CLASS 9th

MATTER IN OUR SURROUNDINGS

Handwritten Notes

Matter In Our Surroundings

- **Characteristics of these 'Particles' of Matter**
  - Particles of matter have spaces between in them.
  - Particles of matter are continuously moving.
  - Particles of matter attract each other.
- **States of Matter**
  - The Solid State
  - The Liquid State
  - The Gaseous State
- **Changes of States of Matter**
  - Effect of Change in Temperature
  - Effect of Change in Pressure
- **Evaporation**
  - Cooling Effect due to evaporation

The air we breathe, the food we eat, stones, clouds , stars, plants and animals, even a small drop of sand- everything is matter.
Basically everything in this universe is made up of material which scientists have named matter.

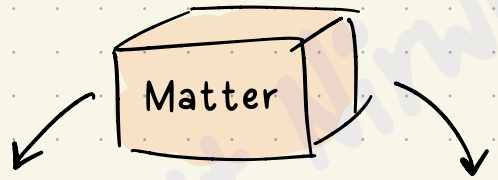
#Kitaabi Definition: Matter is anything that occupies space and have mass.

Matter on the basis of Physical Properties: Solid, Liquid and Gas

Matter on the basis of Chemical Properties: Elements, Compounds and Mixtures

*But in this chapter we'll study about physical nature of matter only.

Physical Nature of Matter



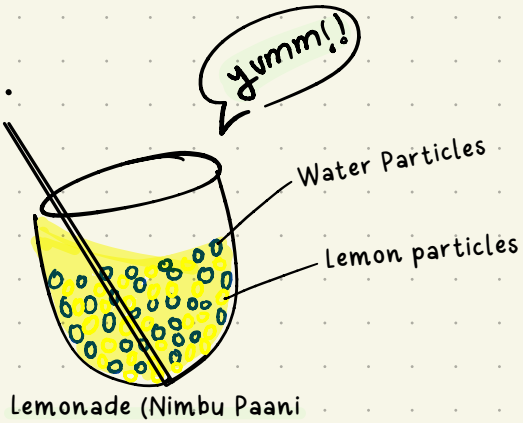
Every matter is made up of particles.

And, these particles are very very small in size

Characteristics of these 'Particles' of Matter:

[I] Particles of matter have spaces between in them.

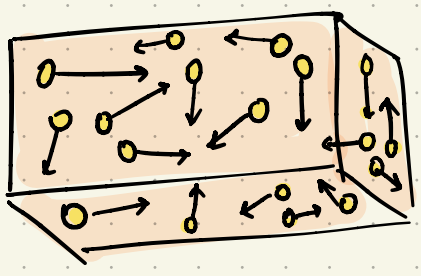
When we make tea, coffee or lemonade (nimbu Paani), particles of one type of matter get into the spaces between particles of the other. This shows that there is enough space between particles of matter.



Lemonade (Nimbu Paani

[II] Particles of matter are continuously moving.

The particles inside a matter are continuously moving and due to this motion, they generate kinetic energy.



K³B

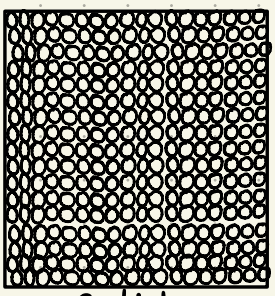
Have you noticed when we put a small drop of die in a glass of water, it instantly dissolves/intermix into it changing the colour of water?
This intermixing of particles of matter on their own is know as Diffusion.

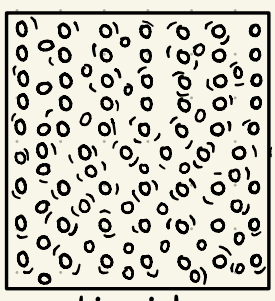
Now, tell me one thing?
What happens when you put a spoon of sugar into a bowl filled with water? - It will dissolve (but very slowly)
Now what will happen if we place this bowl on a gas burner?
- The rate of diffusion/intermixing will become faster, right ?

