What is Matter?

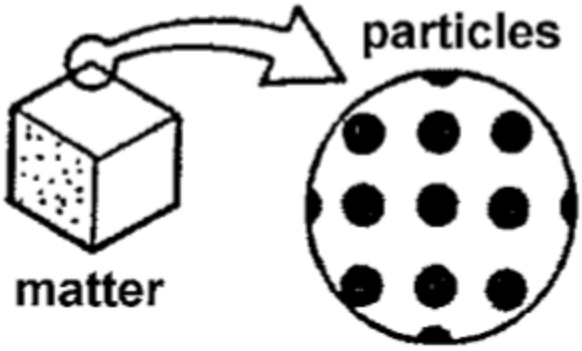
Matter is anything that occupies space and has mass.examples air, water, stones,air,books,chair,pen,computer etc.

Constituents of Matter

According to the early Indian philosophers, every living and non-living thing is made of five basic elements called the **Panchtatava** – **Air**, **Water**, **Earth**, **Sky**, **and Fire**. Therefore, matter is a composition of these five constituents.

Physical Nature of Matter

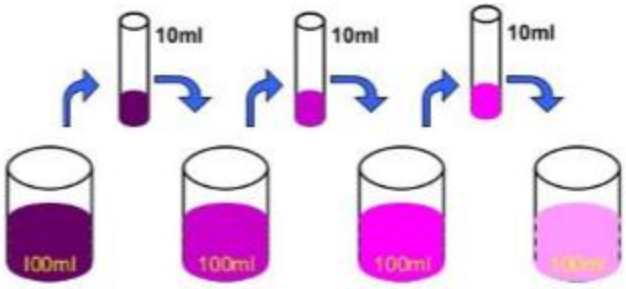
Is matter continuous or particulate?



Matter is particulate in nature. This means that matter consists of particles as you can see in the microscopic image of a cube above.

For Example, If we put a drop of red color in water the color of the water turns red. This happens because the particles of red color mix with the particles of water.

What is the size of these particles?



- The size of the particles of matter is very small.
- They can be broken into further particles as well. **For Example**, On dilution of a colorful solution, like potassium permagnate solution as shown in the figure below, we can still see the color. This means there are millions of particles present in the color which just divide themselves on dilution.

- **Which of these is matter** – happiness, air, sandwich, thoughts, juice, and eraser? Air, sandwich, juice, and eraser as they have mass, they occupy space and can be broken into further particles.

Characteristics of Particles of Matter

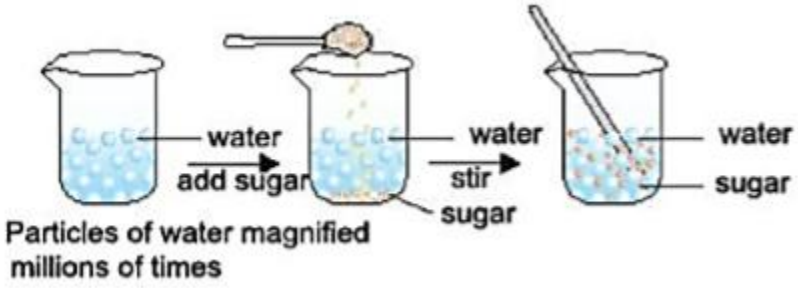
Particles of matter have three characteristic:

1. Particles of matter have spaces between them
2. Particles of matter are moving all the time
3. Particles of matter attract each other

Particles of Matter have spaces between them

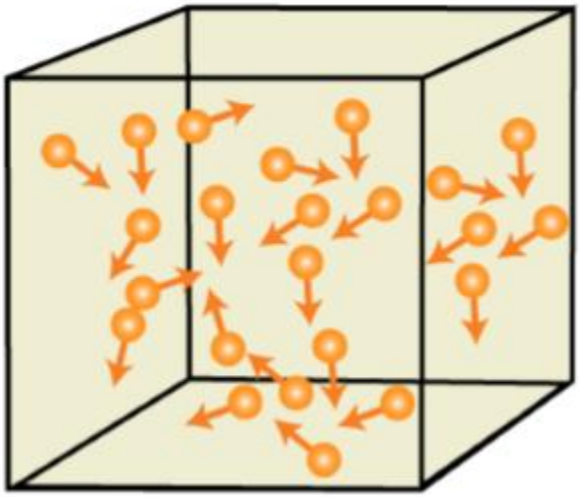
Have you ever wondered what causes salt to get dissolved in water?

Salt gets dissolved in water because their particles have spaces between them. The particles of the salt get in between the spaces between the particles of water and a mixture is formed.



- We cannot see these particles through naked eyes.

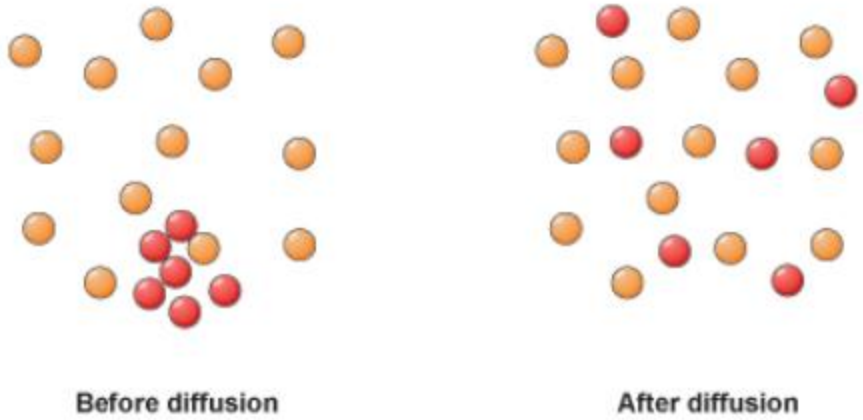
Particles of Matter are continuously moving



Particles are continuously moving

- Particles of matter are in motion all the time. Hence, they possess kinetic energy.

