

6th Science Lesson 3 Notes in English

3] Matter around Us

Introduction

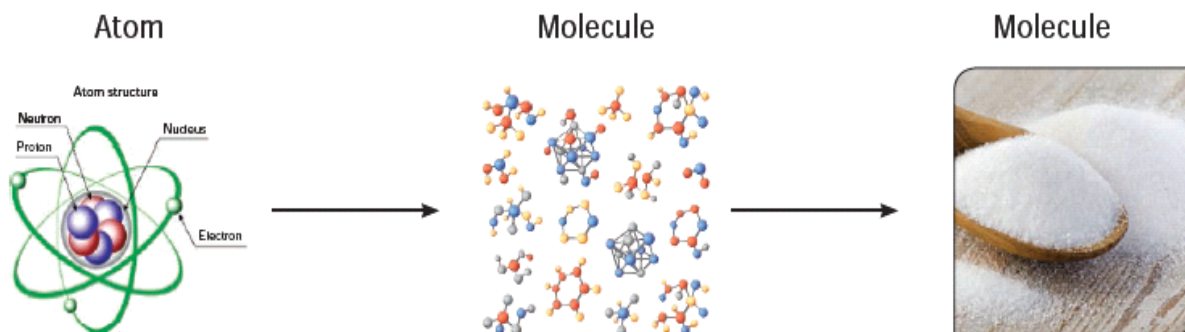
- Matter is all around us. The air you are breathing is also a matter. Matter is defined as anything that has mass and takes up space.
- Matter is found in three major states; solid, liquid and gas. All matter is made of atoms. Atoms are the smallest particle of matter.
- They are so small that you cannot see them with your eyes or even with a standard microscope. A standard sheet of paper is about millions atoms thick.
- Science has come up with a technology to identify structure of atoms Scanning Electron Microscope (SEM) and Tunneling Electron Microscope (TEM) which uses electricity to map atoms.
- There is more about atoms in the later, but first let's learn about the three states of matter.
- Silicon atoms on a surface via Scanning Tunneling Microscopy, (STM).

Physical Nature of Matter

- Matter occupies space and has mass. But what is its nature? Ancient philosophers pondered over such questions.
- In India a philosopher named Kanada and in Greece a philosopher named Democritus came to somewhat similar idea.
- Imagine you have a piece of thread. You cut it into two with the same piece. Take again one of the pieces and cut it again into two.
- Repeat the above process for many times. At some point piece of the thread will be so small to see, or we may not have sharp enough knife to cut further. But this is imaginary 'thought experiment'. Therefore these are not possible practically.
- Imagine if you can cut as fine as possible and are able to see even the very small things. Can we cut the rope into two without an end?
- Kanada and Democritus said, No; we cannot go on endlessly. There will be a point at which we will not be able to cut the thread further.
- That is the point when we will reach molecules or atoms. We will read more about molecules and atoms later. Suffice to say that all matter is made up of very small particles.
- Gold is made up of tiny gold particles and water is made up of tiny water particles. These tiny particles present in all matter are called as atoms or molecules.
- The particles in matter are extremely small and cannot be seen even with a powerful microscope. What we can see is only group of particles.

Characteristics of the particles of matter

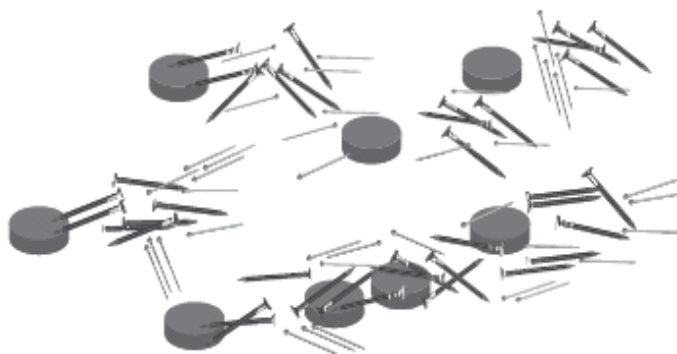
- Particles of matter have a lot of space in between them. In different forms of matter this spacing will be different.
- Let us add a spoon full of sugar to a glass of water. Stir well. Sugar disappears completely. Where has it gone? Will the glass of water be now sweet?



- Water particles have space between them and sugar particles are now occupying those spaces.



- Particles of matter attract each other. It is this attraction which keeps the particles together. This attractive force will be different for different forms of matter.



