and in batteries.
3. $Ca(OH)_2$→to make bleaching powder, to reduce hardness of water and to neutralize acidity of soil.
4. $Al(OH)_3$→to reduce hyperacidity of stomach.
5. $Mg(OH)_2$→ to reduce hyperacidity of stomach.
6. NH_4OH →to remove grease and stains from clothes and to make fertilizers.
7. CaO→for softening hard water, production of cement.

Differences between acid and base:

Acid	Base
• Acids give hydrogen ions when dissolved in water.	• Bases give off hydroxyl ion when dissolved in water.
• It turns blue litmus paper into red.	• It turns red litmus paper into blue.
• It has a sour taste.	• It has bitter taste and soapy touch.
• Its P^H value is below 7.	• Its p^H value is above 7.

Differences between bases and alkalis:

Bases	Alkalis
• All metallic oxides are called bases.	• Water soluble metallic oxides are called alkalis.
• All the bases are not alkalis.	• All the alkalis are bases.

Salts: Salt is a chemical substance which is formed by partial or complete replacement of hydrogen ions of an acid by a metal or ammonium radical. It is formed by the reaction between acids with bases, metals with acids, etc.

For example,

$2HCl + Zn \rightarrow ZnCl_2 + H_2$ $H_2SO_4 + Mg \rightarrow MgSO_4 + H_2$

$2HNO_3 + Ca \rightarrow Ca(NO_3)_2 + H_2$ $HCl + NaOH \rightarrow NaCl + H_2O$

$H_2SO_4 + KOH \rightarrow K_2SO_4 + H_2O$ $2HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + 2H_2O$

A salt contains two types of radicals: acidic radical and basic radicals.

Acidic radicals: The radical present in a salt which is derived from acid is called acidic radical.

Basic radical: The radical present in the salt which is derived from base is called basic radical.

Types of salt on the basis of chemical nature.

1. **Neutral salts(Normal salts):** The salts which are formed by the reaction between strong acids with strong bases or between weak acids with weak bases are called neutral salts.

   $HCl + NaOH \rightarrow NaCl + H_2O$

   In this reaction Nacl is neutral salt because it formed by the reaction between strong acid and strong base.

2. **Acidic salts:** The salts which are formed by the reaction between strong acids with weak bases are called acidic salts.

   $H_2SO_4 + 2NH_4OH \rightarrow (NH_4)_2SO_4 + 2H_2O$
   In this reaction $(NH_4)_2SO_4$ is acidic salt.
3. **Basic salts:** The salts which are formed by the reaction between weak acids with strong bases are called basic salts.

   $H_2CO_3 + Mg(OH)_2 \rightarrow MgCO_3 + H_2O$

In this reaction $MgCO_3$ is a basic salt.

Properties of salts:

1. Generally salts are neutral, but some may be acidic or basic in nature.
2. Most of the slats are water soluble, but chloride salts of silver and lead and sulphate salts of lead and barium are insoluble.
3. Salts of metals like Na, K, Mg, Ca, Al, and Ba are white or colourless whereas salts of Cu, Co, Mn, Ni, Fe, and Cr have colour.
4. Salts are electrovalent compounds. They conduct electricity in molten or solution state.
5. Some salts are amorphous whereas some are crystalline.

Salts which are formed by the neutralization of a strong acid and a strong base or a weak acid and weak base are neutral to indicators and salts of strong acid and a weak base are acidic and salts of weak acid and strong base are basic.

Uses of salts:

1. NaCl(Sodium Chloride) →it is used as preservative and for taste.
2. $CuSO_4$ (Copper Sulphate) →it is used as fungicides and also as electrolyte.
3. $CaSO_4$(Calcium Sulphate) →it is used in manufacturing of cement and plastering of fractured bones.
4. $(NH_4)_2SO_4$ (Ammonium Sulphate) →it is used for making fertilizers.
5. $MgSO_4$ (Magnesium Sulphate) →it is used for treating constipation.
6. Na_2CO_3(Sodium Carbonate) →it is used for making glass, soap and detergent.
7. NH_4Cl (Ammonium Chloride) →it is used in dry cell.
8. $FeSO_4$ (Ferrous Sulphate) →it is used to make medicines.
9. $NaHCO_3$ (Sodium Bicarbonate) →it is used for making baking powder and in fire extinguisher.
10. $ZnSO_4$ (Zinc Sulphate) →it is used for making white paint.
11. AgBr (Silver Bromide) →it is used in photography.

Applications of neutralization reaction:

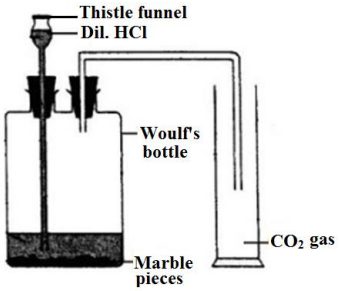
1. $Mg(OH)_2$ is used to neutralize the acidity produced inside the stomach.
2. CaO is used to neutralize the acidity of the soil.
3. Bee or ant sting injects formic acid in the skin. In order to neutralize the acid soap is used.
4. Wasp sting injects base in the skin. Vinegar is used to neutralize the base.

1. *Na_2CO_3 is a basic salt because it is formed by the reaction between weak acid H_2CO_3 and strong base NaOH.*
2. *$CaCO_3$ is a basic salt because it is formed by the reaction between weak acid H_2CO_3 and strong base $Ca(OH)_2$.*
3. *NaCl is a neutral salt because it is formed by the reaction between strong acid HCl and strong base NaOH.*
4. *$NaHCO_3$ is an acidic salt because it is formed by the partial displacement of hydrogen atom of acid H_2CO_3 by Na of base NaOH.*

Some Gases

Carbon dioxide

Laboratories preparation of CO_2:



Principle; In laboratories carbon dioxide gas is prepared by the chemical reaction between pieces of limestone ($CaCO_2$) with dilute hydrochloric acid (HCl).

$CaCO_3 + 2\,HCl \longrightarrow Cacl_2 + H_2O + CO_2$

Precautions:

1. The apparatus should be made air tight.
2. The lower end of thistle funnel should be immersed in the acid.
3. The lower end of delivery tube inside the round bottom flask should not touch the acid.
4. Carbon dioxide gas should be collected in the gas jar by the upward displacement of air.
5. Carbon dioxide gas is soluble in water so it should not be collected in the gas jar by passing through water.

Test for carbon dioxide:

1. When a moist blue litmus paper is kept in the gas jar containing CO_2, it turns into red because CO_2 gas is acidic in nature.
2. When carbon dioxide gas is passed through lime water it turns milky and when it is passed for ling time it again turns colourless.
3. If a burning matchstick is introduced in the jar containing carbon dioxide, it gets extinguished.

General methods of preparation of CO_2:

1. Carbon dioxide gas is prepared by the reaction between acids with metal carbonates or bicarbonates.
   $CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$
   $Ca(HCO_3)_2 + 2H_2SO_4 \longrightarrow CaSO_4 + 2H_2O + 2CO_2$
2. Carbon dioxide gas is prepared by the combustion of hydrocarbons like methane, ethane, ethane, etc.
   $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$
   $2H_2H_6 + 7O_2 \longrightarrow 4CO_2 + 6H_2O$
3. Carbon dioxide gas is prepared by burning carbon in plenty of oxygen.
   $C + O_2 \longrightarrow CO_2$
4. Carbon dioxide gas is prepared heating limestone vigorously.
   $CaCO_3 \longrightarrow CaO + CO_2$

1. *Carbon dioxide gas is collected in the gas jar by the upward displacement of air because it is heavier than air.*
2. *Carbon dioxide gas is soluble in water. So it is not collected in the gas jar by passing through water.*
3. *Dilute sulphuric acid cannot be used in place of dilute hydrochloric acid because calcium sulphate is formed after the reaction, which covers the remaining part of the marble and stops further reaction.*
4. *Moist blue litmus paper is used to detect the CO_2 gas, because it is soluble in water and is acidic in nature.*

Manufacture of CO_2 gas:

CO_2 gas is manufactured in large scale by heating limestone (Marble).

$CaCO_3 \longrightarrow CaO + CO_2$

Physical properties of CO_2:

1. It is colourless, odourless and tasteless gas.
2. It is soluble in water and produces carbonic acid when dissolved in water.
3. It is heavier than air.
4. It is acidic in nature, so it turns blue litmus paper into red.
5. It is neither combustible nor supporter of combustion.
6. When it is cooled below -78^{o}c it changes into solid form, which is known as dry ice.

Chemical properties of CO_2:

1. It reacts with water to give carbonic acid.

$CO_2 + H_2O \longrightarrow H_2CO_3$

2. It reacts with lime water to give milky coloured, water insoluble salt $CaCO_3$. So it turns into milky colour.

$CO_2 + Ca(OH)_2 \longrightarrow CaCO_3 + H_2O$

When it is passed long time in lime water the milky coloured salt $CaCO_3$ changes into colourless water soluble salt $Ca(HCO_3)_2$. So the milky colour disappears.

$CaCO_3 + H_2O + CO_2 \longrightarrow Ca(HCO_3)_2$

3. It is neither combustible nor supporter of combustion. But a burning magnesium continuous to burn in the gas jar of CO_2 gas. During this process white powder of magnesium oxide and black particles of carbon are formed.

$2Mg + CO_2 \longrightarrow 2MgO + C$

4. CO_2 gasreacts with NH_3 gas at 1500^{o}c to form Urea.

$2NH_3 + CO_2 \longrightarrow NH_2 – CO\text{-}NH_2 + H_2O$

Uses of CO_2:

1. It is used to make soft drinks like soda water, coca-cola, etc.
2. It is used to manufacture of fertilizers like urea.
3. It is used to make dry ice, which is used as a refrigerant to preserve foods, fruits, meat, etc.
4. It is used in fire extinguishers.
5. It is used in carbonation process. (The process of purification of sugar by passing CO_2 gas is called carbonation.)
6. It is used by plants for photosynthesis.

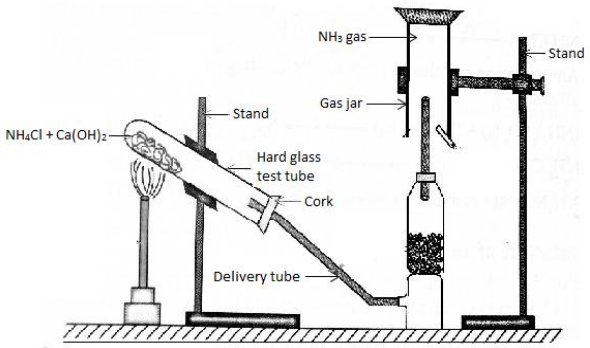
$$6CO_2 + 6H_2O \xrightarrow{sunlight} C_6H_{12}O_6 + 6O_2$$

Ammonia

Laboratory preparation of ammonia gas:

In laboratory ammonia gas is prepared by heating two parts of ammonium chloride(NH_4Cl) and one parts of calcium hydroxide[$Ca(OH)_2$].

$$2NH_4Cl + Ca(OH)_2 \longrightarrow CaCl_2 + 2H_2O + 2NH_3$$



Precaution:

1. The apparatus must be air tight.
2. Ammonia gas is collected by the downward displacement of air because it is lighter than air.
3. The hard glass test tube should be kept in inclined position facing the mouth of the test tube downward to prevent it from cracking.
4. Ammonia gas should be passed through lime tower to get dry ammonia because lime (CaO) absorbs water vapour.

Test of ammonia gas:

1. A moist red litmus paper kept at the mouth of the gas jar turns into blue because NH_3 is basic in nature.
2. It is tested by its specific pungent odour.
3. A glass rod dipped into the conc. HCl is inserted into the gas jar it gives white fumes of NH_4Cl.

Some general methods of preparation of ammonia gas:

1. Ammonia gas is prepared by heating ammonium salts like ammonium chloride, ammonium sulphate and ammonium carbonate.

   $(NH_4)_2CO_3 \xrightarrow{\Delta} H_2O + CO_2 + 2NH_3$ $(NH_4)_2SO_4 \xrightarrow{\Delta} H_2O + CO_2 + 2NH_3$

   $NH_4Cl \xrightarrow{\Delta} HCl + NH_3$

2. Ammonia gas can be prepared by the reaction between ammonium salts with strong bases/alkalis.

   $(NH_4)_2SO_4 + 2NaOH \xrightarrow{\Delta} Na_2SO_4 + 2H_2O + 2NH_3$

   $NH_4Cl + KOH \xrightarrow{\Delta} KCl + H_2O + NH_3$

Manufacture of ammonia gas: Ammonia gas is manufactured by heating one part of nitrogen gas and three part of hydrogen gas under high temperature and pressure. This process is called Haber's process.

$$N_2 + 3H_2 \overset{\Delta}{\rightleftharpoons} 2NH_3$$

It is a reversible and exothermic reaction which requires the following conditions,

1. Temperature of about 500^oc should be maintained.
2. High pressure of about 200-900 atm should be maintained.
3. Finely divided iron is used as a catalyst.
4. Traces of molybdenum are used as a promoter.

Physical properties of ammonia gas:

1. It is colourless gas with a pungent smell.
2. It is highly soluble in water.
3. It is lighter than air.
4. It is basic in nature and it turns moist red litmus paper into blue.
5. It is neither combustible nor a supporter of combustion.

Chemical properties of ammonia gas:

1. Ammonia gas dissolves in water to give liquor ammonia.

   $NH_3 + H_2O \rightarrow NH_4OH$

2. Ammonium solution reacts with acids to give salts and water.

   $NH_4OH + HCl \rightarrow NH_4Cl + H_2O$

   $2NH_4OH + H_2SO_4 \rightarrow (NH_4)_2SO_4 + 2H_2O$

3. Ammonia reacts with different acids to give fumes of ammonium salts.

   $NH_3 + HCl \rightarrow NH_4Cl$

   $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$

   $NH_3 + HNO_3 \rightarrow NH_4NO_3$

4. Ammonia gas reacts with carbon dioxide gas at 1500^oc to give urea.

   $2NH_3 + CO_2 \longrightarrow NH_2-CO-NH_2 + H_2O$

Uses of ammonia gas:

1. Liquid ammonia is used in refrigerator for cooling purpose.
2. It is used for manufacture of nitric acid, plastic, washing soda, etc.
3. It is used to develop blue print of the maps.
4. It is used as a cleansing agent to remove oil, grease, etc.
5. It is used to manufacture of chemical fertilizers like urea, ammonium sulphate, ammonium chloride, etc.
6. It is used for making dyes, rayon, nylon, explosives, etc.

1. *Ammonia gas is lighter than air so it is collected by the downward displacement of air. (or gas jar is inverted downward)*
2. *The hard glass test tube should be kept in inclined position facing the mouth of the test tube downward to prevent it from cracking due to collection of water drops on the hot part of test tube after condensation of evaporated water produced during the chemical reaction.*
3. *Moist red litmus paper used to test the ammonia gas because ammonia gas is highly soluble in water; moreover ammonia is basic in nature.*
4. *Ammonia gas is not collected by the downward displacement of water because it is highly soluble in water.*
5. *Promoters are those chemicals which increases the efficiency of the catalyst.*
6. *Dilute sulphuric acid cannot be used in place of dilute hydrochloric acid because calcium sulphate is formed after the reaction, which covers the remaining part of the marble and stops further reaction.*

Metals

Metals: Metals are the electropositive elements which are good conductors of heat and electricity.
Minerals: Minerals are those naturally occurring chemical substances which contain metals in some amount.
Ores: Those minerals from which metals can be extracted conveniently and profitably are called ores.
Alloys: alloys are the mixture of metals or non-metals.

Some alloys of copper, their composition and their uses:

Alloys	Composition	Uses
Brass	Cu + Zn	To make nut bolts, condenser tubes and medals.
Bronze	Cu + Zn + Sn	To make household utensils and coins.
German silver	Cu + Zn + Ni	To make utensils and bells.
Gun metal	Cu + Zn + Sn + Pb	To make ball bearings and parts of machines.
Bell metal	Cu + Zn	To make bells and decorative items.

The increasing order of melting point of five metals is Al < Ag < Au < Cu < Fe.
The increasing order of density of five metals is Al < Fe < Cu < Ag < Au.
The increasing order of reactivity of five metals is Au < Ag < Cu <Fe <Al.

Differences between minerals and ores:

Minerals	Ores
• They contain metals in more or less amount.	• They contain metals in more amounts.
• We cannot extract metals from minerals.	• We can extract metals from ores.
• All minerals are not ores.	• All ores are minerals.

Occurrence of metals in Nepal:

Metals	**Ores**	**Districts**
Iron	Magnetite and Haematite	Lalitpur, Tanahun, Bhojpur, Ramechhap, Pyuthan, Chitwan
Copper	Chalcopyrite and copper glance	Udayapur, Dhading, Makawanpur, Solukhumbu.
Gold	Sandy alluvial soil, free gold	Rapti, Mustang, Kathmandu
Magnesium	Magnesite	Udayapur, Dolakha
Cobalt	Cobaltite	Palpa, Gulmi
Calcium	Limestone	Kathmandu, Udayapur,Dhading, Makawanpur
Bismuth	Bismuth	Makawanpur (Bhimphedi)
Lead	Lead deposit	Lalitpur, Ganesh Himal (Rasuwa)

Metallurgy: The process by which metals are extracted from their respective ores is called metallurgy.

By which properties metals are used to make pots and pans?
Metals are good conductor of heat and are malleable. Because of these properties metals are used to make pots and pans.
By which properties of copper it is used to make wires?
Copper is good conductor of electricity and is ductile. Because of these properties copper is used to make wires.

Some metals:

Metals	Position in Periodic table			Ores	Physical properties	Uses
Iron	d-bloc	8- group	4-period	**Haematite, magnetite, iron pyrite and siderite.**	It is gray white in colour. It is good conductor of heat and electricity. It is malleable and ductile. Its melting point is 1500^0C and boiling point is 2500^0C. Its specific gravity is 7.86.	It is used for manufacturing of rods, pipes and wires. It is used for making parts of vehicles and railway tracks. It is used for making nails, nuts and bolts. It is used for making cooking utensils and agricultural tools. It is used for making weapons. It is used as catalysts in chemical reaction as catalyst. It is used for manufacturing of steel.
Aluminium	p-block	13-group	3-period	**Bauxite, feldspar, cryolite and kaolin.**	It is white in colour. It is good conductor of heat and electricity. It is malleable and ductile. Its melting point is 660^0C and boiling point is 1800^0C. Its specific gravity is 2.7.	It is used for making cooking utensils. It is used for making bodies and parts of airplanes, ships, cars and motorcycles. It is used for making electric cables. It is used for making silver paint. It is used for making aluminium foil used for packaging medicines, chocolates and for packaging foods. It is used for making coins.
Copper	d-block	11-group	4-period	**Copper pyrite (chalcopyrite), copper glance (chalcocite), and cuprite.**	It is reddish brown in colour. It is good conductor of heat and electricity. It is malleable and ductile. Its melting point is 1083^0C and boiling point is 2350^0C. Its specific gravity is 8.95.	It is used for making electric wires. It is used for making household utensils. It is used for making coins. It is used as in electroplating and electrotyping. It is used for making alloys like bronze and brass.
Silver	d-block	11-group	5-period	**Silver glance (argentite), silver copper glance and horn silver.**	It is white in colour. It is good conductor of heat and electricity. It is malleable and ductile. Its melting point is 960^0C and boiling point is 1955^0C. Its specific gravity is 10.5.	It is used for electroplating. It is used for making medals. It is used in photography. It is used for making ornaments. It is used for filling teeth (Crown bridge). It is used for shining mirrors.
Gold	d-block	11- group	6- period	**Calaverite, alluvial soil and quartz veins (reef gold)**	It is bright yellow in colour. It is good conductor of heat and electricity. It is malleable and ductile. Its melting point is 1063^0C and boiling point is 2530^0C. Its specific gravity is 19.3.	It is used for electroplating. It is used for making medals. It is used in photography. It is used for making ornaments. It is used for filling teeth (Crown bridge). It is used for making gold leaf electroscope. It is used in medicines.