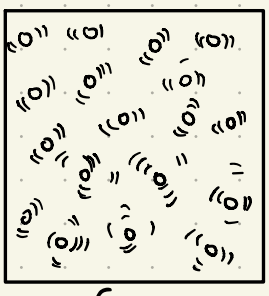
This shows that rate of diffusion increases on increasing temperature.
OR
We can also say, with the increase in temperature, the kinetic energy of particles also increases.

[III] Particles of matter attract each other.

Particles of matter have force acting between them. This force keeps the particles together.
The strength of this force of attraction varies from one kind of matter to another.
For Example:
- Particles of solid matter will have high force of attraction which makes solids not easy to break
- Liquids will have relatively lower force of attraction, and
- Gases then will have relatively more less.


Solid


Liquid


Gas

L.P. [NCERT Intext Pg 3]

L.P. 1- Which of the following are matter?
Chair, air, love, smell, hate, almonds, thought, cold, lemon water, smell of perfume.
Ans- The chair, air, almonds, lemon water, and the smell of perfume are considered matter because they have physical properties, occupy space, and possess mass.
Love, smell, hate, thought, and cold, on the other hand, are not matter as they are abstract concepts, sensations, or mental processes that lack physical properties.

L.P. 2: Give reasons for the following observation:
The smell of hot sizzling food reaches you several metres away, but to get the smell from cold food you have to go close.
Ans- As we know as we increase the temperature, the kinetic energy of the particles increases and as a result they move faster as compared to the food which is cold. This is the reason why the smell of hot sizzling food reaches us several metres away, but to get the smell from cold food we have to go close.

L.P. 3: A diver is able to cut through water in a swimming pool. Which property of matter does this observation show?
Ans- The diver is able to easily cut through the water in the swimming pool because of the weak forces of attraction between water molecules. It is this property of water that contributes to easy diving

States of Matter

The Solid State

- Solids have a definite shape, distinct boundaries and fixed volumes, that is, have negligible compressibility.
- Solids have a tendency to maintain their shape when subjected to outside force.
  For example: Rubber band.
  A rubber band changes shape under force and regains the same shape when the force is removed.

- But, if excessive force is applied it will break. Therefore-
- Solids may break under force but it is difficult to change their shape, so they are rigid. For example: Salt & Sugar both the crystals have a particular shape which is fixed either you put it in any jar or plate.
- Generally, solids have higher density as compared to liquids and gases.

K³B

Sponge changes its shape when compressed, how come it is a solid?
Generally, solids are considered incompressible because of the higher intermolecular attraction and closed packed nature. Sponge is an exception to these only because of its porous nature and air cavities. It has minute pores in which air is trapped, on pressing the air is expelled.

The Liquid State

- Liquids do not have fixed shape, distinct boundaries but have a fixed volume. Which means they take up the shape of the container in which they are kept. For example: Water is a liquid that takes the shape of any container it is poured into. It flows and fills the shape of the container.
- Liquids flow and change shape, so they are not rigid but can be called fluid

K³B

As the aquatic animals live under the water, have you ever thought about how they breathe?
As we have discussed earlier, solids and liquids can diffuse into liquids. So, the gases from the atmosphere diffuse and dissolve in water. The aquatic animals can breathe under water due to the presence of dissolved oxygen in water.

- The rate of diffusion of liquids is higher than that of solids. This is due to the fact that in the liquid state, particles move freely and have greater space between each other as compared to particles in the solid state.

The Gaseous State

- Gases do not have fixed shape, distinct boundaries and no fixed volume. But they are highly compressible as compared to solids and liquids.
- They completely fill the container they are kept in. For example: Air is a gas that expands to fill the space it is given. It does not have a fixed shape or volume and can be compressed or expanded easily.
- Due to its high compressibility, large volumes of a gas can be compressed into a small cylinder and transported easily. For example: The liquefied petroleum gas (LPG) cylinder that we get in our home for cooking or the oxygen supplied to hospitals in cylinders is compressed gas. Compressed natural gas (CNG) is used as fuel these days in vehicles.