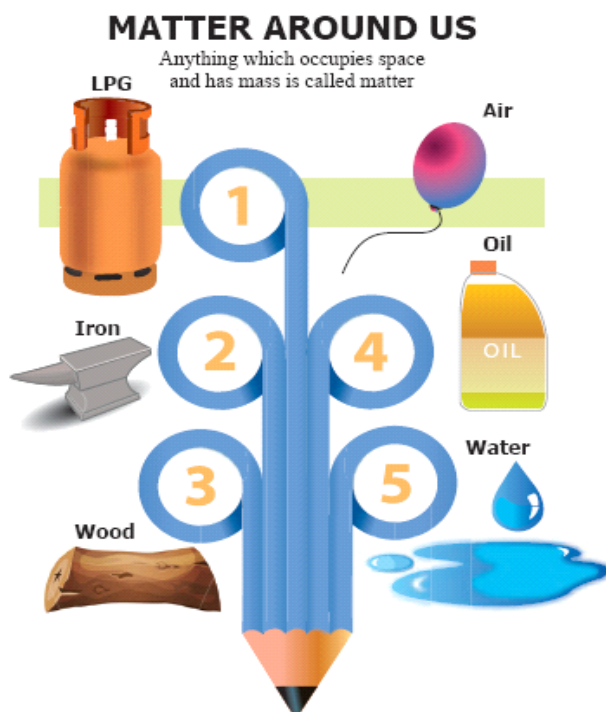
Grouping of Matter on the basis of Physical states

- You already know what grouping is all about. Matter can be grouped into Solids, Liquids and Gases based on the above characteristics. These are called the physical states of matter.

Mass, Shape and Volume of Solids, Liquids and Gases

Let us first take any solid say a stone:

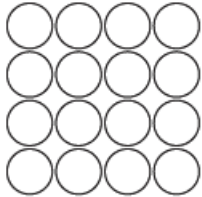
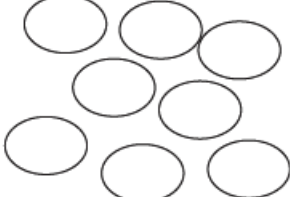
- A solid does not need a container; it stays where it is because its particles are tightly packed into a definite shape that, ordinarily, does not change. If you take the stone from the ground place it on the table or shelf its shape and volume do not change.
- For example, pencil and books are used for studying; the bucket and the comb are made of plastic while the table and ladle are made of wood.
- The scrub brush and broom are rough but the toy bear is soft.
- Light can pass through the glass of water and the spectacles but not through the apple or iron box.
- The cow and the bird are living things while the rest are not.
- Water in the glass is a liquid but air in the balloon is a gas and the rest are solids.
- The feather and the paper cup can float but not the apple or the piece of stone. The rubber band can be stretched but not the comb.
- Thus we can see similarities and differences between things and group and sort them in many different ways.



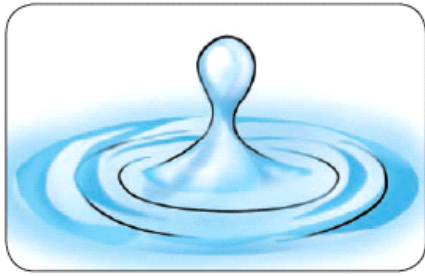
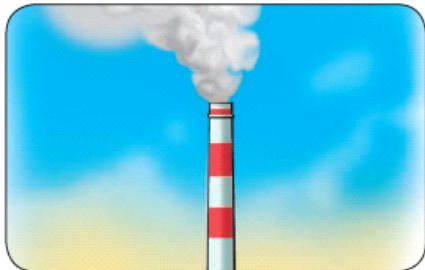
Diffusion

- Let us place a book on a table. Let it not be disturbed. Observe for five minutes.
- Now take a glass of water and add just a drop of ink carefully at the centre. Do not shake or stir.

- Now light an incense stick and keep in one corner of the room.
- Let us answer the following questions.
 - 1) Did the book move?
 - 2) Did the ink particles move and spread itself in the water? How long did it take for complete mixing?
 - 3) Did you get the smell of the incense stick from where you are standing?
 - 4) How fast did you get the smell? How did the smell reach you?
- We may conclude that the particles of gases and liquids can move and that among gases more easily.
- We call this movement as **diffusion**. **Diffusion** is the tendency of particles to spread out in order to occupy the available space.