Hydrocarbon and Its Compounds

Hydrocarbon: Those compounds which are formed by the combination of carbon and hydrogen are called hydrocarbon. They are of two types;

1. Saturated hydrocarbons (Alkanes) 2. Unsaturated hydrocarbons(Alkenes and Alkynes)

Saturated hydrocarbons: The hydrocarbon compounds in which carbon atoms are connected by a single covalent bond are called saturated hydrocarbons. They are also called alkanes. Their general formula is C_nH_{2n+2}. They are also called paraffin because they are chemically less reactive.

Naming of hydrocarbon compounds: There are two system of naming of hydrocarbon compounds, they are;

1. Common system. 2. IUPAC system.

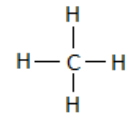
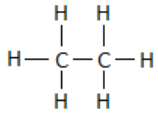
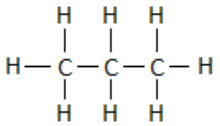
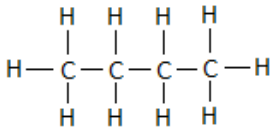
Common system: The naming of organic compound and hydrocarbon compounds without any rules and structural values is called common system.

IUPAC system (International Union Of Pure and Applied Chemistry): The naming of organic compounds and hydrocarbon compounds by using root words and suffices is called IUPAC system. Some root words are as below;

Carbon number	Root words
C_1	Meth
C_2	Eth
C_3	Prop
C_4	But

No. of bond	Suffices
Single bond (—)	ane
Double bond(=)	ene
Triple bond (≡)	yne

Some alkanes, their structural formula, molecular formula and their names.

Structural formula	Molecular formula	Name	Uses
	CH_4	Methane	1. It is used as a fuel in the form of LPG. 2. It is used to make carbon black which is used in rubber industries. 3. It is used to make printing inks.
	C_2H_6	Ethane	1. It is used as a source of heat for cooking purpose in the form of bio gas. 2. It is used for making shoe polish and diethyl ether.
	C_3H_8	Propane	1. It is used in petroleum industries for cooling process. 2. It is used in gas lighter.
	C_4H_{10}	Butane	1. It is used as a fuel in the form of LPG. 2. It is used in rubber industries as a raw material.

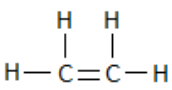
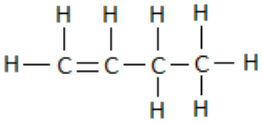
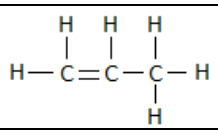
Methane gas is mostly found in marshy places, so it is also called marshy gas.

Unsaturated hydrocarbons: The hydrocarbon compounds in which any two carbon atoms are connected by double or triple covalent bond are called unsaturated hydrocarbons. They are of two types;

1. Alkenes
2. Alkynes

Alkenes: The hydrocarbon compounds in which any two carbon atoms are connected by double covalent bond are called alkenes. Their general formula is C_nH_{2n}.

Some alkenes, their structural formula, molecular formula and their names.

Structural formula	Molecular formula	Name	Structural formula	Molecular formula	Name
	C_2H_4	Ethene/Ethylene		C_4H_8	Butene/Butylene
	C_3H_6	Propene/Propylene			

Alkynes: The hydrocarbon compounds in which any two carbon atoms are connected by triple covalent bond are called alkynes. Their general formula is C_nH_{2n-2}.

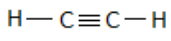
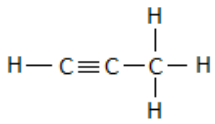
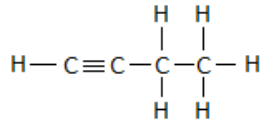
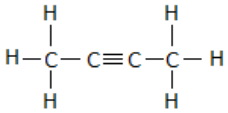
Differences between saturated and unsaturated hydrocarbons:

Saturated hydrocarbon	Unsaturated hydrocarbon
• They have single covalent bond between carbon atoms.	• They have double or triple covalent bond between any two carbon atoms.
• Their general formula is C_nH_{2n+2}	• Their general formula are C_nH_{2n} or C_nH_{2n-2}
• They are less reactive.	• They are more reactive.

Differences between alkanes and alkenes:

Alkanes	Alkenes
• They are hydrocarbon having single covalent bond.	• They are hydrocarbon having double covalent bonds between any two carbon atoms.
• Their general formula is C_nH_{2n+2}.	• Their general formula is C_nH_{2n}.
• They are less reactive.	• They are more reactive.

Some alkynes, their structural formula, molecular formula and their names.

Structural formula	Molecular formula	Name
	C_2H_2	Ethyne/acetylene
	C_3H_4	Propyne/methyl acetylene
	C_4H_6	Butyne/Ethyl acetylene
	C_4H_6	Butyne/Dimethyl acetylene

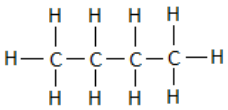
Alkenes are also called olefins because they produce oil like substances.
Alkenes are more reactive than alkanes and alkynes are more reactive than alkenes.
When alkenes or alkynes react with sufficient hydrogen they form alkanes.

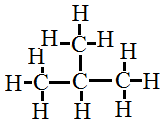
Homologous series: The series of organic compounds having same general formula and similar chemical properties in which each successive members differs by CH_2 group is called homologous series.eg. CH_4, C_2H_6, C_3H_8, C_4H_{10} ……

Characteristics of homologous series;

1. All members of the series can be represented by same general formula.
2. Each successive member of the series differs by CH_2 group.
3. All members of the series shows similar chemical properties.

Isomers: Hydrocarbon compounds having same molecular formula but different structural formula are called isomers.


n-butane


Iso-Butane

Alkyl groups or alkyl radicals: The hydrocarbon units derived by the removal of one hydrogen atom from alkane are called alkyl group or alkyl radicals.

Functional group: The atom or group of atoms which determines the chemical behavior of organic compounds is called functional group. Some examples of alkyl groups and functional groups are as follows;

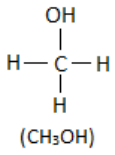
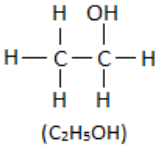
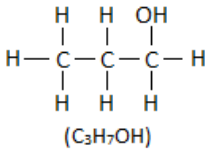
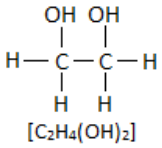
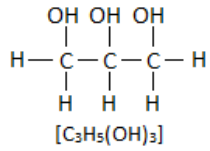
Alkanes	Alkyl radicals
CH_4(Methane)	CH_3(Methyl)
C_2H_6(Ethane)	C_2H_5(Ethyl)
C_3H_8(Propane)	C_3H_7(Propyl)

Name of functional groups	Symbol of functional groups	Organic compounds formed
Hydroxyl	-OH	Alcohol
Ether	-O-	Ether
Amino	$-NH_2$	Amine
Carboxylic acid	-COOH	Acid
Aldehyde	-CHO	Aldehyde

Alcohol: Alcohols are the hydroxyl derivatives of saturated hydrocarbon compounds. Depending upon the number of hydroxyl group alcohols are of three types;

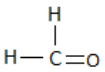
1. Monohydric alcohol(Alcohol having only one –OH group)
2. Dihydric alcohol(Alcohol having two –OH group)
3. Trihydric alcohol(Alcohol having three –OH group

Some alcohols and their uses:

Types of alcohols	Structural and molecular formula	Names	Uses
Monohydric alcohols	 (CH_3OH)	Methyl alcohol (methanol)	It is used in sprit lamp. It is used to dissolved fats, oil, paints, varnish etc. It is used in dry cleaning. It is used to manufacture of formaldehyde and methyl chloride.
	 (C_2H_5OH)	Ethyl alcohol (ethanol)	It is used as alcoholic beverage. It is used as preservative for biological specimen. It is used as thermometric liquid. It is used as solvent for fat, oil, resins etc.
	 (C_3H_7OH)	Propyl alcohol (propanol)	
Dihydric alcohol	 $[C_2H_4(OH)_2]$	Glycol	
Trihydric alcohol	 $[C_3H_5(OH)_3]$	Glycerol (glycerine)	It is used as a sweetening agent in confectionary, beverages and medicines. It is used as a lubricant by watch mechanic. It is used in soaps and cosmetics. It is used in preserving tobacco and fruits from drying out.

Properties of glycerine: It is colourless, viscous liquid. It is sweet in taste.

Formaldehyde: It is a naturally occurring gaseous compound having molecular formula HCOH. It is also known as methanol. It is highly soluble in water and its solution in water is known as formalin. Its structural formula is,



Physical properties of formaldehyde:

1. It is colourless gas and has a characteristic odour of irritating.
2. It is highly soluble in water.

Uses of formaldehyde:

1. It is use as disinfectant as it kills most bacteria and fungi.
2. It is used in preserving biological specimens.
3. It is used to treats warts.
4. It is used in leather industries for tanning.
5. It is used in the manufacture of Bakelite.

Glucose: It is one of the monosaccharaides of carbohydrates having molecular formula $C_6H_{12}O_6$. It is a crystalline white powder which dissolves easily in water and is sweet in taste. It is found in fruits and honey. It helps in transportation of free sugar in the blood of animals. It helps our body to produce ATP which is utilized to release energy in our body. It also helps to maintain balance in metabolic activities. It is also called dextrose.

Useful effects of glucose:

1. Glucose is an important primary source for the brain cells and is also a source of energy for almost all the cells thought the body.
2. It is used as sweetener in food medicine and beverage.
3. It regulates the various metabolic activities of the body.

Harmful effect of glucose:

High blood glucose;

1. High blood glucose causes hypertension, depression and swollen of certain body parts.
2. It also causes heart diseases.
3. When the blood glucose level is too high, the body does not use glucose properly or it does not make the hormone insulin in adequate amount which causes diabetes.

Low blood glucose;

Low blood glucose in the blood causes short-term complication like confusion and dizziness and long term complications like restless in nights, shakes and tremors, emotional instability, sweating, vision problems. Blurred speech, etc.

Materials Used In Daily Life

Cement: cement is a mixture of fine gray powder of calcium silicate and calcium aluminate.

Raw materials:

a. Limestone($CaCO_3$) b. Special type of clay c. Gypsum($CaSO_4 .2H_2O$)

Process of manufacturing:

1. The mixture of limestone and clay are first crushed and ground to fine powder.
2. The powder of raw materials is then mixed with water and is blended which is called slurry.
3. The slurry is then passed from the top of rotary kiln, where it is heated up to 1600^0c.
4. The heated mixture is obtained from the bottom of the rotary kiln in the form of red hot ball which is called cement clinker.
5. The cement clinker is cooled and ground into fine powder and finally 2.5% gypsum is added to it. (Gypsum is added to the cement to increase its setting time.)

$$CaCO_3 + Al_2O_3 + SiO_2 \xrightarrow{\Delta} CaSiO_3 + CaAl_2O_3$$

Uses of cement:

Cement is used for making houses, buildings, roads, bridges etc. in the following three ways:

1. Mortar: It is the mixture made by blending of cement, sand and water. It is used for plastering walls and joining bricks, stones, etc.
2. Concrete (plain cement concrete/PCC): It is the mixture made by blending of cement, sand, gravel and water. It is used for roofing and flooring.
3. Reinforced cement concrete/RCC: It is the mixture made by blending of cement, sand, gravel and water with iron framework. It is used for making pillars, roof of buildings, bridges, etc.

Glass: Glass is an amorphous transparent homogenous mixture of metal silicates.

Glass is also called super cooled liquid because the molecules of glass move slowly from top to bottom like the molecules of liquid. A vertically placed mirror of glass of windows becomes slightly thicker at the bottom than at the top after many years.

Properties of glass:

1. Glass is a homogenous mixture of different types of metallic silicates.
2. It is hard and transparent.
3. It is a super cooled liquid.
4. It is a bad conductor of heat and electricity.
5. It does not react with acid, base, salt and other chemicals.

Types of glass:

1. Quartz glass /silica glass (hard, strong and has very low coefficient of thermal expansion)
2. Water glass (soluble in water)
3. Ordinary glass/soda lime/ soft glass (it is easily soften while heating)
4. Hard glass/potash lime glass (its melting point is high)
5. Borosilicate glass/Pyrex glass (it does not expand on heating and contract of cooling)
6. Lead crystal glass/flint glass or optical glass (it has high refractive index)

Compositions of different glass:

1. Silica $\xrightarrow{\Delta}$ Quartz glass
2. Silica + sodium carbonate $\xrightarrow{\Delta}$ Water glass

   ($SiO_2 + Na_2CO_3 \xrightarrow{\Delta} Na_2SiO_3 + CO_2$)

   Silica + potassium carbonate $\xrightarrow{\Delta}$ Water glass

   ($SiO_2 + K_2CO_3 \xrightarrow{\Delta} K_2SiO_3 + CO_2$)
3. Silica + sodium carbonate + calcium carbonate $\xrightarrow{\Delta}$ Ordinary glass
4. Silica + potassium carbonate + calcium carbonate $\xrightarrow{\Delta}$ Hard glass
5. Silica + sodium carbonate + calcium carbonate + boric oxide $\xrightarrow{\Delta}$ Borosilicate glass
6. Silica + potassium carbonate + lead oxide $\xrightarrow{\Delta}$ Lead crystal glass

Uses of different types of glass:

1. Quartz glass: to make quartz crystals, crucibles, etc.
2. Water glass: to make silica garden, fire proof materials, gums, glue and paste.
3. Ordinary glass: to make ordinary glass vessels, windows panes, glass bottles, etc.
4. Hard glass: to make test tubes, beakers, conical flask, round bottom flasks, etc.
5. Borosilicate glass: to make beakers, measuring cylinders, conical flasks, round bottom flasks, etc.(these all are used for measuring volume of liquids)
6. Lead crystal glass: to make lens, prism, glass slab, electric bulbs.

Coloured glass: Coloured glass can be prepared by adding different metal oxides in the mixture during the preparation of glass. Some metal oxides and the colour obtained in glass are as given below:

a. Cobalt oxide → blue b. Nickel oxide → black c. Chromium oxide → green d. Manganese oxide→ purple

e. Copper oxide → red f. Ferric oxide→yellow/brown g. Tin oxide → milky white

If boric oxide is added to the glass, the glass thus prepared does not expand on heating and contract on cooling.
If lead oxide is added to the glass then its refractive index increases.
Annealing: During the preparation of ordinary glass the hot molten mass of the raw materials is poured into the die and is allowed to cool down slowly, this process of cooling of glass materials is called annealing.

Ceramics: Ceramics is a type of clay which contains the compounds of carbon, hydrogen, nitrogen, oxygen and silica. The materials made from ceramics clay are also called ceramics.

Process of manufacturing of ceramics materials:

1. Ceramics clay is blended with water.
2. Then it is casted into desired shapes.
3. Then it is dried in the sun.
4. Then it is heated in the furnace.
5. The ceramics materials thus heated becomes porous. In order to remove the pores fine salt powdered is sprayed over it in hot state. *The ceramics materials are coated with tin oxide of lead oxide and are heated again which makes a thin layer over the surface, this process is called glazing*

Properties of ceramics:

1. They are poor conductor of heat and electricity.
2. They can withstand high temperature.
3. They are not affected by acids, bases and other chemicals.
4. They are hard and brittle.

Uses of ceramics:

1. It is used in making crockery like cups, bowls, plates, dishes, etc.
2. It is being a poor conductor of electricity; it is used in electrical appliances.
3. It is used to make bathroom tiles, roof tiles, sinks, commodes, etc.
4. It is used to make artificial teeth and artificial leg.

Soap: Soap is a sodium or potassium salt of long chain fatty acids that has cleansing property in water.

Saponification: The process by which soap is prepared by heating fat or oil with sodium hydroxide.

$C_3H_5(COOC_{17}H_{35})_3 + 3NaOH \xrightarrow{\Delta} 3\ C_{17}H_{35}COONa + C_3H_5(OH)_3$

Examples of soaps: Sodium stearate($C_{17}H_{35}COONa$) and sodium palmitate($C_{15}H_{31}COONa$).

Process of soap preparation:

1. Fat or vegetable oil is heated with sodium hydroxides stirring continuously.
2. During heating precipitation takes place and the precipitate starts settling down.
3. Little amount of sodium chloride is added continuously throughout the heating, which helps in precipitation. The solid substance settled is soap and liquid is the glycerol.
4. For making soap hard sodium carbonate is added to it.

Detergent: Detergent are synthetic petrochemicals obtained from hydrocarbons which are more soluble than soap.
Detergent is also called soapless soap because it has cleansing property like a soap but does not contain the chemicals that are found in soap.Examples: Sodium lauryl sulphate, sodium pyrophosphate and alkyl benzene sulphonate.

Differences between soap and detergent:

Soap	Detergent
• Soap is a sodium salt of long chain fatty acids.	• Detergent are synthetic petrochemicals obtained from hydrocarbons
• It is prepared from the animal fat or vegetable oil.	• It is obtained from the hydrocarbons of petroleum.
• It does not work with hard water.	• It works with hard water also.
• It is bio-degradable.	• It is non bio-degradable.

Monomers: A unit molecule which can be combined with other such molecules to form a long chain molecule is called monomer.eg. ethene, ethyne, vinyl chloride, styrene, etc.

Polymer: A long chain molecule which is formed by joining monomers unit is called polymer.

Types of polymers:

a. Natural polymer (eg. Wool, silk, protein, cellulose, natural rubber, starch, etc.)
b. Artificial polymer (eg. polyethene, polystyrene, nylon, PVC, artificial rubber, etc.)

Polymerization: The process by which polymer is made by joining monomer molecules is called polymerization.

Plastic: Plastic is a kind of artificial polymer made by polymerization of carbon containing monomers.

Classification of plastics: a. Thermoplastic b. Thermosetting plastic

Thermoplastic: The plastic which melts on heating and can be remoulded in to different shapes.

Some examples of thermoplastics are;

1. Polythene (polyethylene): A thermoplastic which is formed by the polymerization of many ethene molecules is called polythene.
   $n\ (CH_{2=}\ CH_2) \xrightarrow{polymerization} (\text{-}CH_2\text{-}CH_2\text{-})n$
   It is used for making bottles, buckets, pipes, toys, packing materials, for insulating electric wires, etc.
2. PVC (Polyvinyl chloride): A thermoplastic which is formed by the polymerization of many vinyl chloride (CH=CHCl) molecules is called polyvinyl chloride.
   It is used for making rain coats, curtains, hand bags bottles, cover for motor car seats, buckets, covering for suitcase, etc.
3. Polystyrene: A thermoplastic which is formed by the polymerization of many styrene molecules is called polystyrene.
   It is used for making toys, thermos-flasks, ceiling tiles, thermocol.

Thermosetting plastic: The plastic which does not melt on heating and cannot be remoulded again and again is called thermosetting plastic. This type of plastic hardens more but does not melt on heating.
Some examples of thermosetting plastics are;
Bakelite: A thermosetting plastic formed by polymerization of formaldehyde and carbolic acid (phenol) is called bakelite.
It is used for making handles of pressure cookers, kettles, plugs, buttons, switches, etc.
Melamine: A thermosetting plastic which is formed by polymerization of melamine and formaldehyde is called melamine.
It is used for making cups, plates, bowls, etc.
Differences between thermoplastics and thermosetting plastic:

Thermoplastic	Thermosetting plastic
• It melts on heating.	• It does not melt on heating.
• It can be remoulded.	• It cannot be remoulded.
• It is soft, elastic and less brittle.	• It is hard, strong, non-elastic and more brittle.

Common uses of plastics:
1. Plastics are used as insulators as they are bad conductors of heat and electricity.
2. They are used for making parts of vehicles instead of metals.
3. They are used for making pipes, bags seat covers, water tanks, water bags, etc.
4. They are used for making surgical instruments, medicine cover, medicine bottle, etc.
5. They are used for packing materials.

Demerits of plastics:
1. They are non-biodegradable. So they cause water and soil pollution.
2. Burning of plastic produces poisonous gases which cause air pollution.

Fibers: Fibers are thread like substances which are long, strong and elastic.
Types of fibers: 1. Natural fibers 2. Artificial fibers
Natural fibers: Naturally occurring fibers are called natural fibers. They are of two types; a. Plant fibers b. Animal fibers.
Plant fiber: The fiber which is obtained from plant is called plant fiber. For examples; cotton, jute, hemp, bombax.
Animal fiber: The fiber which is obtained from animal is called animal fiber. For examples; wool, silk, pashmina, etc.
Merits of artificial fibers:
1. The clothes made from natural fibers are comfortable to wear.
2. The clothes made from natural fibers have property of retaining our body heat.
3. The clothes made from natural fibers are more absorbent.