K3B

Have you noticed that we get to know what is being cooked in the kitchen without even entering there?

Due to the high speed of particles and large space between them, gases show the property of diffusing very fast into other gases, this is the reason why we get the smell of hot cooked food in seconds.

	Solids	Liquids	Gases
Constituent Particles	Very closely packed	Less closely packed	Very far away
Force of attraction	Very strong	Less strong	Negligible
Kinetic energy		More	Maximum
Shape and volume	Definite shape and volume	No Definite shape and but definite volume.	Neither Definite shape nor volume
Density	High density	Lower than solid	Least density
Diffusion	No	Yes	Easily

L.P.

[NCERT Intext Pg 6]

L.P. 1- The mass per unit volume of a substance is called density. (density = mass/volume). Arrange the following in order of increasing density - air, exhaust from chimneys, honey, water, chalk, cotton and iron.

Ans- The increasing order of density is
air < exhaust from chimney < cotton < water < honey < chalk < iron.

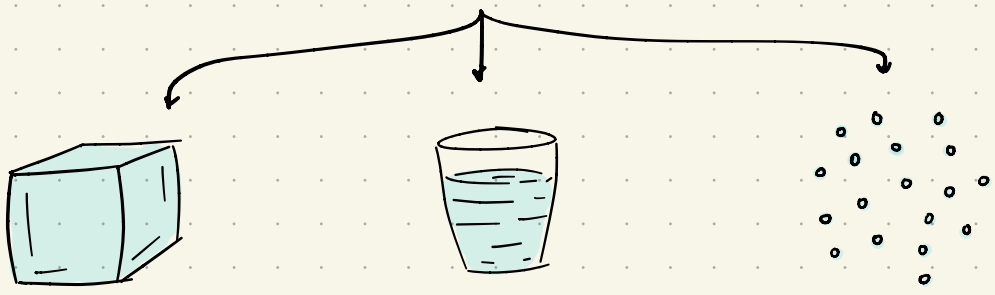
L.P. 2: (a) Tabulate the differences in the characterisitcs of states of matter.
(b) Comment upon the following: rigidity, compressibility, fluidity, filling a gas container, shape, kinetic energy and density.

Ans- (a) above in notes

(b) 1. Rigidity: The condition which does not alter the shape of solids.
2. Compressibility: Compressing particles of gases is called compressibility.
3. Filling a gas container: In the laboratory, after the preparation of gases, they are collected is a gas jar. This is called filling a gas container.
4. Fluidity: Fluidity means flowing liquids freely.
5.Shape: Things are in which form is called shape.
6. Kinetic energy: The energy possessed by a moving the body is called kinetic energy.
7. Density: Density is the mass per unit

Changes of States of Matter

As we know, water exists in three states of matter :-



Solid, as ice | Liquid, as water | Gas, as water vapour

How ?? It means the state of matter are interconvertible !

The phenomenon of change of matter from one state to another and back to the original state is called interconversion of states of matter.

This happens by change in temperature and change in pressure.

K3B

Some Important terms:

Melting: The process of changing a solid into a liquid is called melting. The melting point is the temperature at which a solid changes into a liquid.
Example: When we heat an ice cube, it melts and turns into liquid water. The melting point of ice is 0°C.

Freezing: The process of changing a liquid into a solid is called freezing. The freezing point is the temperature at which a liquid changes into a solid.
Example: When we put liquid water in the freezer, it loses heat and freezes, forming ice. The freezing point of water is also 0°C.

Evaporation: The process of changing a liquid into a gas is called evaporation. It takes place at all temperatures.
Example: When water is left in an open container, it slowly evaporates and turns into water vapor. This process is commonly observed when clothes dry after being washed.