- **Kinetic Energy** – Energy due to motion
- The particles of a matter intermix on their own with other particles of a matter. **For Example**, Salt in water, Various gases in the air, Ink in water.
- **Diffusion** – The process of mixing two different types of particles together is called diffusion. Diffusion becomes faster on heating.



- The kinetic energy of particles also increases on heating.

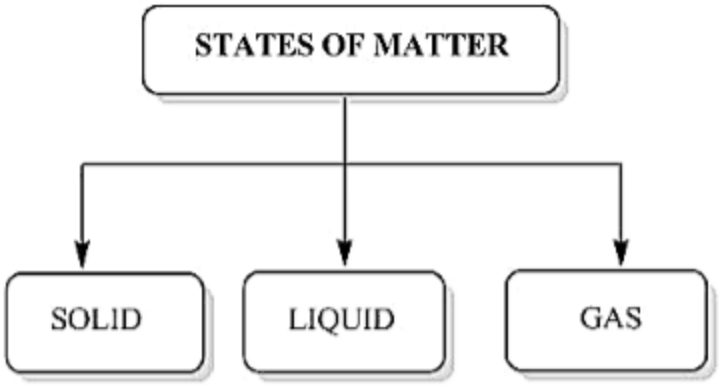
Particles of Matter attract each other

- The particles of matter are always held together because of a force of attraction between them.
- The amount of this force between the particles varies in different forms of matter, as shown in the figure below:
- Solids have the highest force of attraction. That is why we cannot move our hands through a solid object. The particles are so tightly bound.
- Similarly, particles of gases have the least force of attraction in them. We can move our hands easily in the air, can't we? This is because the particles of air are loosely bound.
- We can arrange the force of attraction between different types of matter (solids, liquids, and gases) in increasing order as:
- We can also move our hands through water or liquid matter but not as freely as we can in the air. This means that they are also loosely bound to some extent.

Gas < Liquid < Solids

States of Matter

Now we know that particles of matter have a force of attraction between them. Based on this criterion, we can say that matter is present in three different states: solid state, liquid state, and gaseous state.



The Solid State

- Solids are the objects that have these three properties:
  - They have a specific shape.
  - They have distinct boundaries.
  - They have definite volume.
- There is less kinetic energy among the particles in solids. They are generally arranged in an order. Thus they possess a fixed shape. They cannot be compressed.
- The force of attraction is the maximum among the particles of solids. There is not much space between the particles. Therefore, they cannot be compressed.
- They are rigid and non fluid.
- Rate of diffusion is lowest.
- **Which of these are solids**: Rubber band, Sponge, Salt?
  - All of them are solids. All of these follow the properties of solids. A rubber band and sponge change their shape only when we apply force on to them. It might appear to you as if salt is taking the shape of the container in which you put it but actually each of its grain has its own definite shape.

The Liquid State

- Liquids have the following properties:
  - Liquids have a fixed volume
  - Liquids do not have a fixed shape.
- The force of attraction in liquid particles is less than solids. Therefore, there is a space between the particles of liquids and they can flow easily. They cannot be compressed. That is why they are also called fluids.

- Particles of liquids arrange each other is not fixed. You might have seen that liquids take the shape of the container in which we put them. This is because the particles of liquids have a high kinetic energy, they always keep on moving.
- They are non rigid and fluid.
- Rate of diffusion is higher than solid lower than gases.
- **Can other matter diffuse into liquids?**
    - Yes, other matter can diffuse into liquids whether it is solids, liquids, or gases. This is so because there is a space between the particles of liquid so particles of other matter can slip into those spaces.
    - Diffusing solids into liquids: Mixing sugar in tea
    - Diffusing liquids into liquids: Mixing ink in water
    - Diffusing gases into liquids: The presence of oxygen and carbon dioxide in water

The Gaseous State

- Gases have the following properties:
    - They do not have a fixed volume.
    - They do not have a fixed shape.
- The particles of gases have the least or almost no force of attraction between them. Therefore, the particles have a large number of spaces between them and they can freely move in any direction.
- Also, they can be easily compressed and put into a small container, unlike solids and liquids.
- Since there is a lot of space between the particles, different gases can diffuse into each other easily.
- The kinetic energy between the particles is the maximum in the case of gases. Therefore, the particles move around freely at high speed and there is no fixed shape of gases.

Difference in the characteristic of states of matter

Solid	Liquid	Gas
Definite shape	Indefinite shape	Indefinite shape
Definite volume	Definite volume	Indefinite volume
Maximum force of attraction between particles	Less forces of attraction between particles compare to solid	Negligible force of attraction between particles
Cannot be compressed	Cannot be compressed	Can be compressed
Kinetic energy of particles is minimum	Kinetic energy of particles is more than solid	Kinetic energy of particles is maximum

Particles cannnot move rather they vibrate only at their fixed position	Particles can slide over one another	Particles can move freely
Highest density	Density is lower than solid	Lowest denisty
Cannot flow	Flow	Flow