Demerits of natural fibers:
1. The clothes made from natural fibers do not retain their creases.
2. The clothes made from natural fibers are attacked by insects.
3. The clothes made from natural fibers are not durable.

Artificial fiber: Manmade fiber is called artificial fiber. They are of two types; a. Recycled fibers b. Synthetic fibers
Recycled fibers: Artificial fibers which are made from natural substances are called recycled fibers. Rayon is the example of recycled fiber. Rayon looks like silk in appearance, so it is also called artificial silk.
Synthetic fibers: Fibers which are made artificially by chemical process are called synthetic fibers. For examples; Acrylene, nylon, polyster, terelene, olefin, crestan, orlan, etc.
Nylon: It is a synthetic polymer which is formed by polymerization of amide molecules. So it is also called polyamide.
Uses of nylon: It is used for making carpets, socks, tyres, dresses, fishing nets, parachute ropes, etc.
Terylene: It is a synthetic fiber which id formed by the polymerization of ester molecules. For examples; polyester, kodel, fortel, etc.
It is used for making textiles, suit, etc.
Acrylic fibers: These include creslan, orlan, etc. They are used for making sweater, gloves, etc
Merits of artificial fibers:
1. The clothes made from artificial fibers are strong, durable and elastic fiber.
2. The clothes made from artificial fibers do not wrinkle and are not attacked by insects.
3. The clothes made from artificial fibers absorb less water and dries up easily.

Demerits of artificial fibers:
1. The clothes made from artificial fibers catch fire easily. 2. The clothes made from artificial fibers are less absorbent.

Insecticides: Man made poisonous chemical compounds that are used to kill or control harmful insects are called insecticides. They are of two types;
a. Organic insecticides b. Inorganic insecticides
Organic insecticides: Organic insecticides are the synthetic compounds which are mainly composed of carbon, hydrogen and oxygen. They are of three types: i. Organochlorine insecticides ii. Organophosphorous insecticides iii.Carbamate insecticides
Organnochlorine insecticides: The organic insecticides which contain chlorine as an additional element are called organochlorine insecticides. Eg.Aldrin, Dialdrin, Methoxychlor, DDT(Dichlorodiphenyltrichloro ethane), BHC (Benzene hexachloride), etc.
Organophosphate insecticides: The organic insecticides which contain phosphorous as an additional element are called organophosphate insecticides. Eg.Malathion, Parathion, Phosdrin, etc.
Carbamate insecticides: The organic insecticides which contain amine as an additional group are called carbamate insecticides. Eg.Begon, Termic,etc.
Inorganic insecticides: The insecticides which are made from minerals are called inorganic insecticides. Eg. Calcium arsenate, lead arsenate, fluoride, limes sulphur, etc.

Fertilizers: Fertilizers are those water soluble substances which are used in the soil to increase crop production by supplying essential nutrients. They are of two types; a. Organic fertilizers b. Inorganic fertilizers

Organic fertilizers: The fertilizers which are obtained from the decomposition of plants of animals wastes. They are of two types;

a. Green manure b. Compost manure

Green manure: Green manures are the green plants which are grown, ploughed and mixed in the soil to provide essential nutrients to the growing plants. Some leguminous plants contain rhizobium bacteria in the root nuddles, which provides nitrogen as nutrients to the soil. The decomposed parts of the plant body provide humus.

Compost manure: Compost manure is the organic fertilizer which is made from dead, decayed and decomposed parts of animals and plants or their waste products.

Process of making compost manure: Mixtures of dead plants, waste product of animals are kept in a pit with altering layers. Little amount of lime is also added to the mixture. The mixture decomposed due to bacteria and changed into compost manure.

Role of compost manures:

1. Compost manures supplies almost all the basic nutrients to the soil.
2. It helps to conserve water in the soil.
3. It is biodegradable and environment friendly.
4. It drastically reduces the need of insecticides and fertilizers and their harmful effects to the environment.
5. It maintains the p^H value of the soil i.e. it does not change the acidic and basic properties of the soil.
6. It helps to increase the soil organisms.

Chemical fertilizers: Man made chemical substances which are added to the soil to increase crop production by supplying essential elements are called chemical fertilizers. They are of three types;

a. Nitrogenous fertilizers b. Phosphorous fertilizers c. Potassium fertilizers

Nitrogenous fertilizers: The fertilizers which contain nitrogen are called nitrogenous fertilizers. For examples;

i. Urea [NH_2CONH_2] ii. Ammonium sulphate [$(NH_4)_2SO_4$] iii Ammonium nitrate [NH_4NO_3]

Phosphorous fertilizers: The fertilizers which contain phosphorous are called phosphorous fertilizers. For examples;

i. Ammonium phosphate [$(NH_4)_3PO_4$]
ii. Calcium superphosphate [$Ca(H_2PO_4)_2.2CaSO_4$]
iii. Calcium super phosphate [$3Ca(H_2PO_4)_2$]
iv. Bone meal

Potassium fertilizers: The fertilizers which contain potassium are called potassium fertilizers. For examples;

i. Potassium chloride (KCl)
ii. Potassium nitrate (KNO_3)
iii. Potassium sulphate (K_2SO_4)
iv. Potassium carbonate (K_2CO_3)
v. Ash

Importance of nitrogen to the plants:

1. It helps to increase the chlorophyll content in the plants and makes the leaf green.
2. It helps to increase the crop yield.

Effects of deficiency of nitrogen:

1. It causes less increase the chlorophyll content in the plants and makes the leaf yellowish.
2. It causes decrease in the crop yield.

Importance of phosphorous to the plants:

1. It helps in growth and development of the roots.
2. It helps in ripening of fruits in time.

Effects of deficiency of phosphorous:

1. It causes poor growth and development of roots.
2. It causes delay in ripening of fruits.

Importance of potassium in the plants:

1. It helps in the growth and development of the stem and flowers.
2. It helps to resist diseases.

Effects of deficiency potassium:

1. It causes poor growth and development of the stem and flowers.
2. It reduces the diseases resistant power of the plants.

Differences between organic fertilizers and chemical fertilizers:

Organic fertilizers	Chemical fertilizers
• They are obtained from decomposition of plants of animals wastes.	• They are obtained from chemical processes in industries.
• They are less soluble in water.	• They are more soluble in water.
• They supply nutrients in traces amount.	• They supply nutrients in sufficient amounts.
• Plants absorb them very slowly.	• Plants absorb them very fast.

According to the number of basic nutrients supplied there are three types of nutrients;

1. Single fertilizers
2. Mixed fertilizers
3. Complete fertilizers

Single fertilizers: The fertilizers which supply only one basic nutrient, i.e. nitrogen or phosphorous or potassium are called single fertilizers. For examples; calcium nitrate, potassium chloride, potassium sulphate.

Mixed fertilizers: The fertilizers which supply any two of the basic nutrients are called mixed fertilizers. For examples, potassium nitrate, ammonium phosphate, etc.
Complete fertilizers: The fertilizers which supply all the basic nutrients are called complete fertilizers. It is also called NPK fertilizers. It is made by mixing two or more than two single fertilizers.
Chemical pollution: The pollution created by unwanted and excessive use of chemical substances is called chemical pollution.
Causes of chemical pollution:

1. Use of insecticides: Insecticides are non-biodegradable, so their effect remains for long time. Insecticides like DDT cause water, air and soil pollution.
2. Use of fertilizers: Different fertilizers used are washed away by water and are carried into the water sources. Due to presence of excess fertilizers, many aquatic plants grow into the water, which absorbs oxygen dissolved in water. Due to lack of oxygen aquatic animals cannot survive. Similarly if NO_3 rich fertilizers are washed by rain water and goes to the underground sources and if the water is drunk by children it causes Dwarfness.
3. Household waste: Different harmful gases are produced from the household waste, which causes air pollution.
4. Plastics: Burning of plastics produces harmful gases like carbon monoxide. It causes carbon monoxide poisoning. Similarly if it is thrown in the soil plant cannot grow properly and cannot absorb minerals below the plastics.
5. Smoke from vehicles and industries: Different gases produced from vehicles and industries cause global warming, different diseases and acid rain.
6. Colouring matters used in foodstuff: Different harmful chemicals are used in food items to make them attractive. These chemicals can cause cancer like diseases.
7. Synthetic cleansers: If synthetic cleansers are brought in contact with our body it causes cancer. It is non-biodegradable and also causes water pollution.

Control measures of chemical pollution:

1. Use of insecticides should be reduced and other alternatives should be adopted.
2. Before using insecticides soil test should be done.
3. Household waste should be properly managed.
4. Use of plastic materials should be avoided and other alternatives should be brought in use.
5. Smoke produced from industries and vehicles should be filtered.
6. Chemicals should not be used in food items to make them colourful and such food items should not be consumed.
7. Synthetic cleansers should not be used as far as possible.

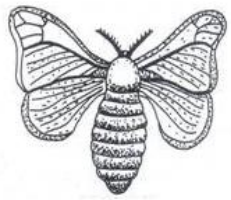
Solid waste: The unwanted or unusable biodegradable and non-biodegradable waste that comes from industries, houses, agricultural operations and community activities are called solid waste.
Types of solid waste;
Biodegradable solid wastes: The solid wastes that can be decomposed into its simpler components by micro-organisms in short period of time are called biodegradable wastes. Eg. Clothes, papers, human wastes, animal dung, vegetable wastes.
Non-biodegradable solid waste: The solid wastes that cannot be decomposed into its simpler components by micro-organisms are called non-biodegradable wastes. Eg. Plastic, foam, pieces of metals, glass pieces, etc.
Solid waste management: Solid waste management is all the activities and actions taken to manage waste from its inception to its final disposal.
Methods of solid waste management:

1. Collection: Solid wastes must be collected by implementing formal waste collection system science it helps for the proper disposal of wastes and controlling the impacts of wastes to the environment.
2. Transportation: After collection of the solid wastes it should be transported to proper places away from the residential area for further processing.
3. Segregation: The biodegradable and non-biodegradable wastes should be segregated after collection.
4. Processing: Many waste management centers or recycling centers must be established far from residential areas and the segregated wastes that can be recycled should be recycled.
5. Landfill dumping: The solid wastes that cannot be recycled should be taken to the dumping sites which is constructed far from residential areas and should be dumped.
6. Incineration: The solid wastes that produce fewer amounts of harmful gases should be incinerated nearby the dumping sites under high temperature.

Invertebrates

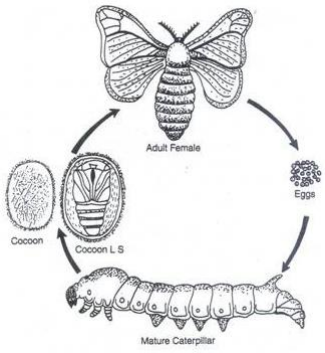
Invertebrates: Invertebrates are those animals which do not have backbone or vertebral column.
Silkworm: Silkworm is a kind of butterfly, belonging to the phylum arthopoda of invertebrate, which produces silk fibers.
Types of silkworm:

a. Seri silkworm (*Bombyxmori*) which feeds on mulberry leaves.
b. Eri silkworm (*Attacusricinii*) which feeds on caster leaves.



Body structure (morphology) of silkworm: The silkworm is creamy white in colour. It is about 2.5 cm in length. Its body is divided into three parts namely head, thorax and abdomen. The head bears a pair of compound eyes, a pair of feathery antennae, and the sucking type of mouthparts. The thorax bears three pairs of legs and two pairs of wings covered with scales. The wings are about 25 mm in length. The abdomen consists of ten segments, which is hairy. The abdomen of female is wider than that of male.

Life cycle of silkworm: The silkworm is dioecious, i.e., the sexes are separate. Copulation takes place in air and the fertilization is internal. The male dies after mating and the female dies after laying eggs. The life cycle of silkworm completes in four stages: eggs, larvae, pupae and adults. Its life cycle completes in about 45 days.



Eggs: A female silkworm lays about 300 eggs on a mulberry leaves. The eggs are covered with a gelatinous secretion by which they stick to the leaves. The female dies after 3-4 days when eggs are laid. The eggs in the beginning are whitish, small and later they change into grey as the development proceeded. In favourable condition eggs are hatch into larvae. Mulberry leaves are not available in all seasons. So the eggs are stored in cool place in order to prevent them from hatching out. When mulberry leaves becomes easily available they are placed over the mulberry leaves and the temperature of about 18^{o}c to 25^{o}c is maintained. Then the eggs begin to hatch out into larvae after 10 to 12 days.

Larva: The larva of silkworm is called caterpillar. It is about 6mm in length and is brown in colour. It is divided into head thorax and abdomen. They are voracious and eat a lot of mulberry leaves. They grow very quickly. After 4or 5 days it stops feeding and becomes inactive. Then the larva moults. The moulting occurs four times at the age 6^{th}, 12^{th}, 18^{th} and 26^{th} days respectively. During every moulting, they do not eat and move for 20 to 24 hours. Duration between each moulting is called instar. After fourth moulting salivary gland is developed in the body of larva, which produces silk fibers as thin thread from its saliva and encloses itself within a case of the fiber, which is called cocoon. The larva stage completes in about 25 to 32 days.

Pupa: It is the inactive stage of silkworm in which larva of silkworm is enclosed inside the cocoon. In this stage it do not eat. In this stage very active changes takes place, which is called metamorphosis. This stage completes in about 12 to 14 days. After 14 days pupa produces an alkaline fluid to moisten one end of cocoon and comes out of the cocoon by making a small hole.
Pupa of silkworm is killed by boiling in hot water or keeping in hot air. By boiling the cocoon, pupa is killed so that it does not come out of the cocoon and the silk thread will not turn into small pieces. Moreover by boiling it, the sticky substance that binds the fiber is removed and the fiber is easily extracted.

Adult: After about 14 days the pupa comes out of the cocoon making a small hole and changes into adult. It is also called imago. Immediately after emerging out of the cocoon the imago moves its wings to dry and then fly. An adult silkworm survives for 5 to 7 days.

The spherical outer covering of pupa of silkworm is called cocoon. It is made up of very fine silk threads of about 1000ft long. The very active changes that takes place during pupa stage of silkworm to become adult is called metamorphosis.

Sericulture: The rearing of silk moths in order to obtain silk for commercial purpose is called sericulture.

Silkworm is very important to human beings because of the following reasons:

1. Silk produced by silkworm is used in making very fine and expensive clothes.
2. The gut of silkworm is used for making surgical thread and fishing rope.
3. Sericulture helps to improve the economic condition of individual, because its cultivation can be easily done at low cost at local level.
4. Silk clothes are usable in all seasons.
5. Silk clothes are shiny, durable, absorbent, elastic and expensive.
6. From a single cocoon 1000 feet long single thread can be extracted.

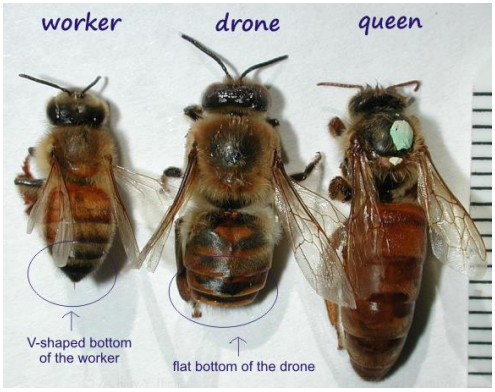
Characteristics of silk:

1. Silk is smooth, light and durable compared to other fibers.
2. Silk is the longest and the strongest of all the natural fibers.
3. It is more elasticity.
4. It is more absorbent.
5. It can be coloured easily.
6. Silk clothes can be worn in all seasons.

Honeybee: Honeybee is a useful insects belonging to phylum arthopoda of invertebrates which produces and stores honey. They are social insects because they live in a colony with co-ordination and discipline as well as perfect work division among them. There are mainly three species of honeybee reared in Nepal; *Apismellifera, Apisellifera and Apiscerana.*There are three types of honeybee in a colony. They are

1. Queen bee 2. Drone bee. 3. Worker bee

Queen bee: The queen bee is the only fertile female in a beehive, having well developed ovaries. It is easily distinguished by its long tapering abdomen, short legs and wings. It has small and round head. It has stinger and can sting the enemies. It is responsible only for laying eggs. The queen has a special smell in its body. All the drones and workers identify their colony on the basis of the smell of the queen. The queen usually mates only once in her life and stores the sperms received from the drone in a sperm sac in her abdomen. The store of sperms lasts for two or more years of egg-laying. When the store of sperms is used up, it may continue to lay eggs but they all are unfertilized and will become drones. One of its larvae formed from fertilized eggs is fed on royal jelly throughout the larva period and it becomes a new queen. There is only one queen in a colony. Its main duties are to lay eggs and to control the colony releasing special smell. A queen live for 2 to 5 years.



Drones: The drones are smaller than the queen bee and larger than the worker bee. Its body is black and hairy. It does not have stinger and poison gland. Their function is to fertilize the queen and to keep the hive warm. They remain mostly inside the hive and fed on the honey collected by the worker. They are produced from the unfertilized eggs. They have 16 numbers of chromosomes in their body cells. There are about 100 drones in a colony. They live for 4 to 5 weeks.

Worker bee: Worker bees are the smallest bees in the colony. They are in largest number in the colony. They are produce from fertilized eggs and have 32 numbers of chromosomes in their body cells. Their body is divided into three parts; head, thorax and abdomen. Their mouth is modified for chewing and lapping. They are infertile female which cannot reproduce. They are very laborious. They have pollen baskets on their legs to collect the nectar. They collect food from outside and store it, make wax cells and feed the developing larvae. They have stinger. There are about 6000 worker bees in a colony.

Life cycle of honey bee: The life cycle of honey bee completes in four stages; egg, larva, pupa and adult. The queen emerges from the hive after 3 to 5 days and mates with the males (drones). The flight of the queen bee and drones outside the hive for mating is called nuptial flight, or mating flight. After 2 to 3 days the queen begins to lay eggs.

Eggs: The queen lays about 300 eggs per day. The eggs are white and elongated. In the first day of laying, the eggs are erect, in the second day, it is slanted and in the third day it is horizontal. The queen lays eggs in drone cells to make males, queen cells to make queens and in worker cells to make worker honey bees. A fertilized egg is laid in a worker of queen cell while an unfertilized egg in a drone cell.

Larva: after about 3 days eggs hatch out into larva. The newly hatched larva is almost microscopic in size without legs and eyes. Larva is fed on diet known as royal jelly for initial three days. As the third day progress larvae that are destined to develop into queen bees continue to feed on royal jelly, while worker larvae and drone larvae feed on honey, water and pollens. If a worker larva is transferred to a queen cell before third day, it develops into a queen, and vice versa. The larva moults for 4-5 times before changing into pupa. The duration of larval stage in queen cell is 5.5 days that in drone and worker cell is 6 days each. Larval stage is voracious eater. The larva of a drone and queen cell is larger than that in worker cell.

Pupa: After about 6 days, the egg cells are capped by workers and each larva is kept inside the sealed cell which is called pupa stage. Reorganization of tissues massively takes place during pupa stage. This stage usually lasts for 7.5 days for queen bee, 12 days for worker bee and 14.5 days for drone bee.

Adult: It is the last stage of the life cycle of honeybee. All the organs develop and the pupa changes into an adult after completing the metamorphosis.

Division of labour in the honeybee on the basis of their age and types:

Drone bee	To fertilize the queen and to keep the hive warm.	
Queen bee	To lay eggs, to guide and control the colony by releasing special odour.	
Worker bee	1-3 days	To practice walking, to give warmth to egg, larva and pupa.
	4-6 days	To feed mature larva and they also take a lot of food.
	7-11 days	To feed royal jelly to the larva and the queen bee.
	12-17 days	They secret wax from 4 pairs of wax glands in the abdomen and build a honey comb using this wax.
	18-20 days	To protect the beehive from enemies.
	After 21 days	They gather nectar and pollen, build a strong and well-insulated hive, and defend the colony from enemies.

Apiculture: The rearing of honeybee for commercial purpose is called apiculture.