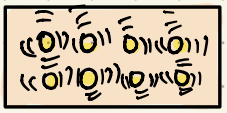
Boiling: The process of changing a liquid into a gas at a specific temperature throughout the liquid is called boiling. The temperature at which a liquid boils is known as its boiling point.
Example: When we heat water in a kettle, it reaches its boiling point and starts boiling, forming steam. The boiling point of water is 100°C.

Condensation: The process of changing a gas into a liquid is called condensation. It occurs when a gas loses heat energy and turns into a liquid.
Example: When steam comes in contact with a cold surface, such as a mirror, it condenses and forms water droplets. This phenomenon is commonly observed in when you put a plate covering hot bowl if maggie, the vapours forms droplets.

Sublimation: It is the process in which a solid directly changes into a gas without passing through the liquid state.
Example: Camphor(kapur), when heated, undergoes sublimation. It changes from a solid to a gas without forming a liquid in between.

Effect of Change in Temperature:

As we know on increasing temperature, the kinetic energy of the particles increases.

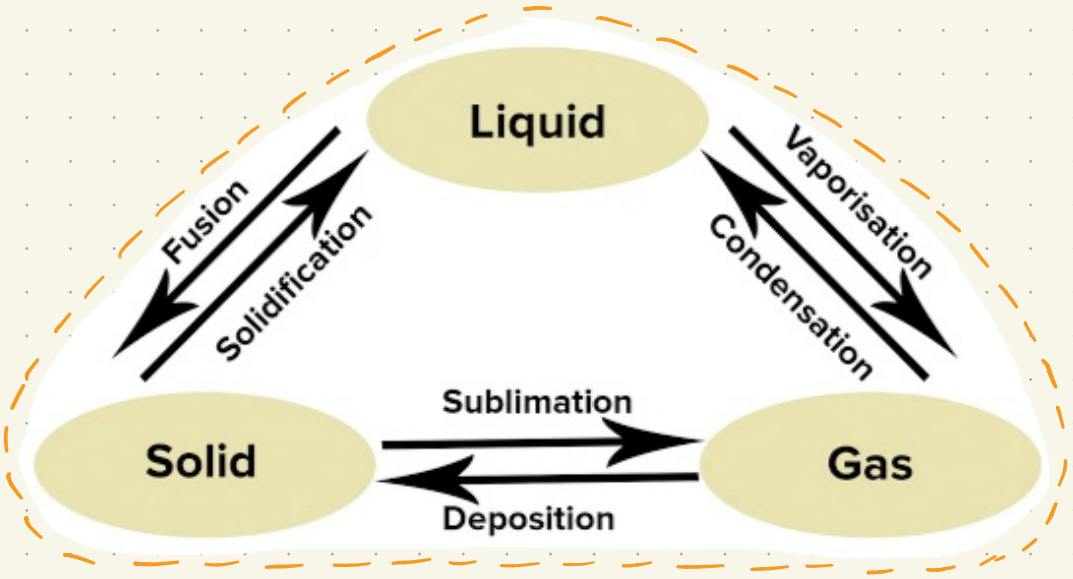


Due to the increase in kinetic energy, the particles start vibrating with greater speed. The energy supplied by heat overcomes the forces of attraction between the particles. The particles leave their fixed positions and start moving more freely.

And as the free space increases it means solid is converting into liquid. A stage is reached (melting point) when the solid melts and is converted to a liquid.

Now, as we further increase the temperature, the force of attraction between the particles becomes more weak and they more more freely and a stage is reached (boiling point) when the liquid boils and is converted into gas.

And do you know opposite is also true- decreasing the temperature by cooling, a gas can be converted into liquid and a liquid can be converted into solid state.



Have you noticed that when the solid melts, its temperature remains the same, so where does the heat energy go?

OR

When a solid is melted on increaing the temperature, the temperature of the system does not change after the melting point is reached, till all the ice melts. Where does the heat go ?

When a solid (lets say ice) is melted by heating, this heat gets used up in changing the state by overcoming the forces of attraction between the particles.

