prepmate®

Science Preview

GENERAL SCIENCE

Prelims

For Civil Services Exams

Table of Contents

PHYSICS

CHAPTER 5 SOUND

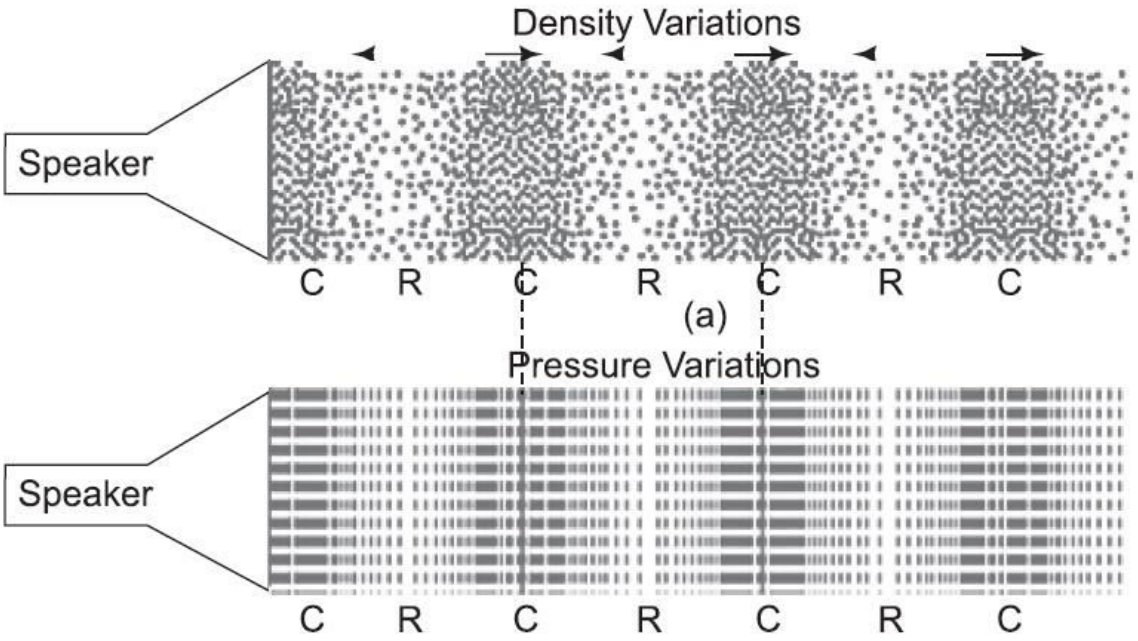
Sound is a form of energy. It is produced on account of vibrations in the particles of a medium. Vibrations are a kind of to and fro motion of the particles in the medium. Sound can be produced by the striking of objects, plucking, scratching, rubbing, shaking, etc. The sound of the human voice is produced due to vibrations in the vocal cords. All the means to produce sound involve vibration of particles.

Propagation of Sound

We know that sound is produced by the vibrations in the particles of a medium. When a particle vibrates, it sets the particles of the medium around it in vibration. The vibrating particle transmits the vibration to the adjoining particle. The adjoining particle displaces from its original position in 'to and fro' motion. This particle further transmits the vibrations to the other particles. This process of transmitting vibrations continues. The amount of vibration reduces as sound wave moves away from its source.

Nature of Sound Waves

1. Nature of sound waves: Sound waves are longitudinal waves in nature. The sound waves consist of compressions and rarefactions. Compressions are the regions of sound waves when the particles of medium are densely packed, and rarefactions are the regions of sound waves where the particles of medium are spread out.



Longitudinal Versus Transverse Wave

A wave is a disturbance which propagates energy from one place to other without transporting matter. For instance, ripples formed on the surface of water when a

stone is thrown on water in a pond. The ripples, so generated, travel in concentric circles of ever-increasing size till they strike the boundary of the pond.

Types of Waves

There are several types of waves. The two most common are longitudinal and transverse waves.

1. Longitudinal wave: In these waves, the individual particles of the medium move in a direction parallel to the direction of propagation of the disturbance. The particles do not move from one place to another but they simply oscillate back and forth about their position of rest. These waves travel in the form of compression and rarefaction. Sound waves and primary waves in an earthquake are examples of longitudinal waves.

2. Transverse wave: In a transverse wave, particles do not oscillate along the line of wave propagation but oscillate up and down about their mean position as the wave travels. Thus, a transverse wave is the one in which the individual particles of the medium move about their mean positions in a direction perpendicular to the direction of wave propagation. Light wave is a transverse wave.

Other Differences

1. Transverse waves act in two dimensions enabling them to be polarised or aligned as they travel on the same plane. They are made up of crests and troughs which are created by the vibration of the waves' travel. On the other hand, a longitudinal wave acts in one dimension only.

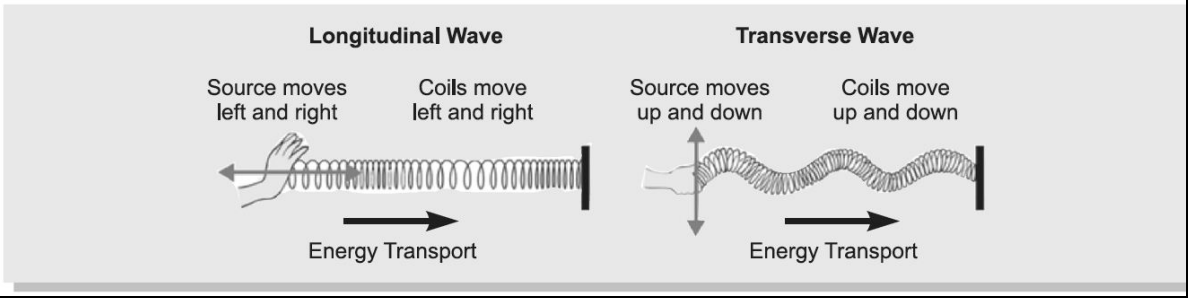
2. Transverse waves do not need any medium to transport their energy from one location to another. Thus, these waves can travel in vacuum. For example, light waves can travel in space.

On the other hand, longitudinal waves need medium for the propagation because particles of a medium move to convey vibration to the adjacent particles. Thus, these waves cannot travel in vacuum. For example, sound waves cannot travel in space.

3. Mechanical waves require the presence of a material medium in order to transport their energy from one location to another. Thus, transverse waves are not mechanical waves. On the other hand, longitudinal waves are mechanical waves.

4. An example of a transverse wave is the secondary wave or S-wave in an earthquake, whereas an example of a longitudinal wave is the primary wave or P-wave in an earthquake.

5. A transverse wave is made up of crests and troughs, whereas a longitudinal wave is made up of compressions and rarefactions.



2. Sound needs a medium to travel: Sound waves are longitudinal waves in nature. These waves, for their propagation, require actual movement of particles to convey vibrations to the adjacent particle. Thus, sound waves cannot travel in vacuum or space.

Moreover, the higher the density of the medium, the higher is the speed of the sound. In a dense medium, the particles are packed together. As a result, sound travels at a faster speed. Therefore, the speed of the sound is maximum in solids and least in gases. For instance, we are not able to hear the sound of a distant train while standing near a railway track but when we place our ear on the railway track, then the sound of the approaching train can be heard.

Speed of Sound in Different Mediums at 25°C

State	Substance	Speed in m/s
Solids	Aluminium	6420
	Iron	5950
Liquids	Water	1500
	Ethanol	1207
Gases	Hydrogen	1284
	Air	346
	Oxygen	316
	Sulphur dioxide	213

3. Effect of temperature on speed of sound: When the temperature of the medium is high, then the speed of sound is also high because high temperature facilitates the high energy in the particles of the medium. Consequently, sound travels faster with the increase in temperature.

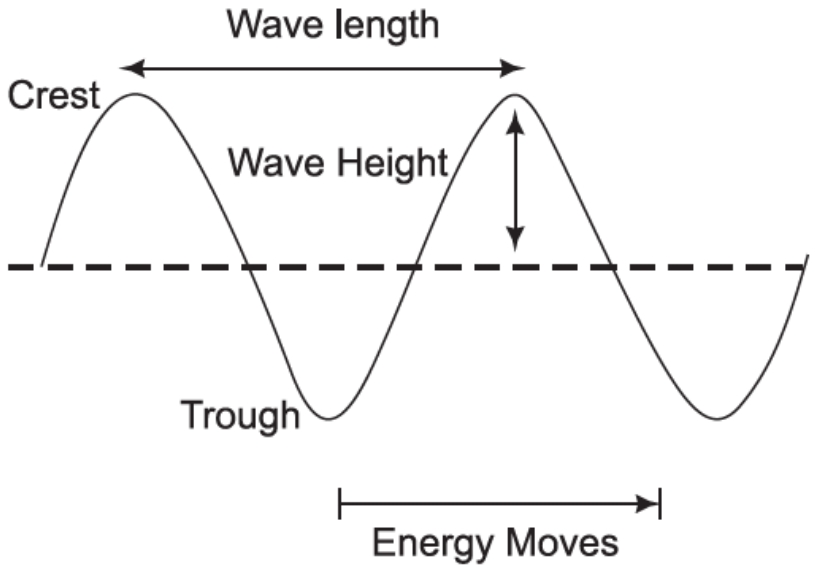
Features of Sound

In terms of physics, a sound can be differentiated from other sounds on the basis of the following features or characteristics of a particular sound.

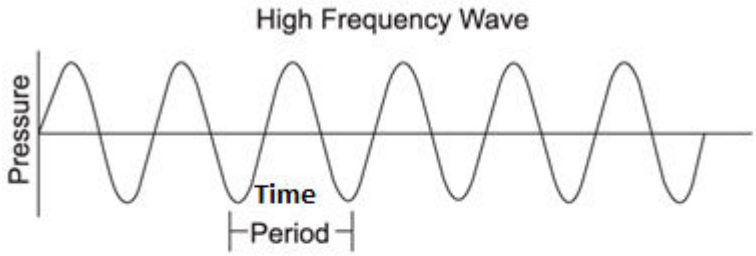
1. Wavelength: Compressions are the regions in a medium where particles are concentrated and represented by the upper portion of the curve. The peak represents the region of maximum compression. On account of concentration of particles, compressions are characterised by high density as well as pressure.

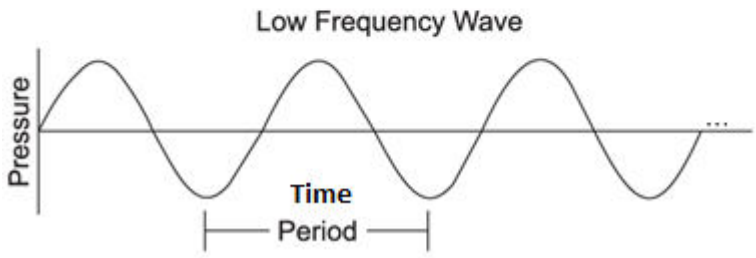
Rarefactions are the regions of low pressure in the medium where particles are spread apart and are represented by valley, that is, the lower portion of the curve. A peak is called the crest and a valley is called trough of a wave.

The distance between two consecutive compressions and rarefactions is called the wavelength. The SI unit of wavelength is metre.



2. Frequency: Frequency of sound refers to the number of oscillations per unit of time. One oscillation is equal to one complete cycle from a rarefaction to successive rarefaction or from a compression to a successive compression.





Frequency determines the pitch of the sound. The faster the vibrations, the higher is the frequency and thus higher is the pitch of the sound.