Particles in a Solid	Particles in a Liquid	Particles in a Gas
		
In solid, the particles are tightly packed with very little space between them. Eg. stone	Particles in liquids are arranged in a random or irregular way and the space between the particles is greater than that in solids Eg. water	The particles in the gases are arranged far apart. They move freely. Eg. Air

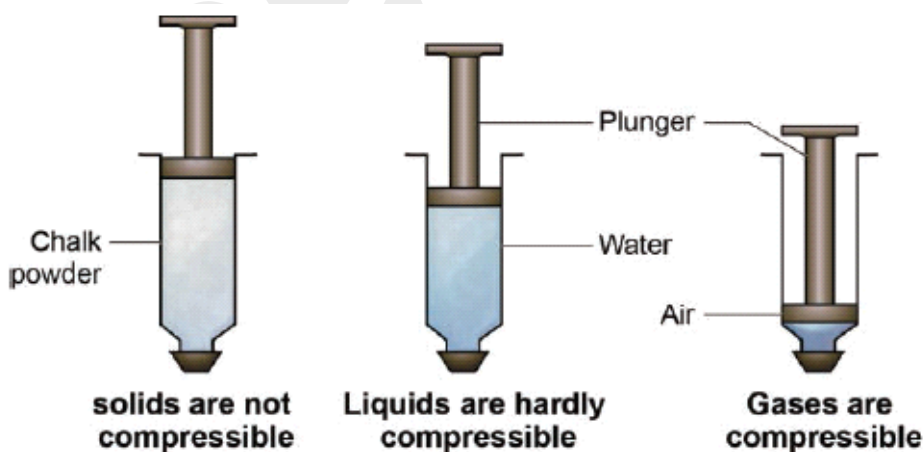
Fact file

1. Liquid atoms are packed more loosely which allows things to be able to pass through it 2. Liquid is effected by gravity more than anything 3. Liquids are always moving due to gravity around it	
1. A gas atoms are spread out so far, you can walk through it without any restriction 2. Gas is not affected by gravity 3. The gas's atoms never stop moving and it never stays in place	

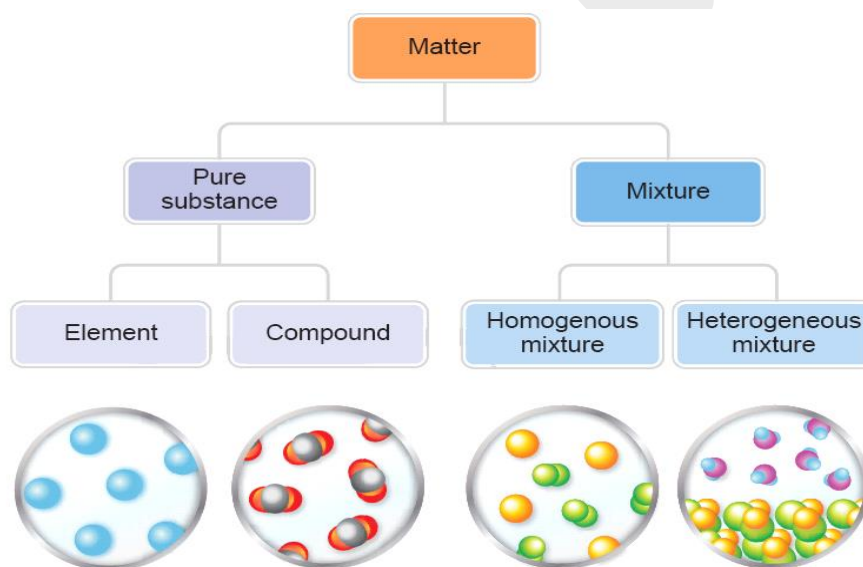
- Movement of particles is restricted in solids and they do not diffuse like liquids or gases.
- In fluids the particles are under motion and hence can push ink or smoke particles here and there.

Compressible as compared to liquids and solids

- Let us take three identical syringes. Close the nozzles tightly with a cork.
- After removing the plunger first let us fill it with fine chalk powder. Now put the plunger back and try to press it down. What do you observe?
- Now let us fill the second one with water. Try pressing the plunger down. What do you observe?
- Let us now draw the piston back to suck air into the third one. Press the plunger down. What do we observe? Is it easy or hard to press?
- Record your observations and share among the group members.
- You would have observed that the plunger moved freely when air was present and in the case of water and chalk powder it was difficult to press and the piston hardly moved.
- We conclude that gases are highly compressible as compared to liquids and solids.