Economic importance of honey bee:

1. Honey bees produce honey, which contains enzymes, vitamins, water and minerals necessary for life.
2. Bee wax is used to make toiletry and goods like candle, saving cream and cold cream.
3. Honey bee help in pollination while collecting nectar and pollen from the flowers of the plants.
4. Apiculture (bee keeping) helps to improve the economic condition of the farmers.

Uses of honey:

1. Honey is rich in vitamins and functions as anti-oxidants.
2. Honey is good for keeping the skin healthy and strengthening the immune system.
3. Honey helps to prevent heart disease, diabetes, hair loss and arthritis.

Royal jelly: It is a gelatinous substance produced by honey bee which is feed to the queen bee or the young ones.

Nervous and glandular system

Nervous system: The system formed by the brain, spinal cord and different types of nerves which controls and co-ordinates all the activities of the body is called nervous system.

Functions of nervous system:

1. It collects information from outside the body with the help of five sense organs.
2. It transmits information to organs, muscles and glands.

Parts of nervous system:

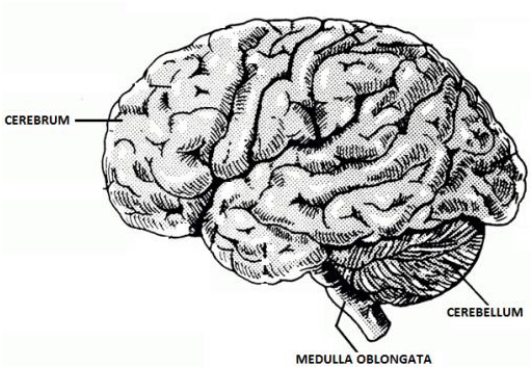
1. Central nervous system
2. Peripheral nervous system
3. Autonomic nervous system

Central nervous system: The system formed by the brain and spinal cord is called central nervous system.

Brain: Brain is a highly developed and delicate organ which acts as the highest coordinating center in the body. It is protected by a bony box called cranium.In an adult human it weighs about 1200-1400 grams. The brain is surrounded by three layers of protective membranes. They are duramater arachnoid and piamater. These three layers are collectively called meninges. ***The space in between the arachnoid and piamater is filled with a fluid which is called cerebrospinal fluid.***

Functions of cerebrospinal fluid:

1. It protects the brain from mechanical shocks.



Parts of brain:

1. Cerebrum 2. Cerebellum 3. Medulla oblongata

Cerebrum: It is the largest part of the brain which occupies 80% of the total mass of the brain. It is a dome- shape structure which spreads into four parts, viz. frontal, parietal, temporal and occipital. It is divided into two parts; right cerebral hemisphere and left cerebral hemisphere. The dorsal surfaces of these hemispheres contain a deep median groove called fissure. There are many convolutions in the hemispheres which increases the surface area of the brain. The more surface area of the brain increases the sites of sensation. The outer part of the brain is made of gray matter and the inner part is made of white matter. Any injury to the cerebrum results coma.

Functions of cerebrum:

1. It controls various mental activities like memory, thinking, learning, reasoning, intelligence, etc.
2. It controls the functions of different organs of the body.
3. It controls anger, emotions, will, speech, etc.
4. It controls feeling of love, hatred, admiration, etc.

Cerebellum:

It is the second largest part of the brain which occupies 10% of the total mass of the brain. It consists of two small hemispherical lemons like structure located above medulla oblongata and below the posterior part of the cerebrum. *(Any injury to the cerebellum causes dizziness and imbalance of the body.)*

Functions of cerebellum:

1. It maintains body balance.
2. It controls muscular tone.
3. It controls voluntary movement.
4. It provides ability to judge distance and when to stop.

Medulla oblongata:

It is the lowermost part of the brain which is cylindrical in shape connected with the spinal cord. It contains various vital reflex centres like cardiac centre, centre of coughing, centre of sneezing, centre of hiccupping, centre of swallowing, etc.*(Any injury to the medulla oblongata causes immediate death.)*

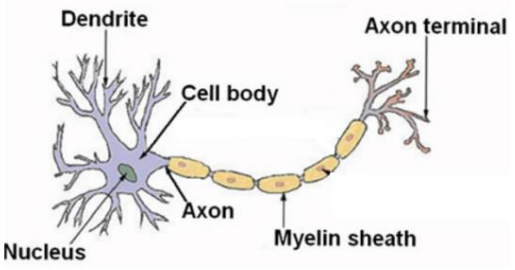
Functions of medulla oblongata:

1. It controls vomiting, coughing, swallowing, etc.
2. It controls heartbeat, breathing and blood pressure.
3. It controls contraction and relaxation of blood vessels.
4. It controls peristalsis movement of digestive tract, secretion of hormones and enzymes, secretion of saliva, etc.

Spinal cord: It is an elongated and cylindrical structure of the nervous system which arises from medulla oblongata and passes down in the neural canal of the vertebral column. The outer surface of the spinal cord is made of white matter and inner surface is made of grey matter. *(Any injury to the spinal cord causes paralysis of the body parts below the part of injury.)*

Functions of spinal cord:

1. It acts as a bridge between different body parts and the brain.
2. It controls reflex action.



Neuron: It is the structural and functional unit of nerve tissues. It is also called a nerve cell. It consists of cell body, axon and dendrites. The axon of the neurons combines to form nerve fibres.

Axon: The longest branch of a neuron is called axon. It transmits the impulses collected to the cell body towards another neuron.

Dendrites: The short branches of neuron are called dendrites. It collects impulses towards the cell body.

Types of neuron on the basis of function:

1. Sensory or afferent neuron
2. Motor or efferent neuron

3. Inter or connector neuron

Afferent neuron: It is the neuron which carries impulses from receptor to the spinal cord or brain.

Efferent neuron: It is the neuron which carries impulses from spinal cord or brain to different parts of body.

Inter neuron: it is the neuron which converts the sensory impulses into motor impulses.

Ganglia: The group of nerve tissues made of gray matter which is found near the spinal cord is called ganglia. They establish communication between the spinal cord and the brain.

Peripheral nervous system: The nervous system which consists of nerve tissue that communicates between the brain and different parts of body is called peripheral nervous system. It consists of two types of nerve fibers;

a. Cranial nerves b. Spinal nerves

Cranial nerves: The nerve fibers that originate from the brain are called cranial nerve fibers. There are 12 pairs of cranial nerve fibers. They originate from the brain and end in the head region. They communicate between the brain and various organs present in the head, i.e. eyes, ears, nose, mouth, tongue, etc.

Spinal nerves: The nerve fibers that originate from the spinal cord and form a network of nerves to different parts of the body are called spinal nerve fibers. There are thirty one pairs of spinal nerve fibers originating from spinal cord. They communicate between the brain, spinal cord and different parts of the body.

Autonomic nervous system: The part of nervous system which controls and coordinates all the involuntary activities of various body viscera is called autonomic nervous system. It is divided into two parts;

1. Sympathetic nervous system: it prepares body for violent action during emergency. For examples; it increases of heart beat, breathing, blood pressure, etc.
2. Parasympathetic nervous system: It helps in reestablishing normal conditions after violent act is over. For examples; it decreases heartbeat, breathing, blood pressure, etc.

Glandular system: the system formed by a group of glands is called glandular system. Glands are the group of epithelial tissues which secrets hormones or enzymes.

Types of glands on the basis of functions:

1. Exocrine glands
2. Endocrine glands

Exocrine glands: The glands which have a duct or tube to pass their secretion are called exocrine glands. E.g. salivary gland, gastric gland, tear gland, sweat gland, etc. Exocrine glands secrets enzymes. The enzymes secreted by exocrine glands are poured to the corresponding parts through the duct.

Endocrine glands: The glands having no duct to pass their secretion are called endocrine glands. E.g. pituitary gland, thyroid gland, pancreas, adrenal gland, etc. Endocrine glands pour their secretion directly into the blood stream. They secrets hormones.

Hormones: Hormones are the chemical substances produced by endocrine glands

(Hormones play an important role to control and regulate various metabolic activities, growth and development of the body, so hormones are also called chemical messenger.)

General properties of hormones:

1. Hormones are produced by endocrine glands.
2. Hormones are required in small amounts, and their effects are long lasting.
3. Hormones are specific in function. They act only on targeted organs, tissues and cells.
4. Hormones act as chemical messengers.

Functions of hormones:

1. They regulate growth and reproduction.
2. They synthesize, store and utilize various substances like glucose.
3. They control and regulate various metabolic activities, growth and development of the body.

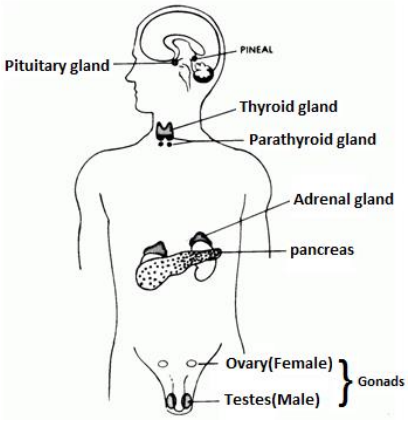
Differences between exocrine and endocrine glands:

Exocrine gland	Endocrine gland
• They have ducts.	• They do not have ducts.
• They secrete enzymes.	• They secrete hormones.
• They discharge their secretions through the duct.	• They discharge their secretions directly into the blood stream.
• They are located near the site of action.	• They are present away from the site of action.

Different endocrine glands present in the human body:

1. Pituitary gland 2.Thyroid gland 3. Parathyroid gland
1. Pancreas 5. Adrenal gland 6. Gonad

Positions of different endocrine glands in the human body are as given in fig.



Pituitary gland:

Location: lower surface of the brain. Number: One Shape: Oval

Secretion of hormones:

1. Growth hormone 2. Catalytic (stimulating) hormone.

Function:

1 Growth hormone controls the physical and mental development of the body.

2 Catalytic hormone control and stimulate in the secretion of other glands.

Effects of hypo secretion (under secretion):

1. Dwarfness, obesity, weak development of sex organs, high B.P., etc.

Hyper secretion (over secretion):

1 Excessive tallness in human called gigantism.

2 Adverse effects in function of other glands.

Thyroid gland:

Location: Neck region Number: Two Shape: Lobe shaped Secretion of hormones: Thyroxin or thyrotrobin, calcitonin.

Functions thyroxin or thyrotrobin:

1 It regulates the growth and development of the body.
2 It controls the activities of nervous system.
3 It stimulates the rate of cellular respiration and metabolism.

Functions of calcitonin:

1. It regulates the level of calcium and phosphate in the blood.
2. It controls calcium absorption and release by the bones.

Effects of hypo secretion of thyroxin:

Obesity, simple goiter, physical and mental weakness, roughness of skin, stammering, hoarseness of sound, less sweating.

Effects of hyper secretion of thyroxin:

Loss of body weight, excessive excitement, digestive disorders, increase metabolic rate, mental imbalance, protruding eyes, excessive sweating, excessive hunger, etc.

(Thyroxin hormone contains iodine. The hypo secretion or lack of iodine in the body causes swelling of thyroid gland. This condition is called goiter.)

Parathyroid gland:

Location: Neck region Number: Two Shape: Oval shapedSecretion of hormones: Parathyroid orparathormone hormone.

Functions of parathormone hormone:

1. It regulates the exchange of calcium between blood and bones.
2. It increases the level of calcium in blood.
3. It controls the proper development of bones.

Effects of hypo secretion of parathyroid hormone:

1. Weakness of bones.
2. Wrinkles are seen on hand and face.
3. Painful jerk of voluntary muscles, the amount of calcium in blood decreases and muscles contracts, this condition is called tetany.

Effects of hypersecretion of parathyroid hormone:

1. Parathyroid tumor and kidney stone may be developed.

Wrinkles are seen on the face and hands when parathyroid glands are removed from the body. It occurs due to lack of calcium in the blood.

Adrenal gland:

Location: Above kidney Number: Two Shape: Crown shaped (cream coloured) Secretion of hormones: Adrenalin.

Functions of adrenalin:

1. It prepares body ready to face various emergency conditions like stress and strain.
2. It controls fear, anger, and blood pressure.
3. It controls emotions, heartbeat, and respiration.
4. It balances salt and water in the body.

Effects of hypo secretion of adrenalin:

1. Weakness, low blood pressure, less sugar content in blood, nausea, unconsciousness, etc.

Effects of hyper secretion of adrenalin:

1. Hypertension, high sugar content in the blood, etc.

Adrenal gland is also called emergency gland because this gland releases emergency hormone (adrenalin) to face the emergency situation and prepare the body for flight, fight or fright.
Feminine characters are seen in males due to over secretion of cortison hormone and masculine characters are seen in female due to over secretion of cortison hormone.

Pancreas:

Location: Below the stomach.Number: OneShape: leaf shape Secretion of hormones: Insulin and Glucagon.

Functions insulin:

1. It controls amount of sugar in blood.
2. It stimulates deposition of extra glucose in the forms of glycogen in liver and muscles.

Functions of glucagon:

1. It increases amount of sugar in blood.
2. It stimulates liver to convert glycogen into glucose.

Effects of hypo secretion of insulin:

1. High level of sugar content in the blood.
2. Person feels more hungry and thirsty.
3. Frequent urination.
4. Loss of body weight.
5. Delay in wound healing.

Effects of hyper secretion of insulin:

1. Decrease in level of sugar in the blood.
2. Person becomes unconscious frequently.
3. The brain enters into coma.

Effects of hypo secretion of Glucagon:

1. Decrease in level of sugar in the blood.

2. Person becomes unconscious frequently.
3. The brain enters into coma.

Effects of hyper secretion of Glucagon:

1. High level of sugar content in the blood.
2. Person feels more hungry and thirsty.
3. Frequent urination.
4. Loss of body weight.
5. Delay in wound healing.

Pancreas gland secrets both enzyme and hormones such as pancreatic juice as an enzyme and insulin as hormone. So it is also called mixed gland.

Gonads: Testes in male and ovaries in female are called gonads.

Testes:

Location: In scrotum
Number: two
Shape: oval
Secretion of hormones: Testosterone or androgen.

Functions of testosterone:

1. Development and maintenances of secondary sex characters.
2. Production of sperms.

Effects of hypo secretion of testosterone:

1. Sterility may occur.
2. Poor development of reproductive organs.

Ovaries:

Location: atuterus
Number: Two
Shape: oval
Secretion of hormones:Oestrogen and progesterone.

Functions:

1. Development of female sexual characteristics
2. Growth of mammary gland.
3. Development of ovum.

Effects of hypo secretion of oestrogen and progesterone:

1. Sterility may occur.
2. Irregularity in menstrual cycle.

Outer surface of the brain and the inner surface of the spinal cord act as mental processing centre which is performed by the cluster of cell bodies; it is made up of grey matter.
Similarly inner part of the brain and outer part of the spinal cord act as impulse transmitting cable which is performed by the cluster of axons which is made up of white matter.
So outer part of brain is made up of grey matter and its inner part is made from white matter. Similarly outer part of spinal cord is made from white matter and inner part of it is made from grey matter.

Blood circulation in human body

Circulatory system: The system formed by heart, blood and blood vessels which transports various materials from one part of the body to another is called the blood circulatory system.
Blood circulation: The process of transportation of oxygen, hormones, nutrients and waste materials through the whole parts of our body with the help of the blood is called blood circulation.
Circulatory system consists of the following main parts; 1. Blood 2.Heart 3.Blood vessels
Blood: Blood is s liquid connective tissue which consists of 55% of plasma and 45% of blood cells. It carries different nutrients, hormones and respiratory gases to different parts of the body. About 5.5 litres of blood is found in the body of healthy adult person.
Plasma: It is a pale yellowish transparent alkaline liquid which occupies 55% of the total volume of the blood. It consists of 90% of water and 10% of plasma proteins, fat, minerals, and other dissolved substances.
Functions of plasma:

1. It transports digested food (nutrients) to various body parts.
2. It transports waste materials like carbon dioxide, urea to the concerned excretory organs from the body cells.
3. It transports hormones to different body parts.
4. It regulates the body temperature.
5. It balances the amount of water in the body.

Blood corpuscles (blood cells): The solid particles that remains immersed in the plasma of the blood are called blood corpuscles.
They are of three types; 1. Red blood corpuscles (RBC) 2.White blood corpuscles (WBC) 3. Platelets
RBC (Erythrocytes):
Shape: Biconcave disc like structure
Presence of nucleus: no nucleus
Number: 45 lakhs to 50 lakhs per mm^3 volume of the blood.
Life span: 120 days
Production place: Bone marrow
Destruction place: liver and spleen
Functions: It transports oxygen from lungs to the different body parts.
If the number is less: There will be less supply of oxygen in the body cells and formation of energy will be less. This diseases is called anemia.

RBCs are red in colour due to the presence of iron rich pigment called haemoglobinHb. It absorbs oxygen and carries to the body cells. The haemoglobin with oxygen is called oxyhaemoglobin.

WBC (leucocytes):
Shape: irregular
Presence of nucleus: Have nucleus
Number: 6000 to 10000 WBC is present per mm^3 volume of the blood.
Life span: 15 days
Production place: bone marrow
Destruction place: liver and spleen
Functions:

1. It fights against germs that cause diseases.
2. It destroys the diseases causing microbes.

If the number is less: Immune power of the body decreases if the number of WBCs decreases below the normal level. This disease is called **leukopenia.**
If the number is more: if the number of WBC increases in the blood it starts feeding RBC. This condition is called blood cancer **(leukemia).**
Types of WBC: 1. Granular WBC: Neutrophil, eosinophil and basophil.2. Non-granular WBC: Lymphocytes and monocytes.

Platelets (Thrombocytes):
Shape: Oval and rounded
Presence of nucleus: Have no nucleus
Number: 2 to 4 lakhs per mm^3 volume of the blood.
Life span: 2 to 3 days
Production place: Bone marrow
Destruction place: Spleen
Functions: It helps in clotting of the blood at the cuts or wounds
If the number is less: It results delay in wounds healing.

Differences between RBCs and WBCs:

RBCs	WBCs
• They are biconcave in shape.	• They are irregular in shape.
• They are small in size.	• They are large in size.
• They are more in number.	• They are less in number.
• They are red in colour.	• They are white in colour
• They transport oxygen for respiration.	• They help in the defense of the body.

Differences between blood cells and plasma:

Blood cells	plasma
• It occupies 45% of the total volume of the blood.	• They occupy 55% of the total volume of the blood.
• It contains haemoglobin.	• It does not contain haemoglobin.
• It is made up of blood cells like erythrocytes, leukocytes and platelets.	• It is made up of water, proteins, fats and other dissolved substances.
• It is red in colour.	• It is pale yellow in colour.

Functions of blood:

Transportation:

1. It transports oxygen from lungs to the body cells.
2. It transports nutrients to the body cells.
3. It transports hormones to the body cells.
4. It transports waste materials produced in the cells to the concerned excretory organs

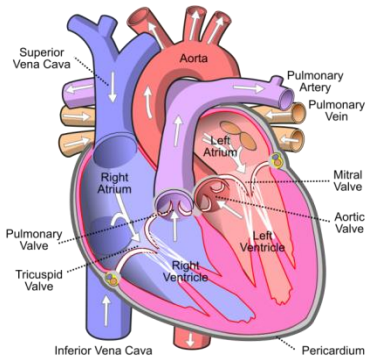
A. **Regulation:**

1. It regulates the body temperature.
2. It maintains the amount of water in the body.

B. Protection:

1. It destroys the diseases causing microbes.
2. It helps in clotting of blood at the cuts or wounds.

Heart: Heart is a hollow muscular organ consisting of cardiac muscles which help in pumping the blood throughout the body. It is situated in the chest cavity just above the diaphragm and between the lungs. The average weight of the heart in adult is 300gm. It is cone-shaped and as big as the owner's closed fist in size. It is surrounded by two layers of membrane which is called pericardium. The narrow cavity in between the pericardium is filled with fluid which is called pericardial fluid.