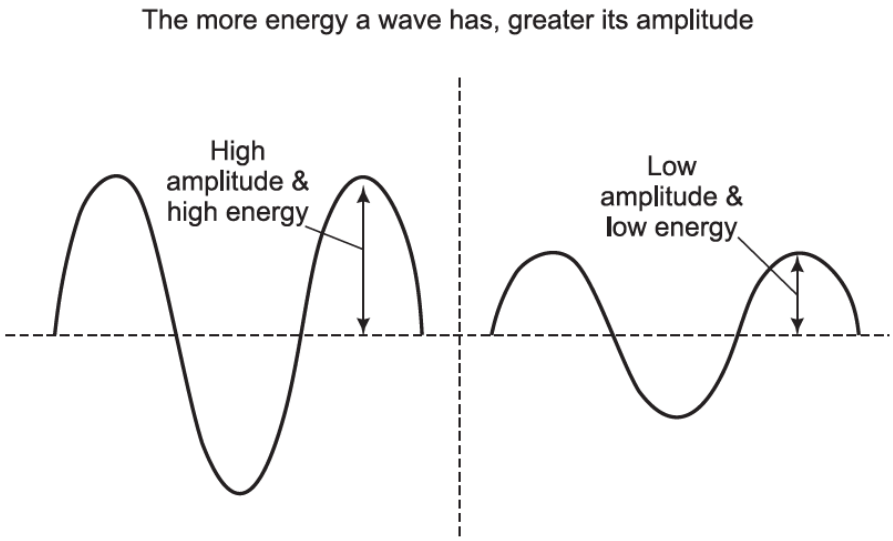
The unit of frequency is hertz (Hz).

Frequency and wavelength are inversely proportional to each other. The higher the frequency, the lower is the wavelength and vice versa.

$$\text{Frequency} = \frac{1}{\text{Wavelength}}$$

3. Amplitude: Amplitude determines the loudness of the sound. A loud sound travels farther because the energy within the oscillating particles reduces gradually with distance.

Amplitude of sound is measured in decibels (db).



4. Speed of sound: It is independent of its frequency or amplitude. The speed of the sound depends on the medium of sound travel, temperature, etc.

Sonic Boom

When the speed of any object is more than the speed of sound, it is said to be travelling at supersonic speed. Missiles, bullets, jet aircrafts, etc., often travel at supersonic speeds. When an object moves at supersonic speed, it produces shock waves in air. These shock waves carry a large amount of energy and produce loud sound called the 'sonic boom'. The shock waves produced by a supersonic aircraft have enough energy to shatter glasses and even damage buildings.

Reflection of Sound

Sound bounces off a solid or a liquid surface like a ball which bounces off a wall. In order for reflection of sound to occur, the surface should be of considerably large size.

Principles

The reflection of sound adheres to the same principles as that applicable in the reflection of light. These principles are as follows:

1. The angle of incidence is equal to the angle of reflection.
2. The incident sound, the reflected sound and the normal sound waves lie in the same plane.

Echo

Echo is produced on account of repeated reflections of a sound.

Sensation of sound persists in our brain for about 0.1 s. To hear a distinct sound (as echo), the time interval between the original sound and the reflected sound must be more than 0.1 s. We know that if the reflecting surface is away from us, then the sound will take more time to reach us.

If we consider the speed of sound as 344 m/s (which is speed of sound in air at 22°C), then the minimum distance which sound should cover to produce echo is given by

$$\text{Speed} \times \text{Time} = 344 \text{ m/s} \times 0.1 \text{ s} = 34.4 \text{ m}$$

A reflected sound travels from the source of sound to reflection surface and back from the reflection surface to the source of sound. Thus, to produce echo, the sound is required to travel from source to reflection surface and back from reflection surface to the source of sound. Therefore,

Minimum distance required to be travelled to produce echo

= 2 × Minimum distance between the source of sound and the reflection surface = 34.4 m

Minimum distance between the source of sound and the reflection surface = $\frac{34.4}{2}$ = 17.2 m

Why Do We Hear Echo of Thunder?

Thunder produced in the sky is reflected multiple times by clouds creating an experience of echo for

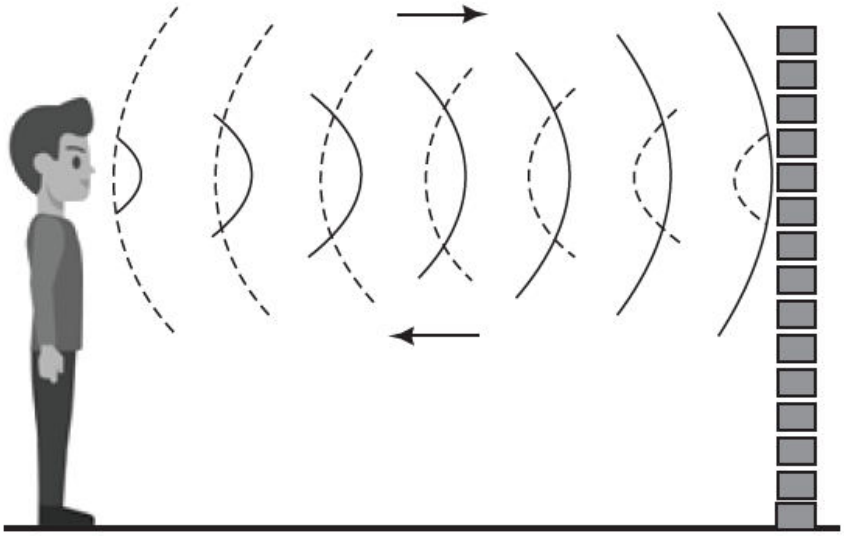
us.

Reverberation

Reverberation refers to repeated reflections of sound resulting in the persistence of sound. It is experienced in rooms, halls and other closed places.

How Is Reverberation Different from Echo?

A reverberation is quite different from an echo. A reverberation is perceived when the reflected sound wave reaches our ears in less than 0.1 s after the original sound wave. Since the original sound wave is still present in our memory, the perception of the reflected sound wave and the original sound wave overlaps. The two sound waves are combined into one very prolonged sound wave.

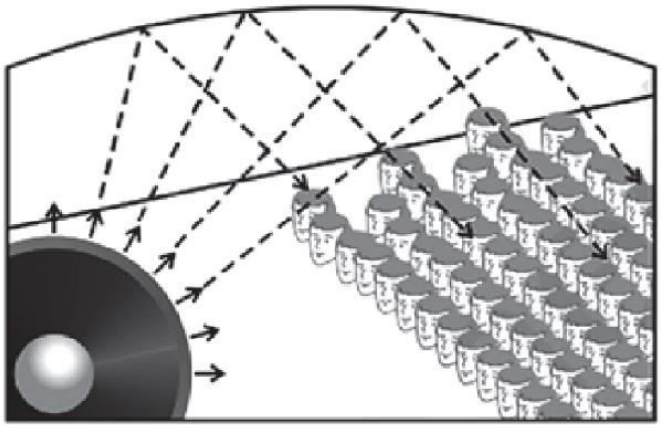


How Can Reverberation Be Reduced?

Reverberation can be reduced by adopting one or combination of the following techniques:

1. By making walls of the room rough: A rough surface has less ability to reflect than a smooth surface.

2. By curving walls and ceiling of the room: Curve in the walls and ceiling divert sound waves into various parts of the room and prevent their concentration at a single place.

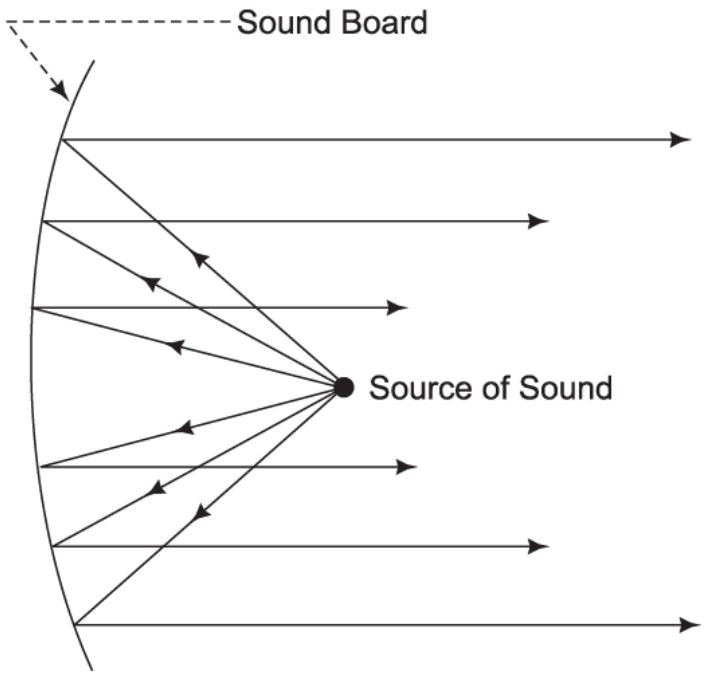


3. By using the soundboard: Sound board may be placed behind the stage so that the sound, after reflecting from the sound board, spreads evenly in the hall.

What is soundboard?

The reflection of sound may take place at curved surfaces. This property is used in the large halls to spread sound evenly throughout the hall. This is done by using sound boards.

The speaker is located at the focus of the sound board and the concave reflecting sound boards are placed behind the speakers in a large hall. The sound board prevents the spreading out of the sound waves in various directions. It sends the sound waves from the speaker, by reflection, towards the audience. This helps in making the speech easily audible even at a distance.



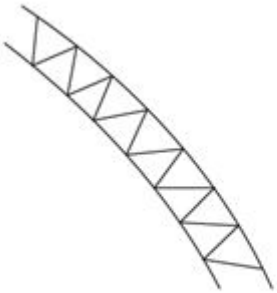
4. By using sound absorbing materials: The roof and walls of the auditorium are generally covered with sound-absorbent materials such as compressed fibreboard, rough plaster or draperies because these materials reduce the formation of echoes by absorbing sound waves. The seat materials are also selected on the basis of their sound absorbing properties.

Applications of Reverberation Phenomenon

The phenomenon of reverberation has various applications as follows:

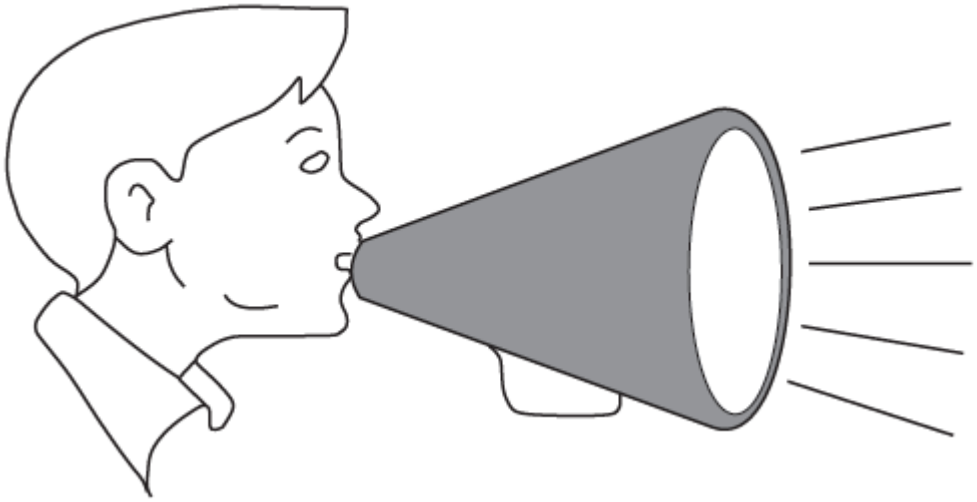
1. Stethoscope: Stethoscope is an instrument used for listening sounds produced within the body such as heart or lungs. In stethoscope, the sound of the heart beat is heard following multiple reflections of sound.