S.no.	Solid State	Liquid state	Gaseous state
1.	Definite shape and volume	No definite shape, liquids attain the shape of the vessel in which they are kept.	Gases have neither a definite shape nor a definite volume.
2.	Incompressible	Compressible to a small extent.	Highly compressible
3.	There is little space between the particles of solid	These particles have a greater space between them.	The space between gas particles is the greatest.
4.	These particles attract the each other very strongly	The force of attraction between liquid particles is less than solid particles.	The force of attraction is least between gaseous particles.
5.	Particles of solid cannot move freely.	These particles move freely.	Gaseous particles are in a continuous, random motion.



Pure Substances and Mixtures

In shops, we find products which are sold as 100% pure! For common people pure means unadulterated- that which does not contain any cheap or harmful additives.

For a Chemist the word 'pure' means something else!

- A pure substance is made up of only one kind of particles.
- Pure substances may be elements or compounds.

- An atom is the smallest particle that an element is made up of same kind of atoms. Molecule is the combination of two or more atom. Compound is the substance formed by the chemical combination of two or more element.

Separation of Mixtures

Are all mixtures used as they are? Or is there a need for separating components?

- Materials we use in our day-to-day life are got from different sources and are very often combined with other substances.
- Mixtures like coffee and ice cream are taken as such. There is no need for separation in these cases.
- Metals occur in the form of ores under the earth's crust. But if we want to use a pure metal, we need to adopt a laborious process of extraction to separate the useful metal from the ore.

Separation:

- The process by which the components of mixture are isolated and removed from each other to get pure substance is called separation.
- To get the original properties and uses of substance we need separation

When and why do we need to separate mixtures?

- When we need to remove impurities or harmful components from the mixtures (eg: stones from rice)
- When the useful component has to be separated from other components (eg: petrol from petroleum)
- When a substance has to be obtained in highly pure form (eg: gold from gold mines)

Wire mesh as a strainer sieve is used to separate gravel from sand at a construction site.

- When very fine insoluble solids have to be separated from a liquid as in butter from curds, **Churning** is performed.
- The mixture is churned vigorously when solid butter will be collected on the sides of the vessel. Both butter and buttermilk are obtained after churning is useful and can be consumed.

Threshing

- Farmers separate grains from their stalks by beating them so hard that the grains are separated from their stalks. This is called **Threshing**.



Winnowing

- Rice, wheat and other food grains are covered in husk which cannot be eaten by us. Husk is very light and gets easily blown away by a breeze or wind.
- This property is made use of in **winnowing**. This is done by dropping the mixture slowly from a height in the presence of wind.
- Lighter solids i.e. husks will be carried by wind and will be collected in a separate heap while heavier solids i.e. grains will fall closer and form a separate heap.



Winnowing

- If the rice that we cook has stones in it we have to pick the stones out.

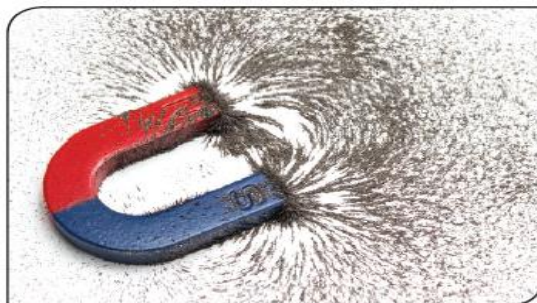
Handpicking

- How do we identify a stone from a grain of rice? If the stones are visibly very different from the grain, they can be easily picked and separated by hand.
- This is **handpicking**. But if the stones look very similar to the rice grains it is difficult to separate.



Magnetic Separation

- In a mixture containing iron, the magnetic property of iron can be used to separate it from non- magnetic substances by using a magnet.
- Substances that are attracted to a magnet are called magnetic. Separating solids using a magnet is called **magnetic separation**.



Sedimentation

- Rice and pulses are often mixed with very fine straw, husk or dust particles which have to be removed before cooking.
- Are you familiar with the way this is done at home? The rice or pulses are washed in water. The lighter impurities float while heavier rice grains sink to the bottom.
- This is called **sedimentation**. The water with the impurities is carefully poured away leaving clean rice at the bottom. This is called **decantation**.