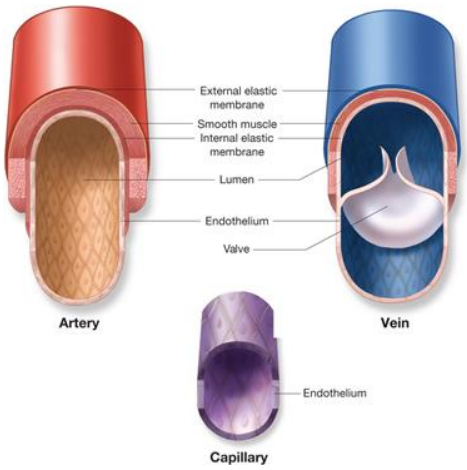
Functions of pericardial fluid:

1. It allows frictionless movement of the heart.
2. It protects the heart from mechanical injury and shocks.

Heart consists of four chambers, four valves, five blood vessels, etc. as below.

Blood vessels: The muscular tube or pipes through which blood flows are called blood vessels. There are three types of blood vessels.

They are 1. **Arteries** **2.Veins** **3.CapillariesArteries:** The thick walled blood vessels that carry blood away from the heart are called arteries. All arteries carry pure blood except pulmonary artery. The blood flowing through the arteries is with high pressure. In order to resist the high pressure the walls of arteries are provided with thick muscles. They are deep-seated inside the muscles in order to resist the high pressure. There no chance of backflow of the blood in the arteries because of high pressure, so they do not have valve in them. Since they have thick muscles, they have narrow lumen. The branches of arteries are called the arterioles. Eg.Pulmonary artery and aorta.



Veins: The thin walled blood vessels that carry blood towards the heart are called veins. All the veins carry impure blood except pulmonary veins. The blood flowing through the veins is with low pressure. So walls of the veins are thinner since they do not have to bear high pressure. They are situated on the surface of muscles. The blood flowing through veins is with low pressure. So there is chance of backflow of the blood in them. In order to prevent the backflow of the blood veins are provided with valve. The branches of veins are called venules. Eg. Pulmonary veins, inferior venacava, superior venacava.

Capillaries: The capillaries are extremely narrow and microscopic blood vessels which connect the arterioles to the venules. They reach each and every cells of the body in order to supply the oxygen, nutrients, hormones etc. to the body cells and to receive the waste matter produced there.

Differences between arteries and veins:

Arteries	Veins
• They are thick-walled blood vessels	• They are thin-walled blood vessels.
• They carry blood away from the heart.	• They carry blood towards the heart.
• They do not have valves in them.	• They have valves in them
• They have narrow lumen.	• They have wider lumen.

Process of blood circulation: Inferior venacava and superior venacava collects impure blood to the right auricle from upper and lower parts of the body respectively. At the time of relaxation of the heart tricuspid valve opens and the blood goes to the right ventricle. At the time of contraction of the heart tricuspid valve closes and pulmonary valve opens and blood goes to the lungs through pulmonary artery. After purification of the blood pulmonary veins collect it to the left auricle. At the time of relaxation of the heart bicuspid valve opens and blood goes to the left ventricle. At the time of contraction of the heart bicuspid valve closes and aortic valve opens and the blood goes to the whole body parts through aorta. Again inferior and superior venacava collects the blood to the right auricles and the process repeats. This whole circulation process is divided into two groups,

1. Systemic circulation. 2.Pulmonary circulation.

Systemic circulation: The circulation of the blood between the heart and the body cells is called systemic circulation. It circulates between the left ventricles and the right auricle.

Pulmonary circulation: The circulation of the blood between the heart and the lungs is called pulmonary circulation. It circulates between the right ventricle and the left auricle.

Differences between systemic and pulmonary circulation:

Systemic circulation	Pulmonary circulation
• The circulation of the blood between the heart and the body cells is called systemic circulation.	• The circulation of the blood between the heart and the lungs is called pulmonary circulation.
• It circulates between the left ventricles and the right auricle.	• It circulates between the right ventricle and the left auricle.
• Aorta, inferior venacava and superior venacava are involved in this circulation.	• Pulmonary artery and pulmonary veins are involved in this circulation.

Heart beat: The rhythmic beat which is produced due to contraction and relaxation of the heart muscles is called heartbeat. The number of heart beat in one minute is called heart beat rate. The average heart beat rate of a healthy young person is about 72 times per minute. The rate of heart beat increases with tension, physical exercise, emotion, fear, fever etc. The heart beat rate may vary with age, sex and condition of the body.

Blood pressure: The pressure exerted by the blood on the walls of arteries is called blood pressure. It is of two types,

1. Systolic pressure 2.Diastolic pressure

Systolic pressure: The pressure exerted by the blood on the walls of arteries at the time of contraction of the muscles of the heart is called systolic pressure. The average systolic blood pressure of a healthy young is taken as 120 mmHg.

Diastolic pressure: The pressure exerted by the blood on the walls of arteries at the time of relaxation of the muscles of the heart is called diastolic pressure. The average diastolic pressure of a healthy young is taken as 70mmHg.

Differences between systolic and diastolic pressure:

Systolic pressure	Diastolic pressure
• The pressure exerted by the blood on the walls of arteries at the time of contraction of the muscles of the heart is called systolic pressure.	• The pressure exerted by the blood on the walls of arteries at the time of relaxation of the muscles of the heart is called diastolic pressure.
• The average systolic blood pressure of a healthy young is taken as 120 mmHg.	• The average diastolic pressure of a healthy young is taken as 70mmHg.
• Systolic pressure is also called upper limit of arterial pressure.	• Diastolic pressure is also called lower limit of arterial pressure.

Sphygmomanometer: The instrument which is used to measure the blood pressure is called sphygmomanometer.

- *The ventricles exert more pressure on its walls. In order to resist the high pressure the walls of ventricles are made more muscular.*
- *The blood flowing through the arteries is with high pressure. In order to resist the high pressure the walls of arteries are made more muscular.*
- *The blood flowing through arteries is with high pressure. So bleeding from arteries cause excess loss of blood in short time. Therefore bleeding from arteries is dangerous.*
- *Left ventricle has to pump the blood with high pressure in order to supply it throughout the whole body cells. In order to resist the high pressure the walls of right ventricles are more muscular than left ventricle.*
- *The blood flowing through the veins is with low pressure. So there is chance of backflow of the blood. In order to prevent the backflow of the blood veins are provided with valves.*
- *Blood pressure of a person is 120/80mmHg,it means that the systolic pressure exerted by the blood on the walls of arteries at the time of contraction of heart is 120mmHg and the diastolic pressure exerted by the blood on the walls of arteries at the time of relaxation of the heart is80mmHg.*

High blood pressure: The condition at which systolic pressure or diastolic pressure exceeds the normal value is called high blood pressure. When the lower limit of blood pressure exceeds 90mmHg or the upper limit of blood pressure exceeds 140mmHg it is called high blood pressure.

Causes of high blood pressure:

1. Obesity
2. Unhealthy lifestyle
3. Regular smoking
4. Consumption of more salts in food.
5. Adrenal and thyroid disorder
6. Genetic cause
7. Lack of physical exercise
8. Drinking alcohol
9. Regular consumption of fatty, oily and spicy foods.
10. Regular consumption of cold drinks.

Preventive measures:

1. We should adopt healthy lifestyle.
2. We should avoid smoking and drinking alcohol
3. We should not consume fatty, oily and spicy foods regularly.
4. We should consume balance diet.
5. Physical exercise should be taken regularly.
6. Consumption of cold drinks should be avoided.

Diabetes: when there is lack of insulin, the excess glucose in blood cannot be changed into glycogen to store in the body. As a result, the amount of sugar increases in the blood and sugar passes out through urine. This disorder is called diabetes or sugar diseases.

Symptoms of diabetes:

1. Excessive hunger and thirsty
2. Frequent urination
3. Blurred vision
4. Weakness
5. Delay in wound healing
6. Muscle cramping.
7. Unconsciousness.

Preventive measures:

1. We should consume balance diet.
2. We should reduce obesity.
3. We should take physical exercise regularly.
4. We should consume fruits and vegetables.
5. We should avoid smoking and drinking alcohol.
6. We should reduce hypertension.

Uric acid: It is the diseases caused due to production of excess uric acid in the body due to excess metabolism of purine contained in our food. Our food like liver, dried beans, peas, salt, fish, etc.contains purine. When the purine breaks in the body, uric acid is produced. Uric acid is important for our body, because it protects the inner part of blood vessels and helps to remove toxins from the body. But if the amount of uric acid is produced in excess amount it results uric acid diseases. Most of the uric acid dissolved in the blood is transported to the kidneys, from where it is passed out in the form of urine.

Symptoms of uric acid:

1. Swelling and burning of skin.
2. Deep pain in muscles.
3. Joint ache.
4. Swelling of joints.

Preventive measures:

1. We should drink sufficient water.
2. We should reduce consumption of pulses, sea foods fatty and red meat.
3. We should consume baking soda.
4. We should eat 10-40 cherries per day. (Cherries contain anthocyanin which reduces burning sensation in the skin and joints.)

Chromosomeand Sex Determination

Chromosomes:

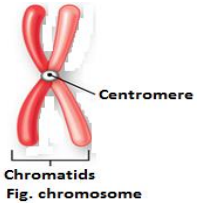


Fig. chromosome

Chromosomes are the thread like structures present in the nucleus of a cell which contain hereditary information of the cell.

Chromosomes are made up of DNA and proteins. Out of which DNA is the most important component. Each chromosome consists of two strands called chromatids. The two chromatids of each chromosome are joined together at a point which is called centromere or kinetochore.

Functions of chromosome;

1. It plays a key role in the cell division
2. It transfers the hereditary characters from parents to their offspring.

Genes: genes are the smallest units of DNA that control the biological characteristics of organisms.

Homologous pair of chromosomes:

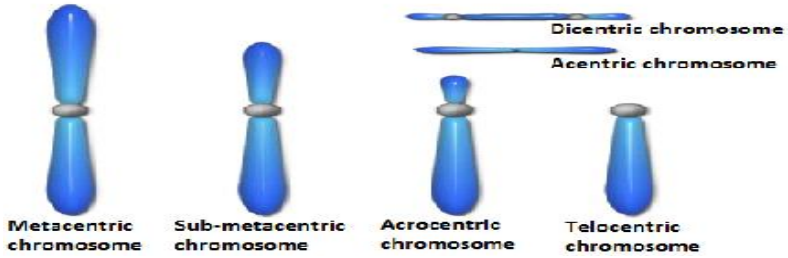
The chromosomes of each species occur in pair. The pairing of homologous chromosomes is called homologous pairing or synapsis. In a pair of chromosomes, one chromosome comes from father and another comes from mother. In human beings there are 23 pairs of chromosomes. Each chromosome of a homologous pair has genes for the same characteristics in the same place.

Chromatin reticulum: During resting stage of a cell chromosomes are seen in the form of long, thin and coiled in structure which is called chromatin reticulum.

Types of chromosomes on the basis of position of centromere:

On the basis of position of centromere chromosomes are divided into four types;

1. Metacentric chromosomes: The chromosome in which the centromere located at the middle is called metacentric chromosome.
2. Sub metacentric chromosomes: The chromosome in which the centromere is located a little away from the middle is called sub metacentric chromosome.
3. Acrocentric chromosomes: The chromosome in which centromere is located near the end is called acrocentric chromosome.
4. Telocentric chromosomes: The chromosome in which the centromere is located at the tip is called telocentric chromosome.



Types of chromosomes on the basis of function chromosomes are divided into two types;

1. Autosomes
2. Sex chromosome

The chromosomes which determine the physical characteristic of organisms are called autosomes. Or the chromosomes that carry genes for the vegetative characters are called autosomes.

The chromosomes which determine the sex of organisms are called sex chromosomes. Or the chromosomes that carry genes for sexual characters are called sex chromosomes.

Differences between autosomes and sex chromosomes:

Autosomes	Sex chromosomes
The chromosomes which determine the physical character s of organisms are called autosomes.	The chromosomes which determine the sex of organisms are called sex chromosomes.
They are 44 in number in human beings.	They are 2 in numbers in human beings.

Differences between metacentric and sub metacentric chromosomes:

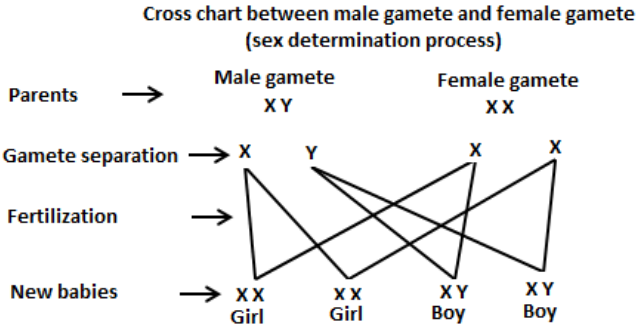
Metacentric chromosomes	Sub metacentric chromosomes
The chromosome in which the centromere located at the middle is called metacentric chromosome.	The chromosome in which the centromere is located a little away from the middle is called sub metacentric chromosome.
It has two equal arms of the chromosome.	It has two unequal arms of the chromosome.

Number of chromosomes:

The number of chromosomes present in the cells of an organism is fixed and is specific. The numbers of chromosomes present in somatic cells of some organisms are as bellow;

Organisms	No of chromosomes in somatic cells	Organisms	No. of chromosomes in somatic cells
Yeast	1 pair	Pine	12 pairs
Housefly	6 pairs	Frog	13 pairs
Pea	7 pairs	Human beings	23 pairs
Potato	14 pairs	Gorilla	24 pairs
Onion	8 pairs	Sugarcane	40 pairs

Diploid cell: A cell which has the full number of chromosomes, with two of each kind, is called a diploid cell. It is represented by 2n. Somatic cells are the example of diploid cell.
Haploid cell: A cell which has half the number of chromosomes, with one of each kind, is called haploid cell. It is represented by n. Generally gamete cells are the examples of haploid cell.
Sex determination: The mechanism by which the sex of a person is determined is called sex determination.
Sex of a person is determined at the time of fertilization, when the male and female gametes fuse together.
In humans, there are 46 chromosomes (23 pairs) present in each cell. In male individuals, there are 22 pairs of autosomes and one pair of sex chromosomes having one X chromosome and one Y chromosome.ie. 44+XY.In female individuals there are 22 pairs of autosomes and one pair of X sex chromosomes. I.e. 44 +XX. Therefore if a sperm carrying X chromosome fertilizes an ovum which carries X chromosome then the child born will be girl or female. If a sperm carrying Y chromosome fertilizes an ovum carrying X chromosome, then the child born will be a boy or male. The process of sex determination can be represented by the following process.



From the cross chart given alongside it is seen that, the child who inherits X chromosome of the father is a girl and the child who inherits Y chromosome of the father is a boy. It proves that, it is the sperm which determines the sex of the child. It is also seen that half of the sperms have X chromosomes and other have Y chromosomes. So there is a 50% of a boy and 50% chance of a girl being born to the parents. This is why the human population is roughly half males and half females.
During sex determination process sex chromosomes in ovum(XX) combines with sex chromosomes in sperm(XY), fifty percent of the result comes out to be male(XY) and fifty percent to be female(XX). So half of the world population is roughly male and half is female.
Genetic disorder:
A genetic disorder is an illness caused by defects or changes in person's DNA. It is of two types;
1. **Mendallion disorders:** (it is the disorder caused by mutation in a single gene of autosomes and sex chromosomes).

Sex linked diseases: A disease that occurs only in a particular type of sex (either male or female) is called sex linked disease.(it is one of the mendalian disorders caused by changes in the genes lying in sex chromosomes). Some examples of sex linked diseases are, 1. Hemophilia found only in male, 2. Baldness in male, 3. Uterine cancer, 4. Colour blindness.
Hemophilia: it is a sex linked disease, a person suffering from which suffer by delay in clotting of blood at the cut or wound.
2. **Chromosome disorders:**The disorders which are caused by the change in the number or structure of chromosomes are called chromosome disorders. Eg. Turners syndrome, Down's syndrome, Klinefelter'ssyndromeetc.

There is a fixed sequence of genes in a chromosome to develop a certain characteristic. When the sequence of genes or the number of chromosomes in a body changes, a variety of disorders are seen in the human body.
(Genetic disorder caused by the change in the sequence of gene is mendalion disorder and the disorder caused by the change in number of chromosomes is chromosome disorder.)
Aneuploidy: The number of chromosomes may increase or decrease when chromosomes cannot separate properly during cell division. This process is called aneuploidy.(chromosomal disorder usually occur, when there is an error in cell division, resulting in cells with too few or too many copy of chromosomes.
Turner'ssyndrome: It is a chromosome disorder which occurs due to lack of X-chromosome in girls or women. In this condition the number of chromosome becomes 44 + X0. It was first described by Turner. This occurs in about 1 out of 5000 live births.
Some common symptoms;Lack of secondary sexual characteristics, poorly developed ovaries, lack of menstrual periods, sterility in females, webbed neck, broad chest etc.
Klinefelter's syndrome: It is a chromosome disorder which occurs due to addition of X- sex chromosome in males. In this condition the number of chromosome becomes 44 + XXY=47. It was first described by Dr. Harry Klinefelter.
Some common symptoms;Growth of breast in males, infertility in males, tall stature, small genitals, female type pubic hair pattern, poor beard growth, mildly impaired IQ etc.
Down's syndrome: It is a chromosome disorder which sours due to addition of extra chromosome in 21 chromosome. It is also called trisomy of chromosome 21. It was first described by Langdon Down. It occurs in 1 in every 1000live births.
Some common symptoms;Protruding tongue, thick palm with creases, furrow in tongue, dwarfism, small and round head, half opened mouth, webbed neck, etc.

Reproduction

Reproduction: Reproduction is a characteristic of living being by which every living organism multiplies to form new individuals of its own kind. Types of reproduction;

1. Asexual reproduction
2. Sexual reproduction

Asexual reproduction: It is a type of reproduction in which fertilization does not occur.

Characteristics of asexual reproduction:

1. Only one organism can reproduce by this method.
2. In this type of reproduction, gametes are not produced.
3. It completes in a short period of time.
4. Fertilization does not occur in this type of reproduction.
5. Parental characters are preserved in this type of reproduction.
6. It is performed by the process of mitosis and amitosis.

Types of asexual reproduction:

A. Fission: It is a type of asexual reproduction in which a unicellular organism divides into two or more than two new individuals. Types of fission:

1. Binary fission
2. Multiple-fission.

Binary fission: It is a type of asexual reproduction in which a unicellular organism divides in to two new individuals. In this process when the individual cell gets fully matured, nucleus elongates, becomes constricted and finally divides along with cytoplasm and two new individuals are formed under favorable condition. Some examples are; amoeba, paramecium, euglena, bacteria, diatoms, etc.

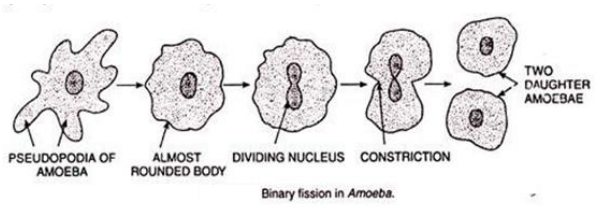
Multiple-fission: It is a type of asexual reproduction in which a unicellular organism divides into more than two new individuals. In this type of reproduction a thick covering or cyst is formed around the cell if the condition is not favourable. Then the nucleus is divided into many nuclei. On return of favourable conditions the cyst breaks and the entire nuclei come out in the form of new organisms.eg, amoeba, plasmodium, chlamydomonas, etc.

A. Budding: It is a type of asexual reproduction in which a bud like structure developed on the parents body detaches after fully grown and develops as a new individual. Eg. Hydra, yeast,etc.

B. Fragmentation: It is a type of asexual reproduction in which a plant body divides into many fragments and each fragments develops into new individuals. Spirogyra, marchantia, etc

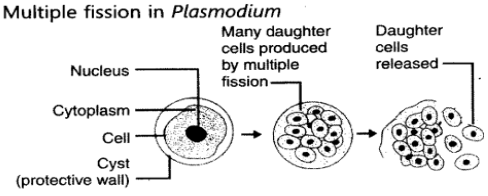
C. **Regeneration:** It is a type of asexual reproduction in which an animal body divides into many fragments and each fragments develops onto new individuals. Planaria, hydra, tapeworm, starfish, sponge, etc.