Stethoscope



Multiple Reflection of Sound in tube of Stethoscope

2. Loudspeakers: Megaphones, horns and musical instruments, such as trumpets and shehanais, are all designed to send sound in a particular direction without spreading it in all directions. In these instruments, a tube followed by a conical opening reflects sound successively to guide most of the sound waves from the source in the forward direction towards the audience.



Range of Human Hearing

The usual range of human hearing is 20–20,000 Hz. Children up to the age of 5 years and some animals can hear sound waves up to 25,000 Hz or 25 kHz.

Frequency less than 20 Hz is referred as infrasound. Some animals such as rhinoceros, elephant and whales can listen to sound with frequency less than 20 Hz.

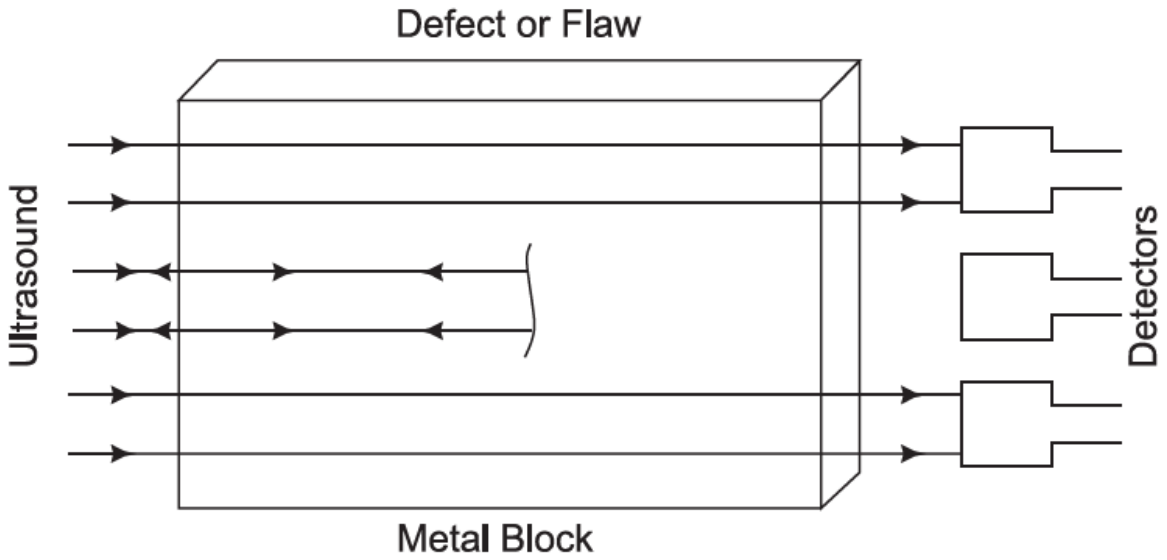
Earthquakes produce low frequency infrasound before the main shock wave hits the area. This sound is detected by certain animals capable of detecting infrasound. These animals exhibit signs of distress even before the actual earthquake.

Sounds with frequency higher than 20 kHz are referred as ultrasound. Certain animals such as dogs, rats, dolphins and bats can listen to ultrasounds.

Applications of Ultrasound

1. Ultrasound waves are used to clean parts of objects which are difficult to reach, for example, spiral tubes and odd-shaped components. Cleaning solution is added to interior components of the objects. Ultrasound waves are made to pass through the interior parts. Due to the high frequency of ultrasound waves, the particles of dust, grease and dirt get detached from objects. The objects get thoroughly cleaned.

2. Ultrasound waves are used to detect cracks in metal blocks. Metallic blocks are often used in the construction of buildings, bridges, large machinery, etc. The cracks or holes inside the metal blocks reduce the strength of the structure. These cracks are often not visible from outside. Ultrasonic waves are allowed to pass through the metal block. Detectors are placed on the opposite side as shown in the given figure. These detectors are used to detect the waves transmitted through a metal block. If there is even a small defect in the block, the ultrasound gets reflected back indicating the presence of the crack or hole.



3. Medical Applications: Ultrasonography or ultrasound scanning is used to generate images of internal organs. Particularly, echocardiography refers to generating images of heart.

Ultrasonography is based on the principle that ultrasound waves reflect back when there is a change in tissue density. These ultrasound waves are then converted into electrical signals which generate images of organs.

Ultrasonography is also used to detect abnormalities, such as stones or tumours in different organs. It is also used to examine the state of foetus during pregnancy.

Ultrasound may be employed to break small 'stones' formed in the kidneys and other internal organs into fine grains. These grains later get flushed out with urine.

4. Sound navigation and ranging (Sonar): Sonar is used to measure distance, direction and speed of other objects. It is usually installed on a boat or mounted on an aircraft. It consists of transmitter which transmits ultrasound waves and detector which receives reflected ultrasound waves. The detector converts these waves into electrical signals which are then analysed to identify nature, distance and direction of the object.

How is Distance Calculated?

The distance between the transmitter and the object that reflected the sound wave can be calculated using the speed of sound in water and the time interval between transmission and reception of the
ultrasound. We know that

Distance = Speed × Time

Thus, distance between the sonar and object × 2 = time interval between the transmission and reception of ultrasound signal × Speed of sound through seawater. Distance between the sonar and object has been multiplied by 2 because ultrasound waves travel from sonar to object and then back from object to sonar.

The above technique to determine the distance is called echo ranging. In other words, echo ranging is the technique used to determine the distance and direction of an object (as underwater) by means of an echo (as in sonar) returned by the object. The use of sonar to detect the location of an object is called echolocation. The sonar technique is also used to determine the depth of the sea and locate underwater mountains, valleys, icebergs, sunken ship, etc.

Use of ultrasound waves by bats

Bats can use sound to navigate. Bats rely on sonar to find their way and forage for food. Most bats produce echolocation sounds by contracting their larynx (voice box). A few other species can do so by clicking their tongues.

Bats produce ultrasonic sounds ranging in frequency from 20 to 200 kHz, whereas humans can hear up to 20 kHz.

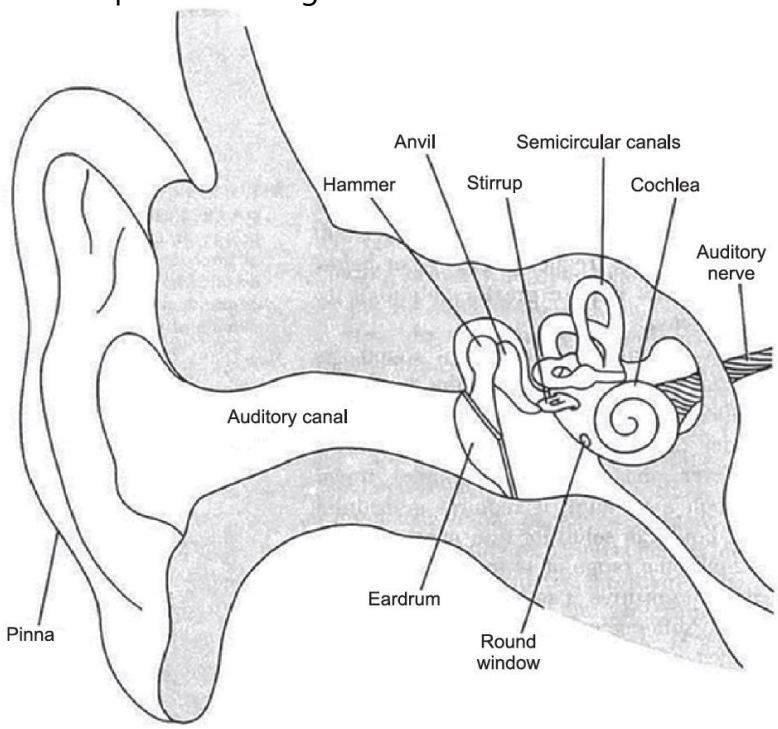
Structure of Human Ear

Ear consists of three parts: outer, middle and inner ear.

Outer ear is known as pinna. It receives sound from surroundings. The received sound passes through the auditory canal and reaches the membrane known as eardrum or tympanic membrane. This eardrum is at the end of the auditory canal.

Compression in sound waves causes eardrum to move inwards and during rarefaction eardrum comes back to original position, causing vibration of the eardrum.

The vibrations are amplified by three bones (the hammer, anvil and stirrup) in the middle ear. The last bone vibrates against the oval window called round window that connects to the cochlea present in the inner ear. Cochlea converts the sound waves into electrical signals. These electrical signals are transmitted via the auditory nerve to the brain. The brain interprets these signals as sound.



Hearing Aid: People with hearing loss may need a hearing aid. Hearing loss is usually associated with the lack of ability to hear sounds with low amplitude. A hearing aid is an electronic battery-operated device. The hearing aid receives sound through a microphone. The microphone converts the sound waves to electrical signals. These electrical signals are amplified by an amplifier. The amplified electrical signals are transmitted to a speaker of the hearing aid. The speaker converts the amplified electrical signals to sound. This sound is heard by the user of hearing aid.

Practice Questions

1. The loudness of sound is related to:
(a) Its frequency
(b) Its amplitude
(c) Its speed
(d) Its pitch

2. Which one among the following waves bats use to detect the obstacles in their flying path?
(a) Infrared waves
(b) Electromagnetic waves
(c) Ultrasonic waves
(d) Radio waves

3. In which one among the following is the speed of sound maximum?
(a) Air at 0°C
(b) Air at 100°C
(c) Water
(d) Wood

4. 'Pitch' is a characteristic of sound that depends upon its
(a) Intensity
(b) Frequency
(c) Quality
(d) None of these

5. The pitch of the voice of women is in general
(a) Marginally lower than that of men
(b) Higher than that of men
(c) Much lower than that of men
(d) The same as that of men

6. What sound level (in decibels) is considered hazardous for hearing?
(a) 30 dB
(b) 40 dB
(c) 60 dB
(d) 80 dB

7. The optimum sound level for human hearing is:
(a) 90 dB
(b) 60 dB
(c) 120 dB

(d) 100 dB

8. The ceilings of a concert hall are generally curved
(a) Because they reflect the sound to the audience.
(b) Because they can absorb noise in the hall.
(c) To amplify the sound waves in the hall.
(d) As any sound from outside cannot pass through a curved ceiling.

9. Which one of the following statements is **not** correct?
(a) Sound waves in gases are longitudinal in nature.
(b) Sound waves with frequency less than 20 Hz are infrasonic in nature.
(c) Sound waves with higher amplitudes are more audible.
(d) Sound waves with high frequencies are loud to hear.

10. Which one of the following statements is **not** correct?
(a) The velocity of the sound in air increases with the increase in temperature.
(b) The velocity of the sound in air is independent of frequency.
(c) The velocity of the sound in air increases with the increase in the density of air.
(d) The velocity of the sound in air is affected by the change in amplitude and frequency.

Answer Keys

Practice Questions

1. (b)	2. (c)	3. (d)	4. (b)	5. (b)
6. (d)	7. (b)	8. (a)	9. (d)	10. (d)

Solutions

Practice Questions

3. (d) The speed of sound is maximum in solids because of their high density.

8. (a) The reflection of sound takes place at curved surfaces. This property is used in the large halls to spread sound evenly throughout the hall.

9. (d) The loudness of sound is related to its amplitude and not frequency.

10. (d) The velocity of sound depends upon the nature and temperature of medium. It is not affected by frequency and amplitude of sound.

CHEMISTRY

CHAPTER 1 MATTER

Matter is anything that occupies space and has mass. In other words, matter has both mass and volume. It can be in any form such as solid, liquid or gas. For instance, the air we breathe, the food we eat, the water we drink, plants, stars, stones, clouds or a particle of sand are all matter.