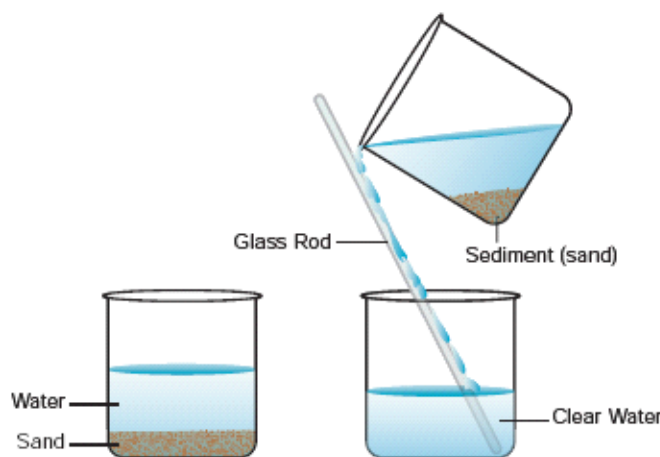
Sedimentation:

- The settling down of heavier component of a mixture when allowed to remain undisturbed for some time is called sedimentation.

Decantation:

- This process is done after sedimentation.

- The supernatant liquid is slowly poured out from the container without disturbing the sediment.
- The part that has settled down is called sediment. The water that is obtained after decantation is called the decantate.
- The process of removal of water above the sediment is called decantation. But even after decantation the water is not completely free from fine soil particles.



Filtration

- We will use filter papers to remove the finer impurities.
- A filter paper has very fine pores much smaller than soil particles. Let us see how to use the filter paper.
- Take a piece of filter paper. Fold it to make a cone slowly pour the muddy water over the filter paper. On filtration clear water (filtrate) flows down the funnel and mud settles as residue on the filter paper.
- The method of separating insoluble component (sand, mud etc.) from a mixture using a filter paper is called filtration.
- The liquid which passes through the filter and comes down is called filtrate and the insoluble component left behind on the filter is called residue.

Food Adulteration

- Sometimes, things that we buy in the market are mixed with harmful and unwanted substances. This process is called adulteration.
- Food can also get adulterated due to carelessness or lack of proper handling.
- We must be careful about the common adulterants in our consumable goods especially in food.
- Consumption of any adulterated food will be harmful and can be a health hazard.
- An adulterated substance will not indicate the true properties of the original substance.
- For example: Used tea leaves are sometimes used as adulterants in tea. Turmeric powder is adulterated with a bright yellow chemical which is poisonous to our health.

FAST FACTS

- Matter is anything that has mass and occupies space.
- All matter is made up of extremely small particles.
- Matter is classified into solids, liquids and gases on the basis of two important factors.
 - The way the particles are arranged
 - The way the particles attract each other.
- Difference between the properties of solids, liquids and gases is due to the difference in the arrangement of the particles and the nature of the attractive forces between them.
- A pure substance can be an element or a compound and is made up of only one kind of particles.
- A mixture is an impure substance containing two or more components physically mixed in any proportion.
- Separation of mixtures is done
 - To remove harmful components
 - To obtain the useful component
 - To obtain a substance in a highly pure form
- Separation method to be adopted depends on the properties of the components.
- Handpicking – For smaller quantities containing particles reasonably large in size to be recognized can be picked by hand.
- Winnowing – Adopted to separate lighter solids from heavier ones
- Magnetic separation – Used to separate magnetic substance from non-magnetic substance
- Sedimentation – Settling down of suspended, insoluble and heavy solid particles (used to separate solid – liquid mixtures)
- Decantation- Process of pouring out the clear supernatant liquid without disturbing the sediment
- Filtration –Process of separating insoluble solid particles (residue) from a liquid (filtrate) by using a filter paper.
- Adulteration – make impure by the addition of a foreign or inferior substance.

More to know:

- Besides solids, Liquid and gases there are two more states plasma and Bose – Einstein condensates.
- Plasma is not a common state of matter on Earth, but may be the most common state of matter in the universe. For example, stars including sun are covered in plasma.
- Bose – Einstein condensate is a gas – like state of matter that exists at extremely cold temperatures. It was predicted around **1925 and confirmed in 1995, this is used in the field of cryogenics.**
- A drop of water contains about 10²¹ water particles. One dot that you make with your pen has more than two lakh molecules.

- **Purity of gold is expressed in terms of 'carat'.** 24 carat gold is considered to be gold in its purest form.
- In washing machines this principle is used to squeeze out dirt from clothes and the method is called centrifugation.
- **Rice husks** are the hard protecting coverings of grains of rice. In addition to protecting rice during the growing season, husks can be used as building material, fertilizer, insulation material and fuel.
- Combination of methods are used sometimes for complete separation.
- If the mixture of sand and salt in water has to be separated several steps will be involved: Sedimentation, decantation, filtration, evaporation and condensation.
- In most houses people use commercial water filter to remove not only the impurities but also to kill the harmful germs in water using UV rays.
- RO – a process of removing impurities from water to make it potable.