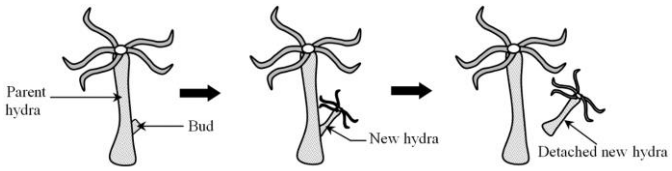
D. Sporulation: It is a type of asexual reproduction which takes place by means of spores.eg. mucor, marchantia, moss, mushroom, fern, etc

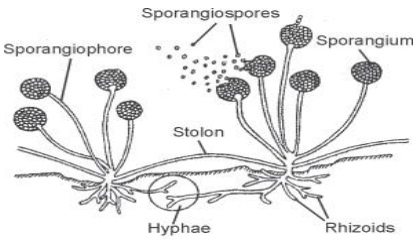


Binary fission in *Amoeba*.

(*ii*) Multiple fission in *Plasmodium*







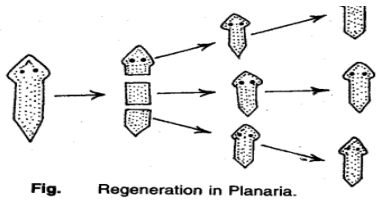


Fig. Regeneration in Planaria.

E. **Vegetative propagation:** It is a type of asexual reproduction which takes place by means of vegetative parts of plants like leaf, stem and roots. It is of two types;

1. Natural method of vegetative propagation.
2. Artificial method of vegetative propagation

Natural method of vegetative propagation: It is a type of vegetative propagation which takes place naturally.it is of the following types;

1. Vegetative propagation by roots: sweet potato, dahlia, gladiolus, etc.
2. Vegetative propagation by stem: potato, ginger, onion, garlic, mint, cynodon(Dobo), etc.
3. Vegetative propagation by leaf: Begonia, bryophyllum, etc.

Artificial method of vegetative propagation:

1. **Cutting:** It is a type of vegetative propagation in which a small pieces of the stem containing node and internode is cut and is kept in the soil. Eg. Rose, sugarcane, etc.
2. **Layering:** It is a type of vegetative propagation in which a portion of the areal stem grows roots while still attached to the parent body and is detached as a new individual plant. Types of layering;

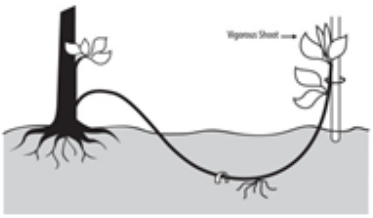
a. **Simple layering:** it is a type of layering in which a low growing flexible stem is bent down and a targeted part of it is kept into the soil leaving the remaining part above.

b. **Compound layering:** it is a type of layering in which a low growing flexible stem is bent down and targeted parts of it are kept into the soil leaving the remaining parts above.

c. **Tip layering:** it is a type of layering in which a low growing flexible stem is bent down and tip of it is kept into the soil leaving the remaining part above.

d. **Mound/stool layering:** It is a type of layering in which a young plant cut above the soil is covered with the mixture of fertile soil and saw dust and the shoots are separated from it after development of roots.

e. **Air layering:** It is a type of layering in which a targeted part of a areal stem is covered with fertile wet soil after removing barks and is separated from the plant body after development of the roots and kept into the soil.

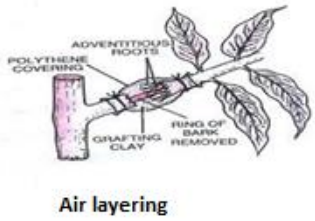


simple layering

compound layering

Tip layering

mound or stool layering



Air layering

C. Grafting: It is an artificial method of vegetative propagation in which stems of two closely related varieties are joined together. There are three types of grafting. The plant which is fixed to the ground is called stock and the plant which is joined with the stock is called scion. Both the stock and scion are joined together with tape or plastics.

1. Whip grafting: It is a type of grafting in which stems of two plants are obliquely cut and joined together.
2. Tongue grafting: It is a type of grafting in which tongue like deep structures are cut on both the stock and scion and are joined together.
3. Cleft grafting: It is a type of grafting in which the stock is cut and split down in the middle making a cleft and the scion cut in the shape of wedge is inserted into the cleft of the stock and is finally joined together.

D. Tissue culture: It is a modern technique of vegetative propagation in which numbers of plantlets can be developed from a small tissue of a plant by placing it in a suitable medium.

Process of tissue culture: A flask is sterilized under high temperature and pressure to kill any fungal or bacterial contaminants. Then it is filled with culture solution, which contains plant nutrients and plant hormones. A small tissue of a plant is kept in the culture solution. Then the tissue develops into an unorganized mass called callus. The callus later develops into shoots and roots. Finally the small plantlets are separated and are planted into the soil. *(Auxin and cytokinin are the two plant hormones are used in the tissue culture. Auxin helps in the development of roots and cytokinin helps to develop shoots.)*

Advantages of tissue culture:

1. Large no of plants having identical features to the parents can be produced by this method.
2. Adult plants can be produced within a short period of time.
3. Many plantlets can be produced without seeds.
4. Healthy and disease free plants can be propagated by this method.
5. Endangered plants can be conserved by this method

Significance of asexual reproduction (Vegetative propagation):

1. It is easier, faster and cheaper method of reproduction.
2. The plants produced by vegetative propagation bear flowers and fruits earlier than those produced from seeds.

3. Plants which do not produce seed or do not produced viable seeds are propagated by this method.
4. The new plants produce by this method are genetically similar to their parents.

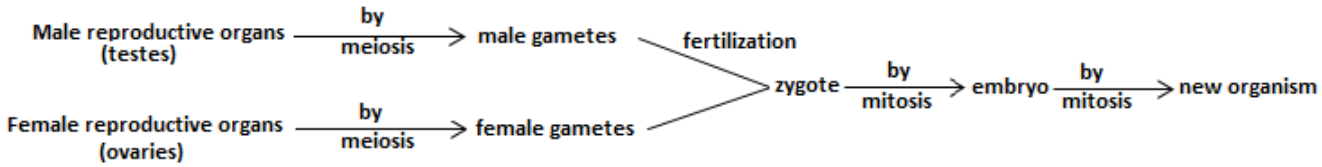
Sexual reproduction: it is a type of reproduction which takes place by the fusion of gametes.in this method male gamete and female gamete fuse to form zygote which later on develops into embryo and finally into new organisms.

Fertilization: the process of fusion of a male gamete and female gamete to form a zygote is called fertilization.

Differences between male gamete (sperm) and female gamete (ovum):

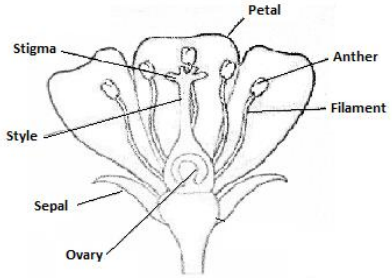
Sperm	Ovum
1. It is motile and smaller in size.	1. It is non-motile and larger in size.
2. It is male sex cell produced by the male sex organ.	2. It is female sex cell produced by female sex organ.
3. They are more in number.	3. They are less in number.

Fertilization process in organisms:



Characteristics of sexual reproduction:

1. Both the parents are involved in this method.
2. In this type of reproduction, gametes are produced.
3. Fertilization occurs in this type of reproduction.
4. Variation takes place in this type of reproduction.
5. It completes in a long period of time.
6. This type of reproduction is performed by the process of meiosis.



Different parts of flower: ☛

Sexual reproduction in flowering plants: After pollination one of the pollen grains produces pollen tube which grows down towards the style and finally reaches the ovule in the ovary. An egg cell (female gamete) is present inside the embryo sac in the ovule. The tip of the pollen tube ruptures in the ovule and discharges two male nuclei (gametes) into it through the micropyle. One male gamete fuses with the egg cell and forms a zygote. This fusion is called fertilization. Another male gamete (n) fuses with the diploid (2n) secondary nucleus (fusion product of two polar nuclei) and forms the endosperm nucleus. This process is called triple fusion.

The fertilization in flowering plants involves the fusion of two male gametes separately, i.e., one male gamete with egg cell (ovum) and another male gamete with the secondary nucleus. Therefore, the fertilization in flowering plants is called double fertilization.

Differences between self-pollination and cross- pollination:

Self-pollination	Cross- pollination
• It is the process of transfer of pollen grains from anther of a flower to the stigma of same flower or another flower of the same plant.	• It is the process of transfer of pollen grains from anther of a flower to the stigma of another flower of another plant.
• It is common in bisexual flowers.	• It is common in unisexual and bisexual flowers.
• Variation does not take place in the offspring.	• Variation takes place in the offspring.
• External agents are not required.	• External agents are required.

Differences between pollination and fertilization:

Pollination	Fertilization
• The transfer of pollen grains from anther to the stigma of a flower is called pollination.	• The process of fusion of male gamete with female gamete is called fertilization.
• It takes place in flowers only.	• It takes place in both plants as well as animals.

Differences between asexual and sexual reproduction:

Asexual reproduction	Sexual reproduction
• Only one parent is involved.	• Both the parents are involved in this method.
• Fertilization does not occur in this type of reproduction.	• Fertilization occurs in this type of reproduction.
• Variation does not take place in this type of reproduction.	• Variation takes place in this type of reproduction.
• It completes in a short period of time.	• It completes in a long period of time.

Significances of sexual reproduction:

1. It gives continuity to the race of life.
2. It brings out variation which helps in evolution of organisms.
3. Change or genetic variation in species due to sexual reproduction helps in adaptation in the changing environment.

Heredity

Heredity: The process through which the parental characters pass from generation to generation is called heredity or inheritance.

Hereditary characters: Those characters which are transferred from parents to their offspring are called hereditary characters.

Genes: Genes are the tiny units present in a linear fashion in chromosomes which acts as a hereditary unit of organisms.

Genetics: The branch of biology which deals with the mechanism of heredity and variation is called genetics. ***(Gregor Johnn Mendel is known as the father of genetics, because he was the first scientist to develop the theory of mechanism of heredity and variation.)***

Different contrasting characters in pea plants:

Characters	Dominant characters	Recessive characters
Colour of flower	Purple (P)	White (p)
Position of flower	Axial (A)	Terminal (a)
Height of plant	Tall (T)	Dwarf (t)
Shape of seed	Round (R)	Wrinkled (r)
Colour of seed	Yellow (Y)	Green (y)
Shape of pod	Inflated (I)	Constricted (i)
Colour of pod	Green (G)	Yellow (g)

Why did Mendel select pea plant for his experiment?

1. There are different distinct varieties of pea plants with large number of contrasting characters, so that number of results can be drawn from a single experiment.
2. The life cycle is short so result can be obtained frequently.
3. The pea plants are bisexual and can easily be cross pollinated and self-pollinated.
4. The cultivation of pea plant is easy.
5. Large number of offspring can be obtained from a single plant.

Mendel's experiment: Mendel selected pure tall and pure dwarf pea plant for his experiment. He made crossing between them with the help of a brush. In F_1 (first filial) generation all the pea plants were found tall. The plants of F_1 generation were allowed to self – pollinate. In the F_2 generation, 75% of the pea plants were found tall and 25% short. The ratio of tall and short pea plants in F_2 generation was 3:1 that was termed as phenotypic ratio. These 75% tall plants were further examined in F_3 generation and it was found that 25% of the plants were pure tall and 50% were hybrid tall. Therefore, the net result of this monohybrid cross was 25% pure tall, 50% hybrid tall and 25% pure dwarf i.e. the genotypic ratio of the characters was 1:2:1. (Pure tall, hybrid tall and pure dwarf).

Some terms related to heredity:

Monohybrid cross: It is a cross between two organisms having a pair of contrasting characters. For example; cross between tall and dwarf pea plant, cross between pea plant with purple flower and white flower.

Dihybrid cross; It is a cross between two organisms having two pairs of contrasting characters. For example; cross between tall pea plant with purple flower and dwarf pea plant with white flower.

Dominant character: When a cross is done between two organisms having a pair of contrasting characters one of the characters remain expressed in f_1 generation which is known as dominant characters. In a cross between tall and dwarf pea plant tall is dominant character.

Recessive character: When a cross is done between two organisms having a pair of contrasting characters one of the characters remain hidden in f_1 generation which is known as recessive characters. In a cross between tall and dwarf pea plant dwarf is recessive character.

Phenotype character: The external morphological appearance of an organism is called phenotype. It is expressed in words, e.g., tall, dwarf etc.

Genotype character: The genetic character in an organism that is either dominant or recessive is called genotype. It is expressed in letters, e.g., TT (Pure tall), Tt (hybrid tall), tt (Pure dwarf), etc.

Allelic pair (allele): A pair of genes controlling a pair of contrasting characters is known as allelic pair or allele or allelomorphs.

Hybrid: The organism which is produced from the cross-fertilization of genetically different organisms is called hybrid. The process by which hybrids are formed is called hybridization.

F_1 generation: The generation obtained by crossing two organisms having a pair of contrasting characters is called F_1 generation. It is also called first filial generation. All organisms in F_1 generation are hybrid.

F_2 generation: The generation obtained by crossing two organisms obtained in F_1 generation is called F_2 generation. The recessive character is also expressed in F_2 generation.

Some dominant and recessive characters in human beings:

Dominant characters	**Recessive characters**
Curly hair	Non-curly hair
Dimple cheek	Non dimple cheek
Free ear lobe	Attached ear lobe
Non hitcher's thumb	Hitcher's thumb
Rolling tongue	Non rolling tongue
Folding of tongue	Non folding of tongue

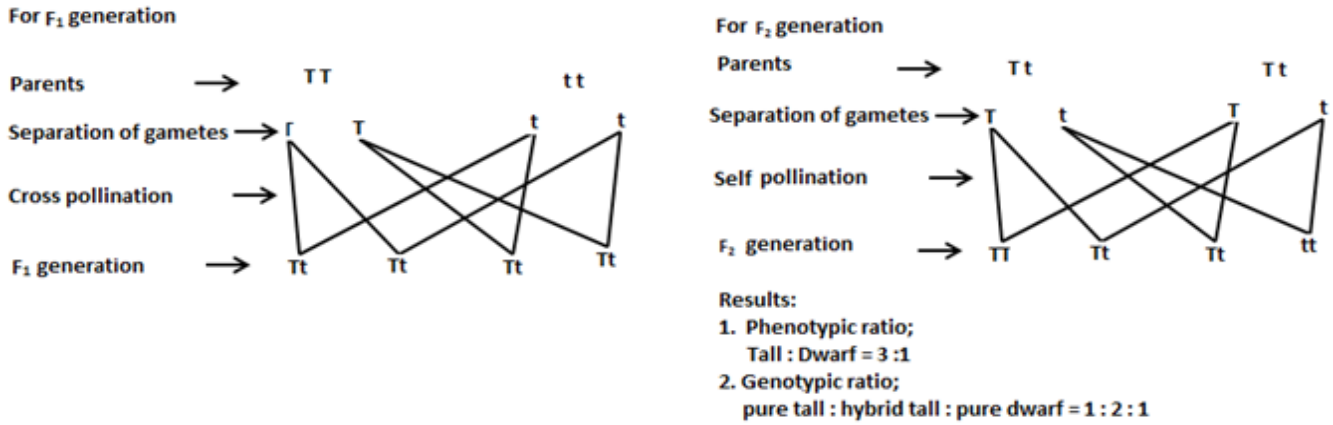
Differences between dominant and recessive characters:

Dominant characters	Recessive characters
• When a cross is done between two organisms having a pair of contrasting characters one of the characters remains expressed in f_1 generation which is known as dominant characters.	• When a cross is done between two organisms having pair of contrasting characters one of the characters remains hidden in f_1 generation which is known as recessive characters.
• It is expressed in all the generations.	• It is hidden in F_1 generation but expressed in other generation.

Mendel's laws:

1. **Law of dominance:** It states that, "in a monohybrid cross between two organisms having a pair of contrasting characters on of the characters remain dominant and another recessive."
2. **Law of purity of gametes (law of segregation**): It states that, "in a monohybrid cross the characters remaining in pair do not intermix with each other, but are separated at the time of gamete formation."
3. **Law of independent assortment: NO NEED**

Monohybrid cross chart between pure tall and pure dwarf pea plants:



Variation: The structural differences which provide individuality to every member of a species is called variation. The members of the same family differs each other due to variation.

Types of variation on the basis of source:

1. Heredity (genetic) variation. 2. Environmental variation

Heredity variation: The variation that occurs due to variation in genes is called heredity (genetic) variation.

Environmental variation: The variation that occurs in organisms due to effect of environment is called environmental variation.

Types of variation on the basis of duration:

Continuous variation: The variation that occurs gradually or continuously is called continuous variation. This type of variation transmits from one generation to another generation. Difference in height, colour are the examples of continuous variation. Various factors like environment, crossing over during meiosis cell division, food, habitat, etc. are responsible for this type of variation.

Discontinuous variation: The sudden heritable change in the genetic material of an organism is called discontinuous variation. It is also called mutation. It may not transmit from one generation to another. A newborn baby with extra limb, a calf with two tails, a puppy with extra limb, a baby with extra finger, unique type of finger print and unique type of blood group are some examples of mutation or discontinuous variation. Various factors like X-ray, UV-rays and harmful chemicals are responsible for mutation. Mutation is inherited only if the mutation occurs in the gametes, or reproductive cells.

Differences between variation (continuous) and mutation (discontinuous):

Continuous variation	Mutation
• The variation that occurs gradually or continuously is called continuous variation.	• The sudden heritable change in the genetic material of an organism is called discontinuous variation or mutation
• It is seen in every generation.	• It is seen only in some generation.
• Factors like environment, crossing over during meiosis cell division, food, habitat, etc. are responsible for this type of variation.	• Factors like X-ray, UV-rays and harmful chemicals are responsible for mutation.

Significances of variation:

1. Variation increases the chance of survival of an organism in the changing environment.
2. Variation helps in organic evolution.
3. Variation provides individuality to an organism of a species from other members of the species.

Environmental pollution and management

Environmental pollution: The degrading condition of one or many components of natural environment is called environmental pollution.

Environmental pollution is a burning issue of the present world that creates difficulty in the lives of all living organisms including human beings. Various pollutants cause environmental pollution. The activities of human beings are responsible for environmental pollution. Some examples of environmental pollution are air pollution, water pollution and soil pollution.

Air pollution: The condition of degrading natural quality of air due to mixing of different pollutants in atmosphere is called air pollution. Sources of air pollution are divided into the following two types:

a. **Natural sources:** Pollutants which are added to air by various natural activities are called natural sources of air pollution. Forest fire, volcanic eruptions, soil erosion etc are natural sources of air pollution which put smoke and dust into the air.
b. **Artificial sources:** Pollutants which are added to air by various activities are called artificial sources of air pollution. CO, CO_2, NO_2, NO, SO_2, Cl_2, NH_3etc gases are produced by;
   i. Burning of fuels
   ii. Wastes released from hospitals
   iii. Atomic power plants
   iv. Agricultural wastes
   v. Industrial solid wastes
   vi. Automobiles industrial
   vii. ization.

Pollutants are classified into two types, on the basis of production. They are;

Primary air pollutants: The air pollutants that introduce in atmosphere immediately after their production from sources are called primary air pollutants. For examples; stink, nitrogen, compounds of oxygen, materials related to halogen group, radioactive rays etc which are produced from burning of petro- products.

Secondary air pollutants: The air pollutants which are formed due to chemical reaction between the primary pollutants are called secondary air pollutants. For examples; formaldehyde, peroxyl, acetile nitrates etc.

Causes of air pollution: There are many causes of air pollution. Some of them are listed as below;

1. The smoke and dust particles emitted by vehicles cause air pollution.
2. The smoke, dust, poisonous gases and harmful chemicals emitted by different industries cause air pollution.
3. The smoke and harmful gases emitted by burning of petroleum products like cooking gas and domestic fuels such as wood, coal, etc. also cause air pollution.
4. Development activities like construction work, mining, etc. can cause air pollution.
5. The harmful gases and dust particles emitted by volcanic eruption cause air pollution.
6. Mixing of bad foul smell and odour in air by excreta, dead bodies, garbage, etc. cause air pollution.
7. By explosion of different types of bombes, also cause air pollution.
8. Mixing of toxic and harmful gases like carbon dioxide, nitrous oxide, methane, etc. in air cause air pollution.