Scientists have classified matter based on their physical and chemical properties. In this chapter, we will study about physical properties of matter. We will discuss about the chemical properties in subsequent chapters.

What Is Matter Made Up Of?

For a long time, scientists were unable to decide as to what really matter was made up of. Two different views on the nature of matter emerged. One believed that matter was continuous such as a piece of stone or a block of wood, whereas the other believed that matter was made up of particles such as sand. This debate existed for a long time. Later on, scientists were able to prove that matter is made up of particles.

Experimental Support

Let us take salt and water. We know that both are matter. We try to dissolve salt in water. We notice that salt completely disappears into water. Also, if we look closely, we will further notice that the level of water in the container does not change. A chunk of salt contains many salt crystals. Each crystal is made up of small salt particles. The particles keep breaking from each other and spread evenly among the interparticle spaces of water. Hence, the level of water does not change.

From the above example, we can clearly make out that matter is made up of particles.

Characteristics of Particles of Matter

1. Size of particles: The particles of matter are very small in size. These particles can be so tiny that we cannot even see them with our naked eye. Let us perform an activity to understand how small particles of matter can be!

Have you ever played Holi with coloured water? A small concentrate can add colour to many buckets of water. Thus, we can conclude that there must be numerous tiny particles in just one small pouch of concentrate, which keep on dividing into smaller and smaller particles.

2. Particles of matter have space among them: This can be concluded by observing the solubility of one matter into the other. Particles of one type of matter spread evenly into the other matter. This shows that there exists some space between the particles of matter. For example, salt crystals when dissolved in water disappear completely.

3. Particles are continuously moving: Particles of matter are continuously moving. This is because they possess kinetic energy and this energy aids their movement. For example, smell of food travels in air. This is because the gaseous particles present in food travel in the surrounding air on account of the energy possessed by them.

When the temperature of particles increases, they travel faster. This is because the increase in temperature of the particles increases their kinetic energy. Movement of particles causes intermixing of particles. Rise in temperature of particles results in faster intermixing.

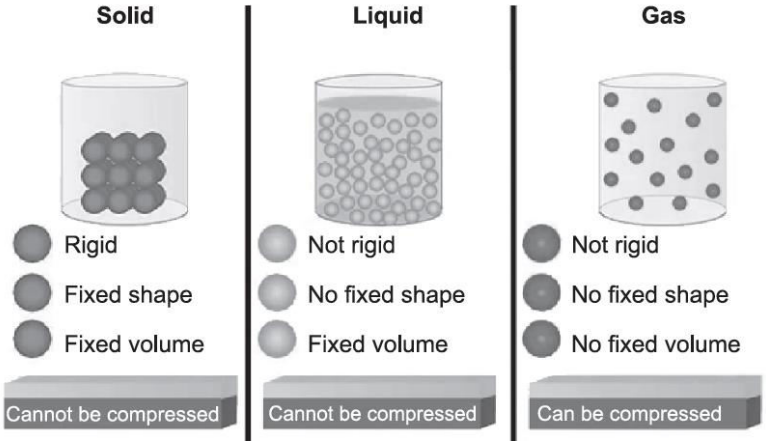
When the particles of two different matters intermix on their own, the process is called diffusion. For instance, the air around us is on account of diffusion of multiple gases. As the temperature of gases rise, the process of diffusion becomes faster.

4. Particles of matter attract each other: Particles of matter are acted upon by an interparticle force of attraction which binds them together. The strength of this force varies from matter to matter. The matter having a weak force is easier to break as compared to the one which has a strong force of attraction. To break any matter, we need to overcome this force.

For example, it is easier to break a chalk than to break a nail. This is because the inter-particle force of attraction among the particles of iron nail is much higher as compared to the chalk. The interparticle force of attraction and the kinetic energy that exists among the particles of matter determine the physical state of any matter, i.e. solid, liquid or gas.

States of Matter

We have already discussed that there exists kinetic energy and a force of attraction among the particles of matter and their combined effect determine the state of matter. Based on this, the matter can be classified into three states: (i) solid, (ii) liquid and (iii) gas. This classification arises mainly because of the variations among the characteristics and the force of attraction that exists among the particles.



1. Solid state: Solids have definite shapes, distinctive boundaries and fixed volumes. They are not easily compressible; they have a tendency to maintain their shape. When subjected to an external force, they may break but it is very difficult to alter their shape. This is because the particles of solid have very less space between them and the movement among the particles is almost impossible. A single particle is locked at its place by other particles surrounding it. Consequently, solids are rigid in shape.

2. Liquid state: Liquids take the shape of the container in which they are poured. Thus, liquids have no definite shape or distinctive boundaries but have fixed volume. Liquids are not easily compressible. Liquids change shape and, thus, are not rigid. We observed earlier that solids and liquids can diffuse in liquids. The gases from atmosphere can also diffuse in water. These gases are essential for the survival of aquatic animals. Thus, we can say that all three states of matter can dissolve in liquids.

The rate of diffusion in liquids is more than that of solids, but less than that of gases. This is because the particles of liquid have much more space among them as compared to those in solid. On the other hand, the particles in liquid have less space among them as compared to those in a gas.

3. Gaseous state: Gases take the shape and volume of the container they occupy. This suggests that gases have no distinctive shape nor do they have any fixed volume. Gases are highly compressible as compared to liquids and solids. The particles of a gas have such a large space between them that they do not form any shape until they are filled in some container.

The liquefied petroleum gas that we use in our households for cooking food is a compressed form of gas. Because of the high compressibility, high volumes of gas can be easily compressed into a cylinder and conveniently transported.

Can Matter Change Its State?

We know that matter exists in three physical forms: solid, liquid and gas. These states of matter are interchangeable. Solid can be changed into liquid and vice versa, liquid into gas and vice versa, and even solid state can directly change into gaseous state and vice versa. There are two ways in which a matter can change its state:

Change in Temperature

Change in state of matter takes place on account of change in temperature. With the increase in temperature, the kinetic energy among the particles increases. Due to increase in kinetic energy, the particles start vibrating vigorously. The kinetic energy among the particles overcomes the force of attraction among them. As a result, the particles are displaced from their positions and begin to move more freely.

Solid to liquid: When the temperature of particles is raised for some time, there comes a stage at which the solid object melts to liquid form. The temperature at which the solid starts converting into liquid is known as the melting point of that solid. For instance, the melting point of ice is 0°C. Depending upon the nature of solid, the melting point is different for different objects.

Latent heat: If we continue to add heat even when the melting point of an object is attained, the temperature of an object will remain the same till the object completely converts into liquid. For instance, if we continue to apply heat, temperature remains constant till all the ice melts into water. If the temperature remains unchanged, then where does this additional heat go?

The extra heat energy is consumed in overcoming the interparticle force of attraction and, thus, changing the state of matter. The heat energy which does not raise the temperature of an object but only changes the state of matter is known as the latent heat. 'Latent' literally means 'hidden' or which is not apparent because it does not raise the temperature of an object. On account of latent heat, we can conclude that at the same temperature water particles have higher energy as compared to the particles of ice.

In the above case, the heat energy required to overcome the force of attraction among the particles of solid to convert it into its liquid form is called latent heat of fusion.

Liquid to gas: If we continue to supply heat to the water particles, they start vibrating at a faster rate. At a particular temperature, a point is reached where the particles gain so much energy that they are able to overcome the force of attraction and start moving freely. At this temperature, the liquid starts converting into gas. The temperature at which a liquid starts boiling is known as the boiling point of that object. For instance, the boiling point of water is 100°C.

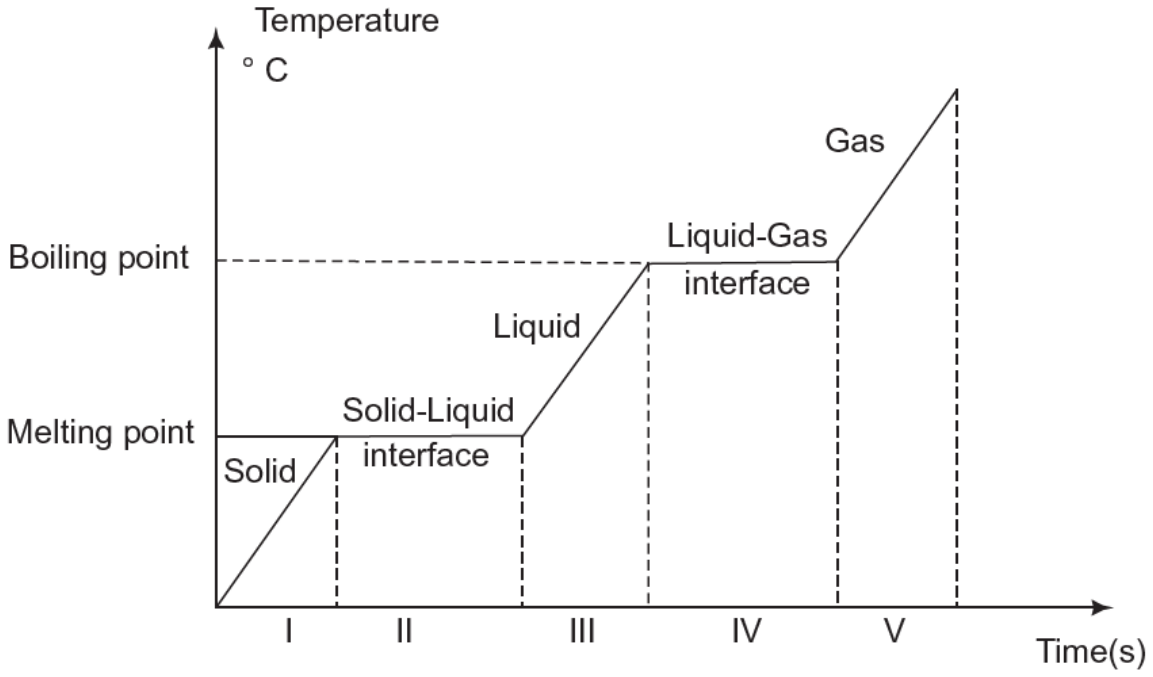
Moreover, if we continue to apply heat once the boiling point has been attained, then the water will continue to convert into water vapour or steam at the same temperature. This is because the particles in water absorb extra energy in the form of latent heat of vaporisation.

Gas to liquid: Vapours can also be converted back into liquid form. For instance, when rising water vapours (steam) encounter a cold surface they lose heat and convert back to liquid form. This process, unlike vaporisation, involves loss of heat. This process of conversion of gas (vapours) into liquid (water droplets) is called condensation and the heat energy released during the conversion is called latent heat of condensation.

Solid to gas: If a matter changes directly from solid state to gaseous state without changing into liquid form, the process is known as sublimation. Naphthalene balls used

in households to protect clothes from larvae of moth exhibit sublimation. Sudden change of temperature can also lead to sublimation. On the other hand, if the matter changes directly from gaseous state to solid state without changing into liquid form, the process is known as deposition. Gaseous CO_2 directly converts to dry-ice when cooled to –78.5°C.

Original State	**Change To**	**Name**
Solid	Liquid	Melting
Liquid	Solid	Freezing
Liquid	Gas	Boiling
Gas	Liquid	Condensation
Solid	Gas (Skipping Liquid Phase)	Sublimation
Gas	Solid (Skipping Liquid Phase)	Deposition



Change in pressure

We know that the difference in various states of matter exists because of the prevailing distance between the particles of that matter. What happens if we put pressure on the particles of matter? Particles of matter can be brought together by applying pressure on them. Applying pressure and reducing the temperature of a gas can liquefy the gas. Liquefaction is the process of conversion of gas to liquid.