As this heat energy is absorbed by ice without showing any rise in temperature, it is considered that it gets hidden into the contents of the beaker and is known as the latent heat. The word 'latent' means 'hidden'.

So now particles of water at 0 C (273 K) have this additonal latent heat which particles of ice dont have. So we can say, particles in water at 0 C (273 K) have more energy as compared to particles in ice at the same temperature.

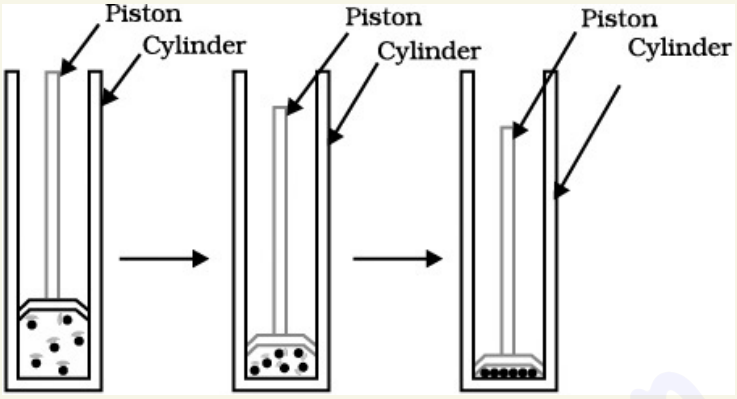
Similarly, water vapour at 373 K (1000 C) have more energy than water at the same temperature. This is because particles in steam have absorbed extra energy in the form of latent heat of vaporisation.

Types of Latent Heat

- Latent heat of Fusion (Solid to Liquid Change)
  The amount of heat energy that is required to change 1 kg of a solid into liquid at atmospheric pressure at its melting point is known as the latent heat of fusion.
- Latent heat of Vapourisation (Liquid to Gas Change)
  The amount of heat energy that is required to change 1 kg of a liquid into gas at boiling point without any rise in temperature is known as the latent heat of fusion.

Effect of Change in Pressure:

As we know the difference in various states of matter is due to the difference in the distances between the constituent particles.
So what if we start putting pressure and compress a gas to make the particles come closer? This will increase the force of attraction between them also as they are more closer now !
Hence, Gases can be liquefied on applying pressure.



By applying pressure, particles of matter can be brought together

L.P. [NCERT Intext Pg 9]

L.P. 1- Convert the following temperature to celsius scale:
a. 300 K b. 573 K

Ans- To convert temperatures from the Kelvin (K) scale to the Celsius (°C) scale, you can use the following formula:
°C = K - 273.15

Using this formula, we can convert the given temperatures:
a) 300 K
°C = 300 - 273.15
°C = 26.85
Therefore, 300 Kelvin is equivalent to 26.85 degrees Celsius.

b) 573 K
°C = 573 - 273.15
°C = 299.85
Therefore, 573 Kelvin is equivalent to 299.85 degrees Celsius.

L.P. 2- What is the physical state of water at:
a. 250 C b. 100 C ?

Ans- (a) At 250°C - Gaseous state since it is beyond its boiling point.

(b) At 100°C - It is at the transition state as the water is at its boiling point. Hence it would be present in both liquid and gaseous state.

L.P. 3- For any substance, why does the temperature remain constant during the change of state?

Ans-The temperature remains constant of the substance during change of state as all the heat is used up for the phase change process & breaking the bonds or interparticle force. Therefore, no external heat is released or absorbed & there is no change in temperature.

L.P. 4- Suggest a method to liquefy atmospheric gases.

Ans-In order to liquefy a gas, the constituent particles or molecules have to be brought closer. The atmospheric gases can be liquefied either by increasing pressure or by decreasing temperature

Evaporation

Evaporation is the process by which a liquid changes into a gas at any temperature below its boiling point. For Example: When we leave a wet cloth in sunlight, the water from the cloth slowly evaporates and turns into water vapor.

Why Evaporation occurs?