Effects of air pollution:

1. **Reduction in visibility:** Air pollution reduces visibility, especially in cold weather. Due to smog, people cannot see nearby objects clearly which makes it much risky to drive vehicles and fly aeroplane due to reduced visibility.
2. **Reduction in solar radiation:** Solar radiation is absorbed by air pollutants and the amount of solar radiation required to reach the earth's surface gets reduced.
3. **Inhibition in biological growth of plants:** Stomata of plant's leaves cannot open properly due to air pollutants due to which plants do not get enough light for photosynthesis. This causes inhibition in growth of plants.
4. **Adverse effect on human health:**
   a. Polluted air causes asthma, bronchitis and allergic cold.
   b. Air pollutants cause irritation in eyes, throat and lungs.
   c. Pollutants gases hinder the function of liver, kidneys, spleen and nervous system.
   d. It causes heart diseases.
   e. Hydrocarbon vapour causes cancer.
5. **Depletion of Ozone layer:**Some chemicals like chlorofluorocarbons (CFC_s), methyl chloroform, carbon tetrachloride, methyl bromide, etc. causes Ozone layer depletion.
6. **Acid rain:** Acid rain is that rain which contains small amounts of acids formed from acidic gases like sulphur dioxide, nitrogen oxides and carbon dioxide present in polluted air. Acid rain contains very dilute solutions of sulphuric acid, nitric acid and carbonic acid.
   Acid rain has the following harmful effects;
   a. Acid rain destroys forests.
   b. Acid rain kills aquatic animals such as fish.
   c. Acid rain corrodes the statues, cemented buildings and historical monuments and damages them slowly.
7. **Global warming:**The increase in air pollutants causes the increase in temperature of earth's atmosphere which is called global warming.

Measures to control air pollution:

Air pollution can be reduced by the following methods:

1. Industries should be established far away from residential areas.
2. Industrial processes should be modified so that they may cause lesser amount of pollution.
3. High chimneys should be established in the industries in order to reduce the impacts of smoke and poisonous gases in the environment.
4. Rapid population growth should be controlled.
5. Radioactive nuclear dust produced in nuclear experiments is a powerful pollutant. So, nuclear experiments should be avoided.
6. Alternative sources of energy such as solar energy, wind energy, hydroelectricity etc. should be used in place of fossil fuels.
7. Curtailing the production and use of various air pollutants.
8. Old and damaged vehicles should not be used. They release large quantities of smoke and unburnt gases.

Water pollution: Water pollution can be defined as the decrease in the quality of water by the presence of various solid and liquid wastes. The contaminants produced due to natural causes and human activities mix into natural water sources which degrades natural and original quality of water resulting water pollution.

Sources of water pollution:

1. **Sewage water:** The waste water containing human and animal excreta, discharged water and other materials from domestic works is called sewage water. The sewage water contains several harmful micro-organisms which cause water-borne diseases in humans.
2. **Contaminated water from industries:** Mixing of untreated industrial wastes containing toxic chemicals, discharged from industries or factories into the nearby water sources cause water pollution.
3. **Agricultural wastes:** Chemical fertilizers and pesticides like DDT, BHC, Aldrin, Dialdrin, etc. used by the farmers in the crop fields dissolve into rain water and run into river, ponds and lakes which become unfit for the living organisms.
4. **Obstruction of flow of water:** If there is any sort of obstruction in the flow of water, it may cause all the pollutants to get collected in the source of water. It causes water pollution.
5. **Oily pollution:** Oil spilled from refineries, tanker and automobile workshops pollute water bodies and kills animals life and affecting growth of phytoplankton. It reduces oxygen supply to the aquatic animals.
6. **Thermal pollution (Heat):** Passage of hot water from industries and thermal plants into water bodies changes the temperature of the water which results the decrease in the content of oxygen and finally killing of aquatic organisms.
7. **Radioactive substances:** Radioactive substances released from nuclear experiments when gets mixed into the water bodies, and assimilates into the body of aquatic animals and causes mutation.

Measures to control water pollution: The various ways of controlling water pollution are as follows;

1. Sewage should be treated properly at sewage treatment plants to make it harmless beforedischarging it into nearby rivers.
2. Farmers should use correct amounts of fertilizers and pesticides in the fields so that excessive amounts of these harmful chemicals are not washed into rivers, lakes and ponds.
3. All the industries should treat the toxic waste produced by them suitably to make them harmless before discharging them into rivers.
4. Water pollution prohibition laws which exist for the industries producing toxic chemical wastes should be implemented strictly by the concerned authorities.
5. Garbage and dead bodies should not be thrown into open drains, rivers, lakes and ponds.
6. People should be made aware of the harmful effects of water pollution.

Soil pollution: The undesirable change in the physical, chemical and biological properties of soil is called soil pollution.

Sources of soil pollution:

1. **Domestic wastes:** introduction of domestic wastes such as unused parts of food materials, dust, excreta, pieces of broken utensils, plastics, rotten agricultural products, papers, etc. in soil causes production of harmful microorganisms which spread various diseases. These materials diminish the fertility of the soil.
2. **Excessive use of pesticides:** pesticides are the poisonous chemical substances which are sprayed on standing crops to save them from the harmful insects and diseases. Such pesticides not only kill harmful insects but also the useful insects such as earthworm. Decrease in population of earthworm, reduces the quality and fertility of the soil.
3. **Industrial wastes:** Many industries dump their waste products such as chemicals, pieces of metals and non-metals, organic and inorganic wastes, etc. which causes soil pollution by destructing natural quality of soil. Polluted soil is poor in fertility and has negative impact in the health of various organisms, animals, plants, etc that live on the earth.
4. **Use of chemical fertilizers:** chemical fertilizers are added to soil in the fields to increase food production. The excessive use of chemical fertilizers makes the soil highly acidic or alkaline. This soil becomes unfit for the growth of crop plants.

5. **Municipal wastes:** Municipalities are the major sources of waste products. These waste products most often do not get disposed in the right area due to which the soils get polluted. The mixing of municipal wastes in soil reduces fertility of soil and it also harms various animals living on the earth.
6. **Acid rain:**Acid rain is that rain which contains small amounts of acids formed from acidic gases like sulphur dioxide, nitrogen oxides and carbon dioxide present in the air. Acid rain contains very dilute solutions of sulphuric acid, nitric acid and carbonic acid. The acid rain increases acidity of soil resulting in degradation of fertility of soil.

Measures to control soil pollution:

1. Excessive use of insecticides should be discouraged and the use of biological methods should be encouraged to control insects and diseases in agriculture sector.
2. Chemical fertilizers should be replaced with organic and compost manure.
3. Domestic wastes should be managed properly.
4. Irrigation with polluted water should be discouraged.
5. Radioactive waste produced from atomic power plant and laboratories should be properly deposit in safe places.
6. Human and animal excreta should be managed and deposited properly.
7. Agricultural activities should be conducted by agro-forest system.
8. Use of non-biodegradable materials should be discouraged.
9. Awareness programmes for conserving soil and land should be generated and the laws regarding it should be strictly implemented.

Conservation and management of forest:

1. The unauthorized felling of forest trees for timber trade and fire-wood should be stopped immediately.
2. Forest fire must be controlled.
3. Systematic and scientific ways must be used to cut down and plant trees.
4. Trees must be planted in bare fields and steep slopes.

Conservation and management of sources of water:

1. Programs must be conducted to conserve watersheds and glaciers.
2. Killing fishes using poisons and electronic equipment's must be banned.
3. The areas hit by landslides, floods, soil erosion, etc. must be afforested.
4. The storage and distribution of water should be done scientifically.
5. Public awareness should be generated to conserve the source of water.

History of the earth

Some hypothesis about the origin of the earth:

1. **George Wofan's hypothesis:** According to this hypothesis, the earth along with other planets and satellites were formed millions of years ago when a huge comet struck the huge round mass of hot gases while revolving around the universe. The broken pieces of the round mass are planets and satellites and the remained central part is the sun. (this hypothesis is also called planetesimal hypothesis)
2. **Kant Laplace hypothesis (Nebular hypothesis):** According to this hypothesis, large masses of nebulae in the sky were cooled and contracted due to their own gravity during their revolution in their own orbits. During this process, an outer ring was detached from the central core and started to revolve around the central mass due to the effect of gravity. The large masses began to break into small masses due to their collision and started revolve around the central mass. The central mass is the sun and other revolving masses are the planets including the earth and satellites**. (large masses of gases and dust in the sky is called nebula)**
3. **Jeans and Jeffery's hypothesis (Tidal hypothesis):** According to this hypothesis an extremely large comet approached the sun during its revolution and it produced a mass of gas from the sun due to tidal effect. The tidal matter fragmented into various small pieces in the course of cooling and resulted in forming planets, satellites, etc. including the earth.

Different geologist and zoologist have studied the rocks and fossils with their radioactivity **(Carbon dating/ radioactive dating**) to estimate the age and structure of the earth. But they have different views and opinions regarding the age and structure of the earth.

Some statistical data about the earth as mention in the world book of encyclopedia is given below:

Estimated age	4.5 billion years	Diameter	12756.3 km.
Total surface area	509,700,000 sq. km.	Mean density	5.5 g/cm^3
Part of land	148,400,000	Mass	6x10^{21} metric tons
Total water body	361,300,000 sq. km.	Number of satellites	1 (Moon)

Geological time scale: The total time period from the origin of the earth to till date is called geological time scale. On the basis of existence of living beings, the geologist has divided the whole geological history into four parts. They are; a. eon b. era c. period d. epoch

Eon: Eon is the largest unit of geological time scale and epoch is the smallest unit of geological time scale. There are four eons;

a. Phanerozoic eon b. Proterozoic eon c. Archean eon d. Hadean eon.

Epoch: It is the smallest unit of geological time scale.

Era: A geological era is a division of an eon in which important changes took place. It is the second largest unit of geological time scale. There are four eras;

1. Precambrian era (4.5 billion years ago to 57 crore years ago)
2. Palaeozoic era (57 crore years ago to 25 crore years ago)
3. Mesozoic era (25 crore years ago to 6 crore 50 lakh years ago)
4. Cenozoic era (6 crore 50 lakhs years ago to recent)

Major events of Precambrian era:

1. Evolution of bacteria before 3.8 billion years and moss before 3.2 billion years.
2. Formation of rocks like gneiss and granite.

Major events of Paleozoic era:

1. Evolution and development of animals and plants.
2. Vital change in climatic condition in the atmosphere.
3. Evolution of terrestrial and aquatic vertebrates and invertebrates.

Major events of Mesozoic era:

1. Formation of hills and peaks.
2. Vital change in the climatic condition in the atmosphere and creation of adaptable environment for land, aquatic and areal animals.
3. Evolution of reptiles in large numbers.
4. Evolution, dominance and extinction of dinosaurs

Major events of Cenozoic era:

1. Expansion and breaking of rocks and formation of mountains.
2. Volcanic eruption and formation of volcanic mountains.
3. Freezing of water due to extreme cold and formation of Himalaya Mountain.
4. Abolution of ancient animals and evolution of new animals.
5. Evolution and development of mammals including human beings.
6. Dominance of human beings.

Brief description of biological history of the earth:

Era	Origin of species
Pre-Cambrian	Existence of bacteria before about 3.8 billion years and moss before 3.2 billion years ago. Evolution of unicellular organisms, development of multicellular animals.
Palaeozoic	Evolution of first vertebrates, aquatic animals in the ocean. Evolution and development of first green terrestrial plants and fish, wings bearing insects and amphibians. Evolution and development of plants of fern family.
Mesozoic era	Evolution and development of birds, flowering plants. Evolution and development of reptiles like tortoise, dinosaurs, etc. Dominance of dinosaurs. Extinction of dinosaurs.
Cenozoic era	Evolution and development of mammals like elephants, whale, sharp toothed tigers, monkeys, etc. Evolution of owl, herbivorous animals. Evolution of human beings. Dominance of human beings.

Fossils: Fossils are the impressions or whole body of organisms left preserved in the sedimentary rocks.

Paleontology: The branch of science which deals with the study of fossils is called paleontology.

Process of fossil formation: When plants and animals are buried inside the earth they remain preserved without decaying for long time and the fossils are formed. If the preserved fossils remain for long time because of chemical reaction the parts are lost and only the impressions are left. In this way another stage of fossils is formed.

Although there is a single mechanism of fossils formation but the ways of sinking of the plants and animals inside the earth are different.

1. Due to natural disaster plants and animals are buried inside the earth and are left preserved and fossils are formed.
2. Dead plants and animals are carried by the river into the ocean bed and are covered by different layers of sand and soil and remain preserved.
3. Fossils of organisms are also formed when plants or animals are frozen inside ice.

Fossilization: The process of formation of fossils is called fossilization.

Identification of fossils:

1. Fossils of organism can be identified by the study of structures of the whole body of organisms left preserved.
2. Fossils of organisms can be identified by the study of impressions left on the sedimentary rocks.
3. Fossils of organisms can be identified by the study of parts of organisms left preserved.
4. Fossils of organisms can be identified by the study of molds and casts.

Importance of fossils:

1. Fossil fuels are formed from the fossils of organisms.
2. It provides the evidence of existence of organisms.
3. It provides the evolutionary trends of organisms.
4. It provides the history of location of organisms.
5. It helped to make geological time scale.

Fossil fuels: The fuels obtained from the fossils of organisms are called fossil fuels. They are of three types;

a. Coal b. mineral oil c. natural gas

Coal: Coal is a black or brown carbonaceous deposit formed by fossils. On the basis of their quality coal are classified into four groups; a. anthracite b. bituminous c. sub- bituminous d. lignite

Carbonization: The process of formation of coal from plant or animal fossil due to high pressure and temperature is called carbonization.

Process of coal formation: When plants and animals are buried inside the earth they remain preserved without decaying for long time and the fossils are formed. If the preserved fossils remain for long time a kind of chemical reaction takes place under high pressure and temperature and the fossils change into coal.

Importance of coal:

1. It is used to generate electricity.
2. It is used in railway transportation.
3. It is used in brick and iron industries.
4. It is used to manufacture petrol, natural gas, coke, etc.
5. It is used to make various organic compounds like phenol, benzene, etc.

Mineral oil: It is a black coloured viscous liquid form of fossil fuel. It is the mixture of hydrocarbons and other elements like oxygen, sulphur, nitrogen etc.
Crude oil: The unprocessed mineral oil is called crude oil.
Petroleum: The mineral oil and natural gases are commonly called petroleum.
Formation of mineral oil: When plants and animals are buried in swamp land inside the earth they remain preserved without decaying for long time and the fossils are formed. If the preserved fossils remain for long time a kind of chemical reaction takes place in presence of cellulose and lignin under high pressure and temperature and the soft parts of the fossils change into mineral oil.
To extract the crude mineral oil from the mine by drilling holes in the earth's surface. Passing pipelines and using motor. The crude oil is processed by fractional distillation and various petroleum-products are extracted from it.
Utility of some major petroleum products:

Petroleum products	Utility
Petroleum gas	In the form of gas fuel.
Petroleum ether	A good solvent for cleansing
Petrol	Fuel for small vehicle
Diesel	Fuel for large vehicles
Kerosene	Domestic fuel
Lubricating oil, grease, Vaseline	Lubrication
Paraffin wax	Candles, match sticks
Petroleum coke	Smokeless fuel
Bitumen and asphalt	For construction of road.

Importance of mineral oil:

1. It is used to operate vehicles, industries, factories, etc.
2. It is used to generate electricity.
3. It is used for domestic fuel.
4. It is used to make various types of chemicals like fertilizers, insecticides, plastics, medicines, explosives, etc.

Climate change and atmosphere

Climate change: It is defined as the variation in the earth's global climate or regional climate over a period of time.

Effects of climate change:

1. It causes loss of biodiversity.
2. It decreases agricultural production and changes the crop pattern.
3. It melts snow in the polar region and the Himalayan region.
4. It increases the sea level due to melting of ice in the polar region.
5. It affects the global water cycle.
6. It causes improper distribution of rainfall.

National efforts for mitigation and adaptation of climate change:

The efforts that are paid in Nepal for reduction and adaptation of climate change are called national efforts. Some of them are as below.

a. National communication report; Government of Nepal submitted its first report to the COP(Conference of the parties) of United nations Organization ,mentioning the issues of climate change such as;

1. The adverse effect of climate change in Nepal and measures of its adaptation.
2. Required strength and policies, rules.
3. Plans for reducing the effects of climate change.

b. **Climate change policy 2067;** Nepal government has made the climate change policy 2067, based on the fact "the atmospheric temperature increased due to climate change has many adverse effects on various sectors like biodiversity, public health, forest, agriculture, socioeconomic aspects etc.

c. Climate change adaptation strategic programme; As per the invitation of climate change investment fund, government of Nepal Joined to it in may 2009AD along with climate change strategic programme in the following five sectors;

1. Climate adaptation of watershed that lie in the ecosystem of hilly regions.
2. Adaptation to risks induced by climate change.
3. Mainstream flow of climate change risk management in development projects.
4. Building a capable community for climate change adaptation with the active participation of private sectors.
5. Promotion of climate change adaptation for vulnerable species.

d. National adaptation programme of action(NAPA); The government of Nepal prepared the National Adaptation Programme of action in 2010AD in order to conduct 250 programmes in the form of nine integrated programmes.

e. Local adaptation plan of action for climate change (LAPA); In order to minimize the adverse impact of climate change at the local level and to provide suitable services to highly endangered communities, regions and family, government of Nepal has conducted this programme in rural areas of our country, based on the four guidelines principle's. Progressive ii. Inclusive iii. Readiness and iv. Flexibility.

f. **Other programmes;** Government of Nepal has conducted many other programmes like,

1. Improved brick factories.
2. Improved stoves.
3. Biogas programme.
4. Encourage programme on carbon storage.
5. Rainwater collection.
6. Pre-information system to natural disaster etc.

International efforts

a. United Nations Framework convention on climate change; The United Nations Framework Convention on Climate Change (UNFCCC) is an international treaty developed to address the problem of climate change. It was held in 1992 at Rio de Jenerio of Brazil. The conference was mainly concentrated on the main five issues. They were "global warming, forest protection, biodiversity, Agenda 21 and Rio declaration."

The main objective of UNFCCC is to stabilize greenhouse gas concentration in the atmosphere at a level that would prevent dangerous human interference with the climate change.

For dealing with the issues, the framework was adopted and opened for signature in June 1992.The government of Nepal signed this treaty in 1992.The parliament of Nepal adopted this treaty in 1994.Since then the articles of the treaty came into action in Nepal.

b. UN Climate Change Conference; On the basis of the treaty of UNFCCC negotiated at the "Earth Summit "in June 1992 countries that signed the treaty must inform the works and programme conducted in their countries related to climate change to their member countries. For this purpose, the Conference on climate change has been conducted 19 times till 2013and the 20^{th} conference was held in Peru in 2014.

c. Agenda 21; Agenda 21 is a non-binding voluntarily implemented action plan of the United Nation. This action plan was formulated on the basis of a slogan "think globally and act locally" to conserve environment and ensure sustainable development. It is a product of the Earth summit held on Rio de Jenerio Brazil in 1992.The "21" in agenda 21 refers to the 21^{st} century. It is a comprehensive plan of action to be taken globally,nationaly and locally by organizations of the United Nations system, government and major groups in every area which human impacts on the environment.

d. Intergovernmental Forum; It was established in 1998.It is a group of scientist of different countries who research, analyze and suggest the measures of mitigation of climate change.

e. Kyoto protocol; To deal with the climate change problem by reducing greenhouse gas emissions, global framework convention on climate change(FCCC) was signed under the auspices of UN in 1992.The convention recognized that the problem of global warming was caused mostly by industrialized countries and hence they should take the first step to limit emissions. The Kyoto Protocol was adopted in Kyoto, Japan in 1997 and entered into force in 2005.It

laid down a timetable for industrialized countries to reduce their gas emissions. According to it industrialized countries have to decrease their emission by at least 5.25%compared to 1990emission by 2008-2012 period. According to the second commitment, the developed countries have to decrease the greenhouse gas emission by at least 18% compares to 1990 emission level by 2013-2020.

f. Measures to reduce Greenhouse gases according to Kyoto Protocol; Developed countries consume a large amount of mineral fuel to operate their industries and factories. As a result a large amount of greenhouse gases are released in to the atmosphere by the developed countries.
Therefore, Kyoto protocol has encouraged the developed as well as developing counties to conduct three additional means viz. i. International emission trading ii. Joint implementation and iii.clean development mechanism to meet their emission targets.

g. Reduction of emission due to deforestation; Carbon plays a prominent role in climate change. Forest is an important natural resource that absorbs and stores carbon in large amount. Therefore developed countries should reduce deforestation and conduct afforestation programmes. On the other hand .developed countries that produce a large amount of industrial gases should provide economic aids to developing countries for conservation and proper management of the forest.