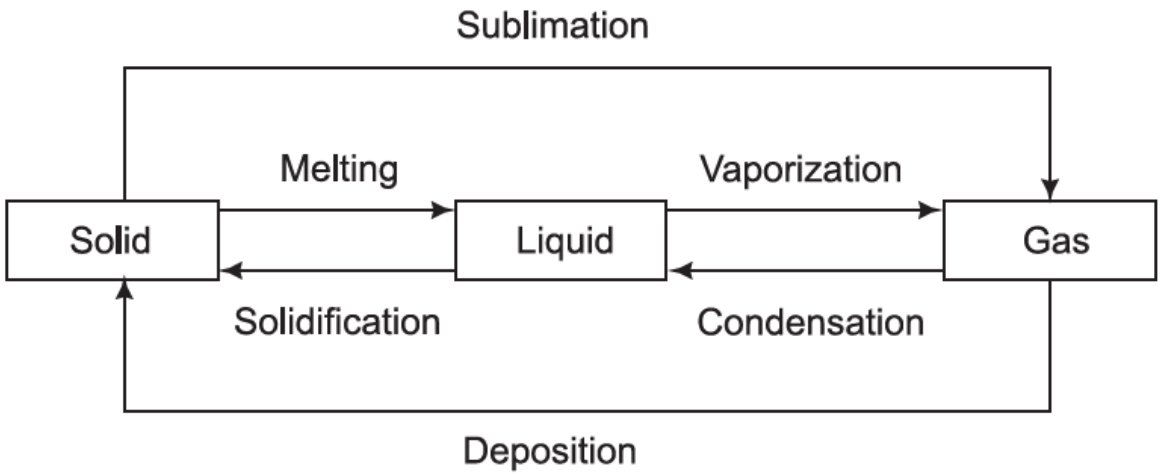
The process of conversion of matter from its gaseous or solid form (both ways) to its liquid form is called liquefaction.

Similarly, a gas can be directly converted into solid by reducing pressure. This process of conversion of gas directly into solid is called deposition.

Let us take the example of carbon dioxide (CO_2). When stored under high pressure, CO_2 turns into solid CO_2. And when the pressure is decreased to 1 atmosphere, solid CO_2 converts into gaseous state without changing into liquid state. As carbon dioxide gas directly converts to solid form, it is called dry-ice.

Atmosphere is a unit to measure the pressure exerted by gas. We have learned that unit of pressure is pascal (Pa). 1 atmosphere = 1.01×10^5 Pa The pressure of air in the atmosphere is called atmospheric pressure. The atmospheric pressure at sea level is 1 atmosphere and is taken as the normal atmospheric pressure. As we go upwards, the pressure of air above us reduces.

Thus, we can conclude that both temperature and pressure play an important role in determining the state of matter, i.e. whether it will be solid, liquid or gas.



Evaporation

The phenomenon of change of water into vapours at any temperature below the boiling point is known as evaporation.

Have you ever noticed that wet clothes dry up without the water reaching the boiling point? When the water is left uncovered in a bucket, it slowly changes into vapour. Why does this happen?

This happens because particles of liquid at the surface tend to possess higher kinetic energy and are less bound by interparticle force of attraction. As a result, these particles are able to break the interparticle force of attraction and change into vapour.

Factors Affecting Evaporation

The following factors help in increasing the rate of evaporation:

- **Increase in surface area:** Increase in surface area, increases the rate of evaporation. For example, if we keep wet clothes in folded form, they take longer time to dry. On the other hand, if we spread the clothes, they dry early.

- **Increase in temperature:** Particles gain more kinetic energy with the increase in temperature (heat) and they convert into vapour form faster.

- **Decrease in humidity:** Humidity refers to the amount of water vapours present in the atmosphere. If the amount of water vapours present in the air is high, the rate of evaporation decreases and vice versa.

- **Increase in wind speed:** Increase in wind speed shifts the water vapours present in the surrounding air and brings in dry air to accommodate more water vapours. Moreover, high speed of wind adds energy to surface water particles and sets them free.

How does evaporation reduce temperature?
Particles of water need heat to increase their kinetic energy in order to evaporate. Thus, the particles at surface absorb heat from their surroundings. This absorption of heat energy from the surrounding reduces the temperature. Thus, evaporation leads to cooler surroundings.

For example, people sprinkle water on the roof or open ground on a long sunny day. Water absorbs the heat from the ground and evaporates, cooling the ground.

It is advised to wear cotton clothes in summers because cotton is a good absorbent of water. It helps absorb the sweat from our body. The sweat then evaporates leaving a cooling sensation.

Why do we see water droplets on the surface of a glass containing ice-cold water?
This happens because the water vapours that are present in the surrounding air come in contact with the surface of the cold glass and lose their energy. As a result, the water vapours change into water droplets and appear on the surface of the glass.

Plasma
Plasma is considered the fourth state of matter. It consists of particles in the form of ionised (positively or negatively charged) gases. High temperatures are required to break the bonds and free the electrons from the particles, making the particles ionised. As plasma is formed at high temperatures, it is usually very hot. Stars (including the sun) are mostly made of plasma, which makes them glow.

In our day-to-day life, the fluorescent tubes and neon signboards consist of plasma. The gas present in them gets ionised when electricity flows through it, which makes

them glow. The colour of plasma depends on the nature of the gas. The fluorescent tubes are usually filled with helium and neon signboards are filled with neon gas.

Relation Between Celsius, Kelvin and Fahrenheit

There are three type of units used to measure temperature namely Kelvin (K), Celsius (C) and Fahrenheit (F).

Relation between Kelvin and Celsius is a follows:

$K = C + 273$

Relation between Celsius and Fahrenheit is as follows:

$F = 9/5(C) + 32$

Practice Questions

1. During summer, water kept in an earthen pot becomes cool because of the phenomena of:
(a) Diffusion
(b) Evaporation
(c) Osmosis
(d) Transpiration

2. The rate of evaporation decreases with
(a) Increase in humidity.
(b) Increase in temperature.
(c) Increase in wind speed.
(d) Increase of surface area.

3. Amount of energy required to change liquid to gas without any change in temperature is termed as:
(a) Latent heat of fusion.
(b) Latent heat of vaporisation.
(c) Heat capacity.
(d) Specific heat capacity.

4. The temperature at liquid–gas interface:
(a) Increases with addition of heat.
(b) Decreases with the addition of heat.
(c) Remains constant.
(d) Has no fixed pattern of change.

5. Consider the following statements:
1. Change of matter from solid to liquid state directly is known as sublimation.
2. Change of matter from gaseous to solid state directly is known as deposition.
Which of the following statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

6. Consider the following statements:
1. The constituent of plasma is superheated uncharged matter.
2. Plasma finds application in nuclear fusion reactors.
Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only

(c) Both 1 and 2
(d) Neither 1 nor 2

7. Consider the following statements:
1. The unit of pressure is N/m^2.
2. The pressure of air decreases with an increase in height.
3. The pressure of water decreases with increase in depth.
Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

8. Which of the following are used to change the state of matter?
1. Variation in temperature
2. Variation in pressure
3. Variation in mass of the substance
Select the correct option from the codes given below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

9. Consider the following statements:
1. The interparticle spaces are least among solids.
2. Liquids have no fixed shape and volume and are nonrigid.
3. The interparticle force of attraction is weakest among gases.
Select the correct option from the codes given below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Perfecting Past Prelims

1. In a pressure cooker, the temperature at which the food is cooked depends mainly upon which of the following? (2021)
1. Area of the hole in the lid
2. Temperature of the flame
3. Weight of the lid
Select the correct answer using the code given below:
(a) 1 and 2 only
(b) 2 and 3 only

(c) 1 and 3 only
(d) 1,2 and 3

Answer Keys

Practice Questions

1. (b)	2. (a)	3. (b)	4. (c)	5. (b)
6. (b)	7. (a)	8. (a)	9. (c)	

Perfecting Past Prelims

1. (a)				

Solutions

Practice Questions

1. (b) In an earthen pot, water gets evaporated quickly through the pores. Some heat energy is utilized during the process of evaporation. Since this energy is taken from the water itself, it leads to a lowering of temperature in the remaining amount of water.

2. (a) With increase in humidity the air surrounding the clothes holds a greater quantity of water vapours. This makes it difficult for new vapours (from the source) to accommodate into the
surrounding air.

3. (b) The heat capacity of a defined system is the amount of heat (calories/kilocalories/joules) needed to raise the system's temperature by one degree (Celsius/kelvin).
Specific heat is the amount of heat needed to raise the temperature of one kilogram of mass by 1 kelvin.

5. (b) Statement 1 is incorrect: Change of matter from solid to gaseous state directly is known as sublimation.

6. (b) Statement 1 is incorrect: Plasma consists of particles in the form of ionized (positively or negatively charged) gases.

7. (a) Increasing depth leads to an increase in hydrostatic pressure i.e. the force per unit area exerted by a liquid on an object. The hydrostatic pressure is exerted by the fluid above the submerged body. Hence, more the fluid more is the pressure exerted.

Perfecting Past Prelims

1. (a) The Pressure cooker is a tightly sealed vessel in which the water is heated and it eventually boils into steam. All the trapped water molecules increase the pressure inside the cooker and assist in faster cooking of the food.
Statement 1 is correct: If the area of the hole in the lid is increased, more steam will move out of the pressure cooker and thus, the temperature inside the cooker will fall down.
Statement 2 is correct: Increase in temperature of the flame increases the heat and pressure within the pressure cooker upto a certain level till the safety valve is open.
Statement 3 is incorrect: The weight of the lid does not affect the temperature inside the cooker.

BIOLOGY

CHAPTER 1 CELL: UNIT OF LIFE

All the organisms are made up of cells. A cell is called the fundamental unit of life because it is capable of existing on its own and performing all the functions which are necessary for a living being. Unicellular (single-celled) organisms such as amoeba are capable of independent existence which shows the cell's capability to exist independently. Cell is the smallest unit of life.

Discovery of Cell

In 1665, Robert Hooke discovered cell for the first time. He listed the following observations regarding cells:

1. All living organisms are composed of cells. Thus, cell is the fundamental unit of life.

2. All new cells come from the pre-existing cells.

The shape and size of the different type of cells vary and it is related to the specific function they perform. In some cases, the shape of the cell could be more peculiar than the other type of cells (like the nerve cells have a typical shape).

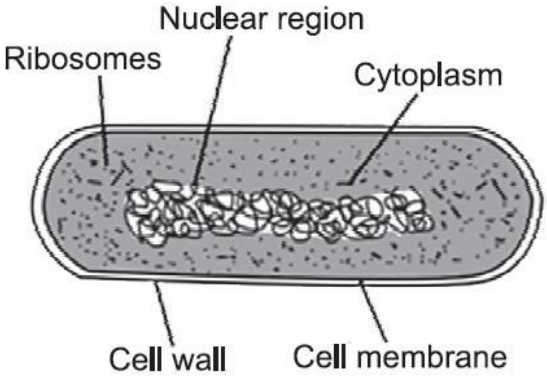
Each living cell has the capacity to perform certain functions that are characteristic to all living forms. Just like human body has different organs to perform different functions, cell has different divisions to perform different tasks, and these divisions are known as cell organelles. Each organelle performs different task. All cells have the same organelles no matter what organism they are found in or what function they have to perform.

Types of Cells

Cells can be divided into two types, which are as follows:

1. Prokaryotic cells: 'Pro' refers to primitive or primary and 'karyote' refers to nucleus. These cells can perform limited functions. Due to the absence of membrane, constituents of cell are not well defined. For example, bacteria, blue green algae, etc.