The particles of liquid have different amount of kinetic energies and those particles which are present at the surface possess comparatively higher kinetic energy as compared to those present in the bulk.

Therefore, these higher kinetic energies' particles from surface are able to break away from the force of attraction of other particles and get converted into vapours.

Factors affecting evaporation:

Temperature: Higher temperatures generally increase the rate of evaporation, as higher temperatures provide more energy to the liquid particles, enabling them to escape and convert into vapor more quickly.
Example: When clothes are hung outside on a sunny day, they dry faster due to the higher temperature, which enhances the rate of evaporation.

Surface Area: Larger surface areas facilitate faster evaporation, as more liquid molecules are exposed to the surroundings and can escape into the vapor phase.
Example: While hanging the clothes outside, we spread them out for faster evaporation.

Humidity: Humidity refers to the amount of moisture present in the air. Higher humidity levels result in slower evaporation, as the air is already saturated with moisture and cannot accommodate more water vapor.
Example: On a humid day, drying clothes takes longer because the surrounding air is already holding a significant amount of moisture, reducing the rate of evaporation.

Wind Speed: Increased air movement enhances evaporation by carrying away the vapor molecules from the liquid surface, thereby maintaining a concentration gradient and allowing more liquid particles to evaporate.
Example: Wet clothes dry faster on a windy day because the moving air removes the water vapor from the clothes, promoting faster evaporation.

Cooling Effect Due to Evaporation:

What does it feels when we put perfume on our palm?
Cool cool right?? But why??
It is because of evaporation!!
When we put some perform or acetone or petrol on our palm, it evaporates very fast (being volatile). During evaporation, particles of the liquid absorbs energy from the surface of the palm to compensate fir the loss of energy, making the surroundings cool. This is why our palm feels cold. And this is known as cooling effect of evaporation.

Daily life examples of this effect:

- After a hot sunny day, people sprinkle water on the roof or open ground because the large latent heat of vaporisation of water helps to cool the hot surface.

- Why should we wear cotton clothes in summer?
During summer, we perspire more because of the mechanism of our body which keeps us cool.
We know that during evaporation , the particles at the surface of the liquid gain energy from the surroundings or body surface and change into vapours. The heat energy equal to the latent heat of vaporisation is absorbed from the body leaving the body cool.
Cotton, being a good absorber of water helps in absorbing the sweat and exposing it to the atmosphere for easy evaporation.

- Why do we see water droplets on the outer surface of a glass containing ice-cold water?
Let us take some ice-cold water in a tumbler. Soon we will see water droplets on the outer surface of the tumbler. The water vapour present in air, on coming in contact with the cold glass of water, loses energy and gets converted to liquid state, which we see as water droplets.

L.P.

[NCERT Intext Pg 10]

L.P. 1- Why does a desert cooler cool better on a hot dry day?
Ans- The water when evaporated from a desert cooler absorbs energy from the surrounding for compensating the loss of energy during evaporation making the surrounding cool. Evaporation is inversely proportional to humidity. So on a hot dry day, the evaporation is more so the surrounding is more cooled.

L.P. 2: How does the water kept in an earthen pot (matka) become cool during summer?
Ans- Water placed in earthen pots is evaporated from minuscule pores it has as it is made of mud particles. This evaporation of water produces a cooling effect. Some of the heat energy that is generated is used in the process of evaporation. Hence, water stored in earthen pots tends to become cooler in summer.

L.P. 3: Why does our palm feel cold when we put some acetone or petrol or perfume on it.
Ans- Already discussed above notes.

L.P. 4: Why are we able to sip hot tea or milk faster from a saucer rather than a cup?
Ans- When we put some acetone or petrol or perfume on our palm, it evaporates. During evaporation, particles of the liquid absorb energy from the surface of the palm to compensate for the loss of energy, making the surroundings cool. Hence, our palm feels cold when we put some acetone or petrol or perfume on it.

L.P. 5: What type of clothes should we wear in summer?
Ans- Cotton, as discussed above in the notes.