Atmosphere

Atmosphere: the layer of air that surrounds the earth is called atmosphere.

It extends up to 9600 km above the earth surface. The major gases present in the atmosphere are N_2, O_2, CO_2, water vapour etc.

According to altitude and temperature, the atmosphere is divided into five different layers. They are as follows;
Troposphere - It extends up to 16km from the earth surface.
Stratosphere- It extends from 16km to 50km above the earth surface.
Mesosphere -It extends from 50km to 80km above the earth surface.
Thermosphere - It extends from 80km to 720km above the earth surface.
Exosphere- It extends beyond 720km above the earth surface.

Characteristics of different layers of atmosphere

Troposphere:

1. It is the lowermost layer of the atmosphere.
2. It contains about 95% of total atmosphere.
3. Different weather related activities such as cloud; rain, lightning, thundering, fog, and tornado storm etc. takes place in this layer.
4. There is a fall of about 6.5^0c in temperature in this layer per kilometer increase in altitude.
5. It has about -56^0C temperature.
6. Upper boundary of this layer is also called tropopause.

1. The temperature of the troposphere varies according to height. It decreases as the height increases. So troposphere is also called variable sphere.
2. Different weather related activities such as rain, cloud, lightning, frost, hailstorm, fog etc. takes place in the troposphere so meteorologist study this layer of atmosphere in order to forecast weather.
3. The temperature of the troposphere decreases with increase in its height because the short waves having high velocity enters the atmosphere and reach the earth surface and changes into long waves which gives heat energy. On returning back to the atmosphere the heat energy is lost into the surrounding.

Stratosphere:

1. Due to presence of Ozone it is also called ozonosphere.
2. **The ozone present in this layer absorbs 99% of Ultraviolet rays coming from the sun and protects us from its harmful effects. So this layer is also called protective layer.**
3. The temperature of this layer increases with increase its altitude.
4. The temperature of this layer at the upper boundary is -2^0C.
5. This layer is clear and cloudless. That's why jet plane fly in this layer.
6. Upper boundary of this layer is called stratopause.

The stratosphere contains ozone whose thickness increases with altitude and it absorbs much solar radiation. Due to absorption of the solar radiation, the temperature of this layer increases as the height increases.

Mesosphere:

1. The temperature of this layer decreases with increase in altitude.
2. It is the coldest region of the atmosphere and has the temperature of -109^0C.
3. Strong wind blows from the west to east during winter and from east to west during spring season.
4. Streaks of hot gases released from meteors can be seen in this layer.

Thermosphere:

1. This layer is completely exposed to solar radiation, so the temperature of this layer increases with increase in its altitude. It increases up to 1200^0C.
2. Due to more effect of solar radiation all gases molecules present in this layer are ionized so this layer is also called ionosphere.
3. Radio waves propagated from the earth surface are reflected by the charged gases ions and helps in communication.
4. The earth magnetic field draws solar particles which give a natural light display in the polar region due to interaction between the ions present in this layer and the solar particles, which is called aurora.

Exosphere:

1. The temperature of this layer is very high and is 6000^0C.
2. This layer of atmosphere is very far from the earth surface, so there is negligible effect of gravity. So some of the atoms in this layer escape into the space.
3. It is the uppermost layer of atmosphere, so it is also called the fringe region.

Ozone: It is triatomic state of oxygen molecule which is pale blue in color.

Ozone layer: The layer of ozone molecules present in the stratosphere of the atmosphere is called ozone layer.

Process of ozone layer formation: When atmospheric oxygen (O_2) in the stratosphere is influenced by UV rays of the sun, it dissociates into nascent oxygen. The nascent oxygen combines with O_2 to form ozone

When UV rays are absorbed by ozone molecules, they dissociates into oxygen gas and nascent oxygen (O). The nascent oxygen combines with nascent oxygen to form oxygen molecules.. It is represented by the following equations.

Formation of Ozone

$O_2 \xrightarrow{UVrays} O + O$

$O + O_2 \xrightarrow{UVrays} O_3$

Destruction of Ozone

$O_3 \xrightarrow{UVrays} O_2 + O$

$O + O \xrightarrow{UVrays} O_2$

Continuous formation and destruction of ozone balances the thickness of the ozone layer.

Ozone layer depletion: decreasing the thickness of ozone layer or formation of hole in it is called ozone layer depletion.

Major gases which are responsible for the depletion of ozone layer;

Chlorofluorocarbon, methyl chloroform, carbon tetrachloride, methyl bromide and oxides of nitrogen. Out of which chlorofluorocarbon is the most responsible for it.

Chlorofluorocarbons (CFCs): CFCs are the compounds that consist of the atoms of carbon, fluorine and chlorine. They are very cheap, nontoxic and non-inflammable.

Sources of chlorofluorocarbon: Air conditioners, refrigerators, aerosol spray cans, industries, research laboratories etc.

The process of ozone layer depletion by CFC is as follows;

$CFCl_3 \xrightarrow{UVrays} CFCl_2 + Cl$

$Cl + O_3 \xrightarrow{UVrays} ClO + O_2$

$2ClO \xrightarrow{UVrays} 2Cl + O_2$

The process of ozone layer depletion by oxides of nitrogen is as follows;

$NO + O_3 \xrightarrow{UVrays} NO_2 + O_2$

$2NO_2 + O_3 \xrightarrow{UVrays} N_2O_3 + 2O_2$

Effects of ozone layer depletion:

Due to depletion of ozone layer more UV rays reach to the earth surface which causes the following effects;

1. It causes various diseases like cataract (blindness), skin cancer, breast cancer, sun burn, leukemia, in human beings.
2. It causes deficiency of immune system of human beings.
3. It may causes mutation in organisms.
4. It causes retardation in growth and development of plants.
5. It causes infertility in living beings.
6. It reduces the rate of photosynthesis in plants.
7. It causes reduction in agricultural products.
8. It causes damage of egg, larva and pupa of insects and aquatic animals.
9. It causes global warming, which results melting of polar ice.
10. It causes increase in sea level and disappearance of many islands and flooding in the coastal regions.

Ways to protect ozone layer:

1. Alternative chemicals should be used in refrigerators, air conditioners and other machines instead of CFCs.
2. Use of hydro fluorocarbon should be promoted instead of CFCs.
3. Use of nitrogenous fertilizers should be reduced.
4. Public awareness should be generated about the consequences of ozone layer depletion and its protection.
5. Discouraging the burning of plastics materials.

Industrial gases:

Various toxic gases like carbon dioxide, carbon monoxide, nitrous oxide, sulphur dioxide etc. which are released from industries are called industrial gases.

The industrial gases, smoke, solid particles etc. released from the factories forms a cloud in the air, which is called industrial smog.

Effects of industrial gases;

1. Industrial gases causes dizziness, headache, cough, eye itching, throat burning, chest pain, lungs cancer etc.
2. It hinders human muscular functioning, mental functioning etc.
3. Carbon monoxide causes carbon monoxide poisoning and also causes respiratory diseases like bronchitis, asthma etc.
4. Some industrial gases cause acid rain which is responsible for destruction of metal and cemented structures.
5. The increase amount of industrial gases in the atmosphere causes global warming.

Acid rain: acid rain is that rain which contain small amount of acids formed from acidic gases like sulphur dioxide, nitrogen oxides and carbon dioxide present in polluted air.

How does acid rain occur?

Ans: Atmospheric gas sulphur dioxide reacts with oxygen to form sulphur trioxide which combines with rain water to form sulphuric acid

$2SO_2 + O_2 \longrightarrow 2SO_3$

$SO_3 + H_2O \longrightarrow H_2SO_4$

Similarly oxides of nitrogen also give acid rain as below:

$4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3$

The earth in the universe

Universe: The vast surrounding space in which all planets, satellites, stars, galaxies, constellations, comets, matter, energy, etc. exist is called universe.

Solar system: The sun and the heavenly bodies in the gravitational field of the sun are collectively called the solar system.

It includes the sun, eight planets, their satellites, comets, meteors, asteroids, plasma, dust particles, etc. The sun is in the center and all the members of it revolve around it in anticlockwise direction in elliptical orbits due to gravitational force between them.

The sun:

10. It is a medium sized star situated at the center of the solar system.
11. Its approximate mass is 1.99×10^{30} kg.
12. Its average diameter is 1.3924×10^{6} km.
13. It is 2.5×10^{4} light year far from the center of the Milky Way galaxy.
14. The distance between the sun and the earth is 1.5×10^{8} km.
15. Its surface temperature is 5700^{0}c.
16. Its core temperature is 1.5×10^{70}c.
17. All types of energy produced by the sun is due to nuclear fusion reaction.
18. The amount of hydrogen present in the sun is about 70% and helium is about 25%.
19. The age of the sun depends upon the amount of hydrogen present in it.
20. On the surface of the sun charged gaseous ions are blowing at a very high speed which is called solar wind.

The speed of solar wind is about 500km/sec.**(The charged gaseous ions which is blowing on the surface of the sun is called plasma)**

Planets: The heavenly bodies which revolve around the sun in elliptical orbits are called planets. There are eight planets which are mercury, Venus, earth, mars, Jupiter, Saturn, Uranus, and Neptune. Among the eight planets mercury, Venus, earth and mars are called inner planets and Jupiter, Saturn, Uranus and Neptune are called outer planets.

Characteristics of Mercury:

1. It is the smallest planet.
2. It is the nearest planet to the sun.
3. It is the fastest revolving planets to the sun.
4. It's almost the same part is facing towards the sun.
5. Its temperature varies between 427^{0}c and -170^{0}c.
6. There are many creators on its surface.

Characteristics of Venus:

1. It is the nearest planet to the earth.
2. It is called twin planet of the earth since it has equal mass and shape of the earth.
3. It is the hottest and brightest planet.
4. It is also called evening or morning star.
5. Its average surface temperature is about 480^{0}c.

Characteristics of Earth:

1. It is the planet with suitable environment for living beings.
2. Its diameter is about 12672km.
3. It takes about 365 days to complete one revolution.
4. It appears blue when viewed from the outer space due to ocean.
5. It is also called green planet due to the presence of green plants on it.

Characteristics of Mars:

1. Its diameter is half of that of the earth.
2. Its temperature is similar to that of the earth during day, but it falls below -38^{0}c during night.
3. It is also called red planet due to presence of red coloured mineral rocks called limonite.
4. There are black spots in the surface of the mars which are named as oceans of the mars; however it has no water at all.
5. Two poles of it are covered with polar ice which is made of ice of gases.
6. Its atmosphere contains traces of carbon dioxide, hydrogen, and nitrogen.
7. It has two satellites. They are Deimos and Phobos.

Characteristics of Jupiter:

1. It is the largest planet.
2. It is the fastest rotating planet in its own axis.
3. It is the planet having highest number of satellites.
4. Red spots are seen on its surface due to atmospheric hurricane.
5. Its average surface temperature is about -143^{0}c.

6. Its revolution period is 12 years.
7. It has 63 satellites.
8. It largest satellite is Ganymede Europa, IO, Callisto.

Characteristics of Saturn:

1. It is the second largest planet.
2. It is the second fastest rotating planet.
3. It has three electrical rings around it.
4. It axis makes an angle of 27^0 with its plane.
5. It has second largest number of satellites.
6. Its surface temperature is -180^0c.
7. Its density is so less that it can float on water.
8. Its revolution period is 29.5 years.
9. It has 62 satellites.
10. Its largest satellite is Titan.

Characteristics of Uranus:

1. It is the third largest planet.
2. Its surface temperature is -216^0c.
3. It is made up of liquid and gases.
4. It has 27 satellites.
5. It is made up of cloud minute crystals of methane, hydrogen and helium gas.
6. Miranda, Ariel and Titania are the main satellites.
7. Its revolution time is 84 years.

Characteristics of Neptune:

1. It is the farthest planet.
2. It is the coldest planet and its temperature is -220^0c.
3. It has a black spot in the size of the earth.
4. Its revolution period 164 years.
5. It has 14 satellites.
6. Triton is the biggest satellite and Nereid is another satellite.

Comets: The broom shaped shining objects with bright head that revolves around the sun are called comets. They are made up of gases, dust and ice. It has mainly three parts, viz. nucleus, coma and tail. Nucleus the central part is made by freezing gas, ice and dust particles. Coma is made up of gas and dust particles around the nucleus. Tail is formed only when it reaches nearby the sun in course of revolution. After the interval of certain years, comets can be seen in the eastern sky before sunrise and in the western sky after sunset.

When a comet reaches nearby the sun, the ice remaining in its outer part gets melted and changes into vapour due to solar radiations, which is blown away by the solar wind in opposite direction and the tail of the comet is formed.

Some information about the comets is given below:

Name of comets	First appearance	Time for one revolution
Halley's comet	240 BC	76 years
Temple-tuttle	1366 AD	33 years
Enke	1786 AD	3.3 years
Schwasman-washman	1927 AD	15 years
Bennet	1969 AD	-
Shoemaker levy	1993 AD	Destructed in 1994 AD by colliding with the Jupiter.

Meteors: Meteors are the small pieces of metallic or stony matter present in the space that enters the earth's atmosphere and burns due to friction between them and the atmosphere and are lost in the atmosphere. They are also called shooting stars or falling stars since they are seen as fast falling stars in the sky. The big and bright falling meteor is also called fire ball. Meteors are formed either by the mass left behind by the comets or by the fragmented mass formed during the origination of solar system.

When a falling meteor enters the gravitational field of the earth with high speed it begins to burns in the atmosphere due to friction with atmosphere and is seen in the form of falling star.

Meteorites: When a falling meteor enters the gravitational field of the earth with high speed it begins to burns in the atmosphere due to friction with atmosphere and some part of it reach to the surface is called meteorites.

Meteoroids: Meteors and meteorites are commonly called meteoroids.

Meteors fall inside the earth's gravitational field at the speed of 70 km/s. Generally mass of meteors ranges from 100gm to 20000Kg. But ***the big meteorite which was fallen in Namibia has the weight of 60 metric ton which is called Hoba.*** It is estimated that about 500 meteorites fall on the surface of the earth every year.

Types of meteorites: a. stony meteorites b. irony meteorites c. stony-irony meteorites

Stony meteorites: The meteorites having more amount of silicon than iron and magnesium are called stony meteorites.

Irony meteorites: The meteorites having more amount of iron and negligible amount of silicon and magnesium are called irony meteorites.

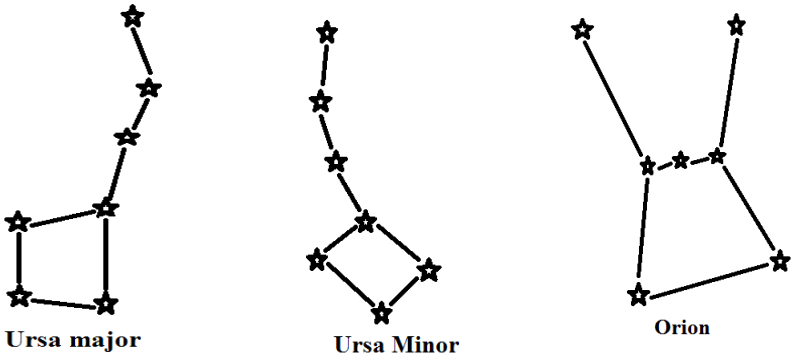
Stony-irony meteorites: The meteorites having almost equal amount of iron and silicon are called stony-irony meteorites.

Constellations: The groups of stars which form a fixed pattern are called constellations. There are 88 constellations. Some constellations can be seen in particular season since the earth revolves around the sun and some constellations can be seen from north and south hemisphere of the earth at the same time since they are very far. Some major constellations are; Ursamajor, Ursa minor, Orion, etc. Out of the 88 constellations 12 are taken as sign of zodiacs. They are; Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpius, Sagittarius, Capricorn, Aquarius and Pisces.

Ursamajor (Saptarishi): Ursa major is also called great bear since its pattern is estimated to be resembled bear. It is seen in the northern sky in the months of Baishak and Jestha at night.

Ursaminor: it is also called little bear and is also known as laghusaptarishi. It is seen in the northern sky in the months of Ashad/shrawan.

Orion: The pattern of orion resembles a hunter. It can be seen in the sky in the months of Poush/Magh in the middle sky of the northern hemisphere.



Importance of constellations:

1. In absence of instruments, constellations were used a indicators of location and direction at night.
2. Calendars were developed on the basis of location of the constellations which were used for weather forecasting.
3. Twelve constellations are used as a sign of zodiac which are used by astrologers for forecasting about a person.

Some superstitions about zodiac sign:

1. There is no any scientific reason to forecast the future of billions of people of the world by the use of only zodiac sign.
2. There is no any scientific reason to say the attitude of the people that resembles their zodiac sign .
3. There is no any scientific reason to see the good omen of the people or work according to the zodiac.
4. There are many examples of unsuccessful conjugal lives of the people that have been matched according to their zodiac sign.
5. There is no any scientific reason of wearing rings according to zodiac signs.

Galaxy: A vast cluster of stars, nebulae, dust and gas all held together by gravity is called a galaxy. There are 10^{12} galaxies in the universe.

The diameter of such galaxies ranges from 100 light year to 10 thousand light year. The stars in the galaxy revolve round a common center which is called galactic center.

Types of galaxies on the basis of shape: a. Spiral galaxy b. Elliptical galaxy c. Irregular galaxy

Spiral galaxy: The galaxy having spiral arms around the central part is called spiral galaxy. They are brighter than other types of galaxies. Eg.Milky Way galaxy and Andromeda galaxy.

Elliptical galaxy: The round and oval shaped galaxies are called elliptical galaxies. A bright light is produced in the middle of these galaxies and the light becomes dim at the edge. These galaxies are very old. Eg.Fornax.

Irregular galaxy: The galaxies having irregular shape are called irregular galaxies. These galaxies are less brighter than spiral galaxies. Eg. IC1613.

Milky Way galaxy: The solar system is situated in the Milky Way galaxy and is situated in one corner of the galaxy. There are 10^{11} stars in this galaxy. The closest galaxy to the Milky Way galaxy is Andromeda. Our solar system takes $2.5x10^{8}$ light years for one complete revolution around the galactic center. This time period is called cosmic year.

Satellites: The heavenly body which revolves around the planet in its own orbit is called a satellite. There are two types of satellites; a. natural satellites b. artificial satellites

Natural satellites: Natural satellites are those members of the solar system which revolve around the planets in their elliptical orbits. There are about 173 natural satellites.

Artificial satellites: Those satellites which are made by humans and launched in space are called artificial satellites. These satellites revolve around the earth in a geostationary orbit at a distance of 36900 km. the energy in the artificial satellites is provided by the solar battery and are launched in the space with the help of rocket. Sputnik I is the first artificial satellite which was launched by Russia on October 4th, 1957.

Geostationary orbit: The orbit at which artificial satellites revolve around the earth at a velocity same as the orbital velocity of the earth so that it seems to be at stationary position is called geostationary orbit.

Moon: moon is the natural satellite of the earth. The distance between the earth and the moon is about 384,400 km. The diameter of the moon is 3456km. and its surface area is 37,940,000km^2. The moon takes 27 days 7 hours 43 minutes and 11.5 seconds to complete one round around the earth. This period is called sidereal month. The period of 29 days 12 hours 44 minutes and 2.8 seconds from one full moon to the next full moon is called synodic month.

Purposes of launching artificial satellites:

1. To acquire exact information about the earth, satellites and universe.
2. To facilitate transmission of radio and TV waves over different parts of the earth.
3. To study overall weather patterns of the earth and help weather forecasting.
4. To construct sky labs or space research station on the surface of the moon inorder to explore space more easily.
5. For military uses and communication purposes, etc.