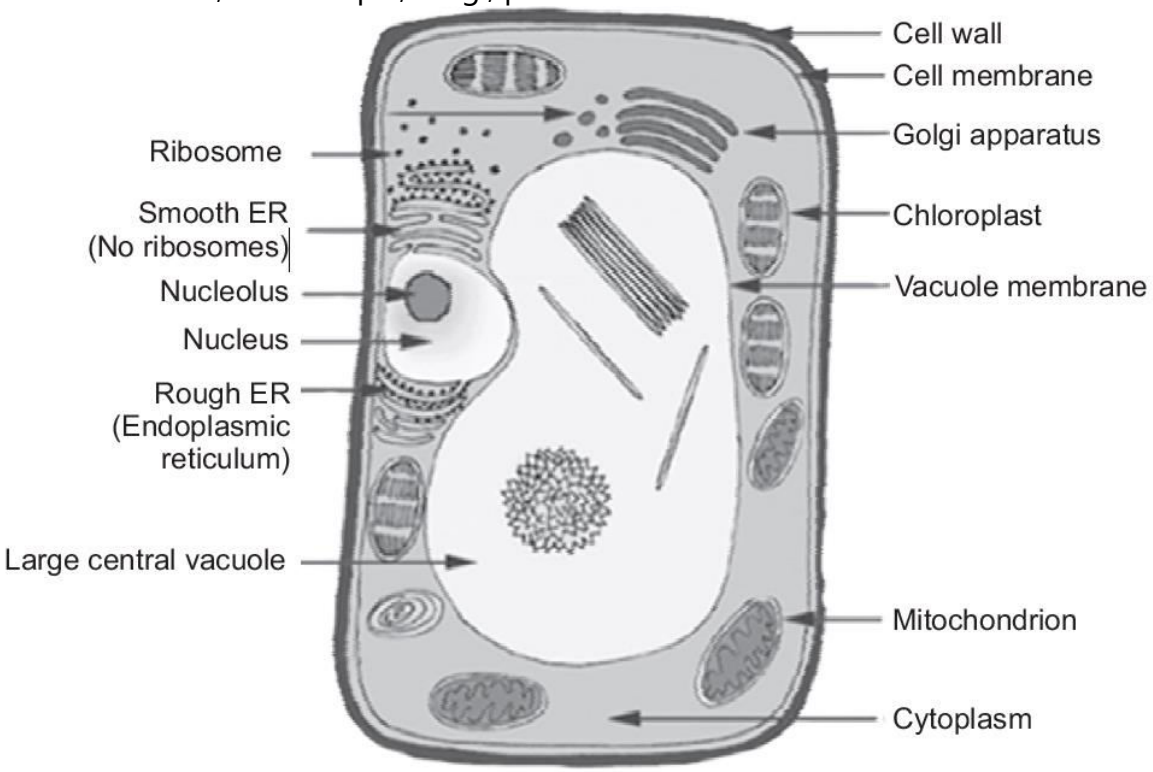
These organisms are single-celled organisms that lack membrane-bound organelles.



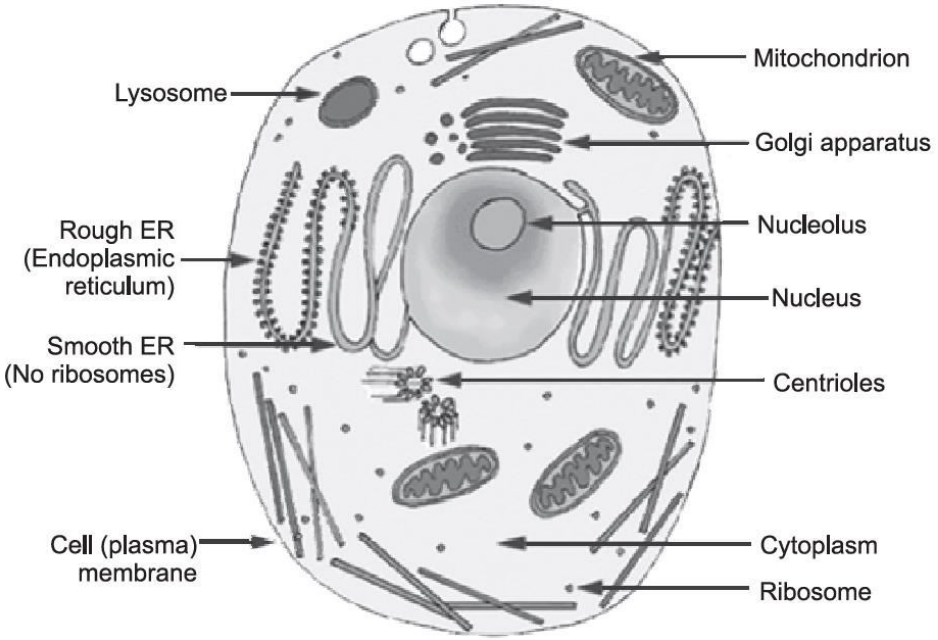
2. Eukaryotic cells: These cells are evolved from prokaryotic cells over millions of years. They possess well defined (membrane bound) nucleus and other organelles. They are advanced and complete cells. Based on the number of cells, organisms are classified into unicellular and multicellular organisms.

Unicellular: They contain a single cell which performs all the functions, for example, Amoeba, Paramecium and Chlamydomonas.

Multicellular: In these organisms, many cells group together and perform different kinds of functions, for example, fungi, plants and animals.



Plant cell



Animal cell

Structural Organisation of a Cell

A single cell is capable of performing various activities on account of different components as follows:

1. Plasma membrane or cell membrane: It is the outermost covering of the cell that separates the inside or contents of the cell from its environment. It is a living part of the cell. It is very thin and delicate.

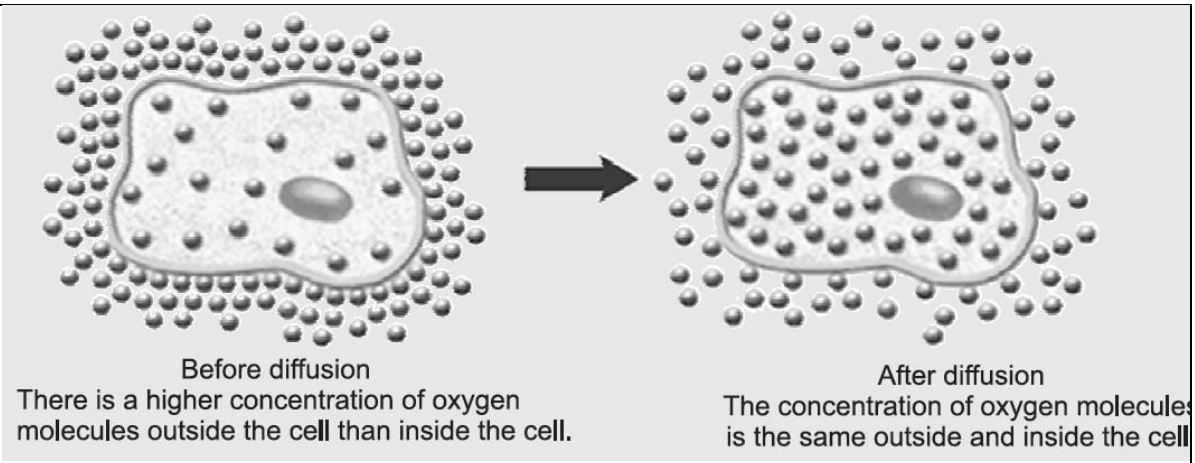
Functions: It allows the entry and exit of selected material from the cell as it is selectively permeable membrane.

Transport of Substances Through Plasma Membrane

There are two processes through which material can pass through plasma membrane:

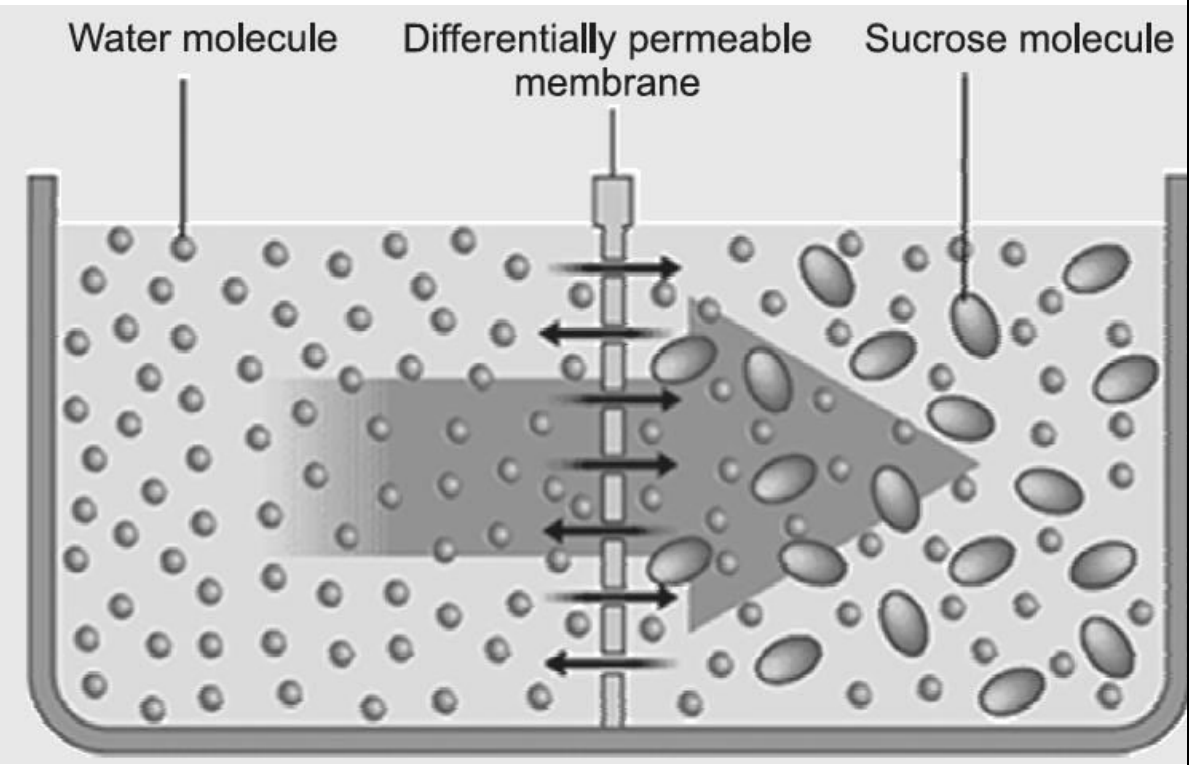
1. Diffusion: It is a process of movement of substances from the place of high concentration to a place of low concentration. Gaseous exchange occurs between cell and blood in our body by process of diffusion.

If the oxygen level in a cell falls in comparison to the blood cell in our body, oxygen molecules enter into cell. Similarly, if carbon dioxide level in a cell increases in comparison to the blood cell in our body, the carbon dioxide molecules move out of cell.



2. Osmosis: It is a process of movement of water from a place of low solute concentration to a place of high solute concentration. Osmosis is opposite to diffusion because solvent such as water moves from low solute concentration to high solute concentration.

In case the concentration of solute such as carbohydrates increases (as compared to its external environment) within a cell, then water enters from outside the cell. On the other hand, if the concentration of solute reduces within a cell, then the cell discharges water.



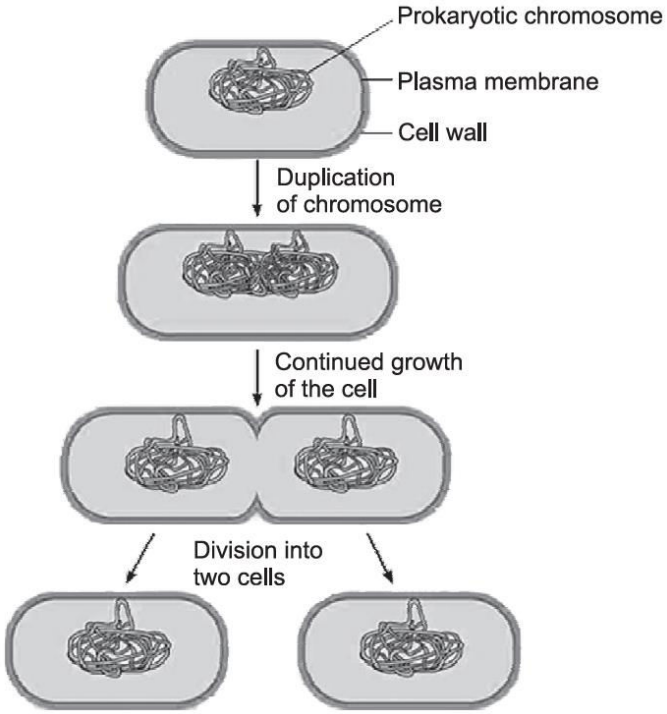
2. Cell wall: In addition to plasma membrane, the cell has another covering known as cell wall. The cell wall lies outside the plasma membrane and provides support to the

cell's structure. It is present in eukaryotic as well as prokaryotic cells. Cell wall is a non-living part of the cell. It is thick, freely permeable and is made up of cellulose.

Functions: It imparts rigidity and protection to the structure of cell. It is present only in plant cells and not in animal cells. It is because of cell wall, plants have hard outer covering. On the other hand, animals are soft to touch.

3. Nucleus: It is a dark coloured, spherical or oval dot-like structure which is present in the centre of each cell. Nucleus has a double-layered covering known as nuclear membrane. The nuclear membrane consists of pores which help in the transfer of materials from inside to the outside. Nucleus has a fluid present in it. The fluid which is inside the nucleus is called nucleoplasm.

Nucleus consists of chromosomes which are rod-like structures. They carry genetic information in the form of DNA. DNA is present in the form of chromatin. Chromatin is an entangled mass of thread-like structure present within the nucleus. Chromatin leads to the formation of chromosomes.



In case of prokaryotic cells, because of lack of clearly defined nucleus, nucleic acids are present and are known as nucleoids.

Functions

- Nucleus determines the functioning of the cell and directs the activities of the cell organelle.
- It plays role in cellular reproduction.
- It is the storehouse of genetic information.

4. Cytoplasm: It is a clear jelly-like fluid that fills the inside of the cell and surrounds all the cell organelles. It helps in keeping the cell's internal components in place. It is thicker than water. In eukaryotes, cytoplasm specifically means the region outside the nucleus but inside the plasma membrane. On the other hand, the division between nucleus and other cell organelle is not clear in prokaryotic cells.

Functions

- Acts as a store for vital chemicals such as amino acids, proteins, sugar, etc.
- Site of metabolic activities of cell.
- Gives shape to the cell.

It further contains many constituents performing specialised functions called cell organelles. The various organelles present in the cytoplasm are as follows:

(i) Endoplasmic reticulum (ER): It is a large network of minute tubes (tubules). ER has structure similar to plasma membrane. ER is absent in prokaryotic cells.
ER is further divided into two types:

(a) Rough ER: Rough ER is rough (appears rough) on account of ribosomes attached to its surface. Ribosomes are a site of protein manufacture. These proteins are transferred by rough ER to various cell organelles.

(b) Smooth ER: Smooth ER helps in the manufacturing of some lipids and proteins which function as enzymes for digestion. These enzymes are used by lysosomes. Ribosomes are absent on smooth ER. Smooth ER also plays other roles such as detoxification of liver cells from effects of many poisons and drugs.

Functions

- Rough ER helps in the synthesis and transport of proteins and smooth ER helps in the synthesis and transport of lipids.

(ii) Golgi apparatus: It consists of system of membrane-bound vesicles (bags) arranged parallel to each other in stacks. These stacks are called cisterns. With the help of Golgi apparatus, the material synthesised in ER is packaged and dispatched to various targets.

Functions

- It helps in storage, modification and packaging of products in vesicles.
- It facilitates the manufacture of complex sugars from simple sugars.
- It is involved in the formation of lysosomes.

(iii) Lysosomes: These are formed by Golgi bodies. These are waste disposal systems of a cell. It contains several digestive enzymes enclosed in a membrane. These enzymes can break down all organic material. In case the cell gets damaged and lysosomes burst, the enzymes present in it digest the whole cell. Therefore, these are also called suicidal bags of the cell.

Functions
- Keeps the cell clean by digesting foreign material as well as worn-out organelles.
- Provides protection against virus and bacteria.

(iv) Mitochondria: These are known as the powerhouse of the cell. They are small rod-shaped organelles. It has two membrane coverings. The outer layer is porous, whereas the inner layer is deeply folded into numerous finger-like structures called cristae. They can make their own proteins as they have their own DNA and ribosomes.

Functions
- They release energy for activities of living cells.
- They store energy in the form of ATP (Adenosine triphosphate) which is the form of energy as required by a cell.

(v) Plastids: These are present only in plant cells and not in animal cells. They are usually spherical in shape. These are double membrane-bound organelles. Like mitochondria, they have their own DNA and ribosomes.

There are three types of plastids:
(a) Chloroplasts: Plastids containing green coloured pigment called chlorophyll are known as chloroplasts. They provide green colour to the leaves. These plastids play role in photosynthesis.

(b) Chromoplasts: Apart from chlorophyll, chromoplasts contain pigments of other colours such as yellow, orange, etc.

(c) Leucoplasts: Leucoplast is a primary organelle in plant cells for storage of certain materials such as starch, oils or proteins.

Functions
- Green plastids manufacture food through photosynthesis.
- Chromoplast gives colour to the flowers.
- Leucoplasts help in storage of protein, starch and oil.

(vi) Vacuoles: These are storage sacks for solid and liquid contents filled in the membrane. These are small sized in animal cells and large sized in plant cells. The

vacuoles of some plant cells may occupy 50% to 90% of the cell volume. Due to its size, other organelles including nucleus shift towards plasma membrane.

Functions

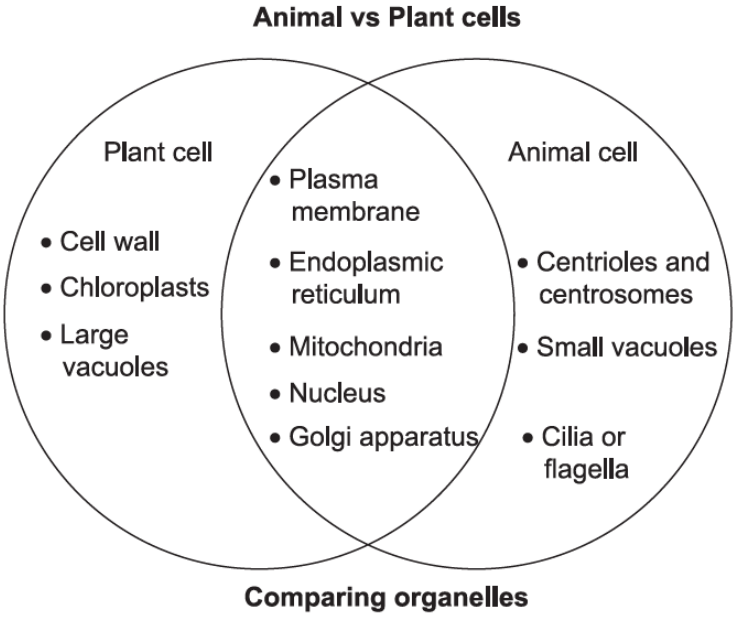
- Provides turgidity (swollen) and rigidity to the cell.
- Vacuoles carry substances important for cell such as amino acids, sugar, some proteins and other compounds.
- They can even store waste products so that the rest of the cell is protected from contamination.

(vii) Centrioles: Every animal cell has two small organelles called centrioles. These spindle fibres act as guides for the alignment of the chromosomes when they separate during the process of cell division. Though centrioles play a role in the reproduction within animal cells, plant cells are able to reproduce without them.

(viii) Cilia or flagella: Cilia and flagella have the same internal structure. The major difference is in their length. Cilia are short, and there are usually many (hundreds) cilia per cell. On the other hand, flagella are longer, and there are fewer flagella per cell (usually one to eight).

Functions: Cilia and flagella facilitate liquid movement along the surface of the cell. In humans, for example, cilia are found in the lining of the trachea (windpipe), where they sweep mucus and dirt out of the lungs.

In unicellular organisms such as protozoa, they help in locomotion.



Tissue

We have learned that the living organisms are made up of cells. In unicellular organisms, single cell performs all the basic functions. On the other hand, multicellular organisms are made up of millions of cells. These cells, in a group, perform specific functions at a specific site in a body. A group of cells, similar in structure, that work together to perform a particular function form a tissue.

Comparison of Plant and Animal Tissues

There are major differences between plant and animal tissue. Plant and animal tissues are totally different.

Plants are stationary and therefore, most of the tissues in them are supportive and give structural strength. The tissues consist of dead cells and, hence, need less maintenance. Growth in the plants is limited to particular regions.

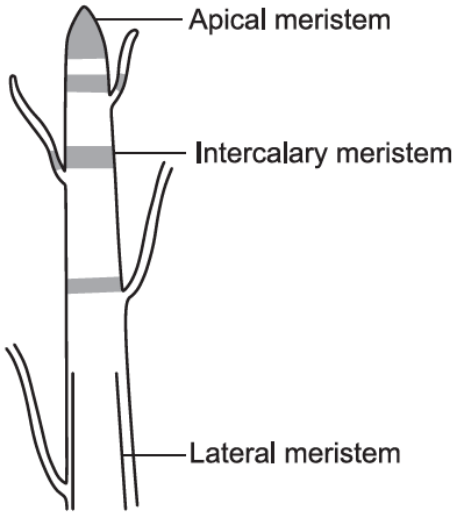
On the other hand, animals move around in search of food and shelter. The tissues consist of living cells and hence need more maintenance and energy. The growth pattern in animals is more uniform than in the plants. The structural composition of animals is very complex.

Plant Tissues

Some tissues in the plants keep on dividing throughout the year, whereas others do not divide at all. On the basis of their dividing capacity, plant tissues can be grouped into two types: growing or meristematic tissue and permanent tissue.

Meristematic Tissue

The dividing tissues, in the plant, are located at specific regions. Therefore, the growth of plants occurs only at these sites. Depending on the region where these tissues are present, meristematic tissues can be of three types: apical, lateral and intercalary.



Location of Meristematic Tissue in Plant Body

Apical meristematic tissue is present at the growing tip of stems and roots. It increases the length of stem and root. Lateral meristematic tissue increases the girth of stem or root. Intercalary meristematic tissue is present at the base of the leaves or internodes on the twigs (slender woody shoot growing from a branch or stem).

The cells of the meristematic tissue are very active, have dense cytoplasm, thin cellulose walls and prominent nuclei. They do not have vacuoles.

Permanent Tissue

Some cells lose the ability to divide and form a permanent tissue. The process of taking up a permanent shape, size and function is called differentiation.

The different types of permanent tissues formed are:

(i) Simple permanent tissue: This type of tissue consists of unspecialised cells with thin cell walls. They are live cells and are loosely packed with large intercellular spaces. This tissue supports the plant and acts as food storage.

Sometimes this tissue contains chlorophyll and performs photosynthesis and is thus called chlorenchyma.

Sometimes, it has large air cavities which make parts of plants to float in air and is called aerenchyma.

Collenchyma is another simple permanent tissue which gives flexibility and mechanical support to the plants.

The tissue which gives hardness and stiffness to the plant is called sclerenchyma. For example, husk of a coconut. This tissue acts as cement, hardens the covering of seeds and nuts and gives strength to the plant.

(ii) Complex permanent tissue: Complex tissues are those which are made up of more than one type of cells. These different types of cells coordinate to perform a common function, for example, xylem and phloem. Both are conducting tissues. Xylem and phloem are discussed later in detail.

Animal Tissues

Different types of tissues are present in our body to perform specific functions. On the basis of the function performed by them, they can be classified into four types:

(i) Epithelial tissue: The covering or protective tissues in the animal body are epithelial tissues. It covers most of the organs and cavities and forms a barrier between different body systems. It is present in the skin, lining of the mouth, lining of blood vessels, lung alveoli, kidney tubules, etc. These cells are tightly packed, form a continuous sheet and

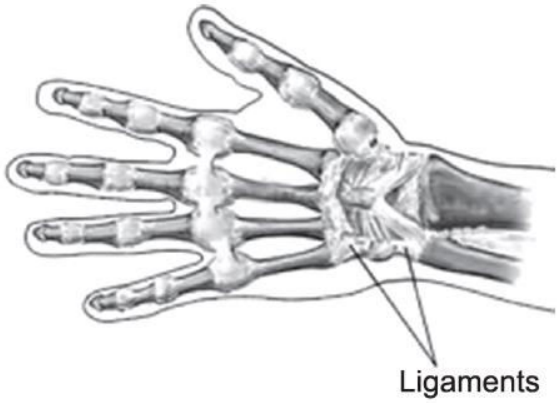
have no intercellular spaces. The epithelial cells are permeable to some extent and, therefore, help in the exchange of materials between different parts of the body and the external environment.

(ii) Connective tissue: The cells of connective tissue are loosely packed and embedded in an intercellular matrix. The matrix may be jelly like, fluid, dense or rigid. The nature of matrix depends on the function assigned to the particular connective tissue. Different types of connective tissue are as follows:

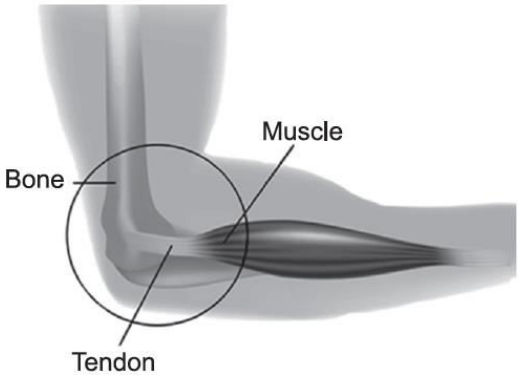
(a) Blood: Blood is a type of connective tissue. It has a fluid matrix in which red blood cells (RBCs), white blood cells (WBCs) and platelets are suspended. Blood transports oxygen, nutrients, hormones and other compounds to various parts of body, and it also helps in removing waste from our body cells.

(b) Bone: Bone is also a type of connective tissue. Bone cells are embedded in a hard matrix which is composed of calcium and phosphorus. This is a strong and nonflexible tissue. It forms a framework for supporting the body and anchors the muscles to support the important organs of the body.

(c) Ligament: Ligament is also a type of connective tissue. It connects the bones to each other. This tissue is highly elastic with considerable strength.



(d) Tendons: This is a fibrous tissue with great strength and less flexibility. It connects muscles to bones.



(e) Cartilage: It is firm, flexible connective tissue found in various forms in the larynx and respiratory tract, in structures such as the external ear, and in the articulating surfaces of joints. It is more widespread in the infant skeleton, being replaced by bone during growth.

(f) Areolar connective tissue: The areolar tissue located in the skin binds the outer layers of the skin to the muscles beneath. Areolar tissue is also found in or around blood vessels, nerves and the organs of the body.

(g) Adipose tissue: Its main role is to store energy in the form of fat, although it also cushions and insulates the body.

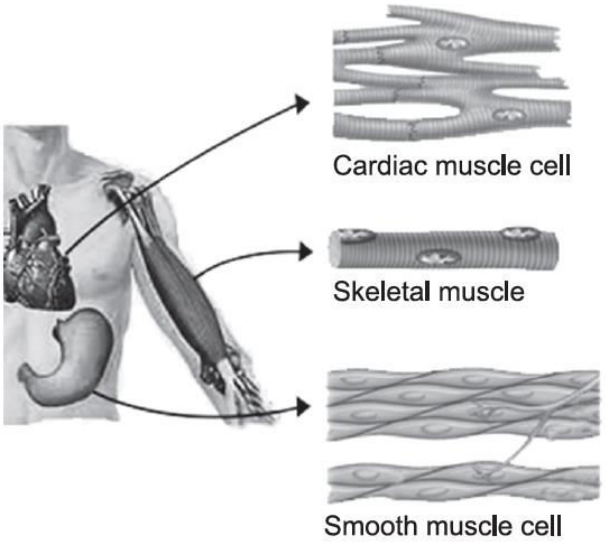
(iii) Muscular tissue: Muscular tissue consists of elongated cells called muscle fibres. This tissue helps in different movements of the body. Muscle fibres also contain special proteins called contractile proteins which contract and relax to cause movement. Different types of muscle fibres are as follows:

(a) Striated muscles: Striated or skeletal muscle fibres are long, cylindrical, unbranched and multinucleated. They show alternate light and dark bands when stained. They are also called voluntary (as they can be moved according to the will) muscles or skeletal (as they are attached to the bones and help in movement) muscles.

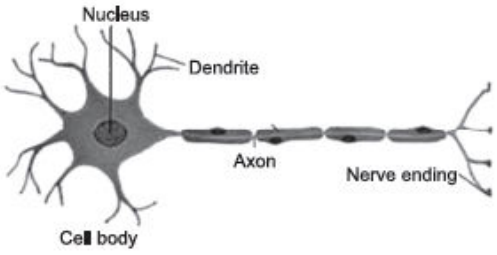
What Causes Fatigue in Our Body?
Our muscles produce lactic acid during intense exercise. It is a by-product of metabolism in our body. It causes muscle fatigue. Lactic acid deposits can be reduced by stretching of muscles. We also feel fatigue when our muscles do not get enough energy.

(b) Unstriated muscles: Unstriated or smooth muscle fibres are long, with pointed ends and uninucleated. They are also called involuntary (as they work on their own without our will) muscles or smooth muscles. They are present in the alimentary canal, blood vessels, etc.

(c) Cardiac muscles: These are the involuntary muscles present in the heart. They show rhythmic contraction and relaxation throughout our life. These muscle fibres are cylindrical, branched and uninucleated.



(iv) Nervous tissue: Nervous tissue is found in brain, spinal cord and nerves. It is made up of nerve cells or neurons. These neurons are highly specialised for being stimulated and transmitting the stimulus from one body part to another. Each neuron consists of a cell body, a single long part called axon and many short branched parts called dendrites.



Neuron: unit of nervous tissue

The combination of nerve tissue and muscle tissue enables human beings and animals to move rapidly in response to the stimuli.

Practice Questions

1. Which one among the following cell organelles is semi-permeable?
(a) Cell membrane
(b) Vacuoles
(c) Cell wall
(d) Nucleus

2. Which one of the following cell organelles is absent in animal cell?
(a) Cell membrane
(b) Endoplasmic reticulum
(c) Cell wall
(d) Mitochondria

3. In the cells of living organisms, other than nucleus, which of the following organelles contains DNA?
(a) Cell membrane
(b) Endoplasmic reticulum
(c) Golgi bodies
(d) Mitochondria

4. Which of the following cell organelles play the most significant role in protein synthesis?
(a) Lysosome and centrosome
(b) Endoplasmic reticulum and ribosome
(c) Golgi apparatus and mitochondria
(d) Lysosome and mitochondria

5. The site of cellular respiration in animal cell is
(a) Ribosome
(b) Mitochondria
(c) Endoplasmic reticulum
(d) Lysosome

6. Which one of the following is the correct combination of subcellular structures in order if their relative size found in plant and animal cells?
(a) Nucleus > Mitochondria > Chloroplast > Chromosomes
(b) Nucleus > Chromosomes > Mitochondria > Chloroplast
(c) Chloroplast > Nucleus > Chromosomes > Mitochondria
(d) Chloroplast > Nucleus > Mitochondria > Chromosomes

7. Consider the following statements:

1. Plant cells have fewer mitochondria than animal cells.
2. Plastids in a plant cell are the organelles enclosed by a single membrane.
3. The Golgi complex in a cell participates in the recycling of plasma membrane.
Which of the statements is/are correct?
(a) 1 and 2
(b) 2 and 3
(c) 1 and 3
(d) 1, 2 and 3

8. Match List 1 with List II and select the correct answer using the codes given below the lists:

(Cell Organelles)	(Physiological Phenomena)
A. Mitochondria	1. Photosynthesis
B. Chloroplast	2. Transpiration
C. Stomata	3. Respiration
D. Cell wall	4. Osmosis

(a) A-1, B-3, C-4, D-2
(b) A-3, B-1, C-4, D-2
(c) A-1, B-3, C-2, D-4
(d) A-3, B-1, C-2, D-4

9. Match List 1 with List II, and select the correct answer using the codes given below the Lists:

List I (Cell organelles)	List II (Functions)
A. Mitochondria	1. Sites for protein synthesis
B. Golgi complex	2. Synthesis of respiratory enzymes
C. Ribosomes	3. Site of photosynthesis
D. Chloroplast	4. Secretion of hormones and enzymes

(a) A-4, B-2, C-3, D-1
(b) A-4, B-2, C-1, D-3
(c) A-2, B-4, C-3, D-1
(d) A-2, B-4, C-1, D-3

10. Consider the following statements: Our muscles ache after performing vigorous exercises because there is
1. A relative deficit of ATP in muscle tissue.
2. Total absence of ATP in muscle tissue.
3. Excessive accumulation of lactic acid in the tissues.
4. Ionic imbalance in the tissues.
Of these statements:
(a) 1, 3 and 4 are correct
(b) 2, 3 and 4 are correct
(c) 1 and 3 are correct

(d) 1, 2 and 4 are correct

Perfecting Past Prelims

1. Which of the following statements are correct regarding the general difference between plant and animal cells? (2020)
Plant cells have cellulose cell walls whilst animal cells do not.
Plant cells do not have plasma membrane unlike animal cells which do.
Mature plant cell has one large vacuole whilst animal cell has many small vacuoles.
Select the correct answer using the code given below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Answer Keys

Practice Questions

1. (a)	2. (c)	3. (d)	4. (b)	5. (b)
6. (a)	7. (b)	8. (d)	9. (d)	10. (c)

Perfecting Past Prelims

1. (c)				

Solutions

Practice Questions

1. (a) Cell membrane is said to be semipermeable as it allows the entry of some specific substances only under certain conditions. It has tiny holes through which it allows the entry of small particles inside it.

2. (c) Cell wall is present in plant cells only. This provides rigidity to the plant cells, whereas animal cells are not rigid due to the absence of cell wall.

5. (b) Mitochondria are organelles that act like a digestive system which takes in nutrients, breaks them down and creates energy for the cell. The biochemical processes of the cell are known as cellular respiration.

10. (c) Statement 2 is incorrect because the energy available to muscles is relatively less and not absent in absolute sense.
Statement 4 is also incorrect because ionic imbalances do not cause pain in muscles.

Perfecting Past Prelims

1. (c) 1 and 3 only

Statement 2 is incorrect: Plasma membrane is present in plant cells as well as animal cells.