CHAPTER - METTER AROUND US

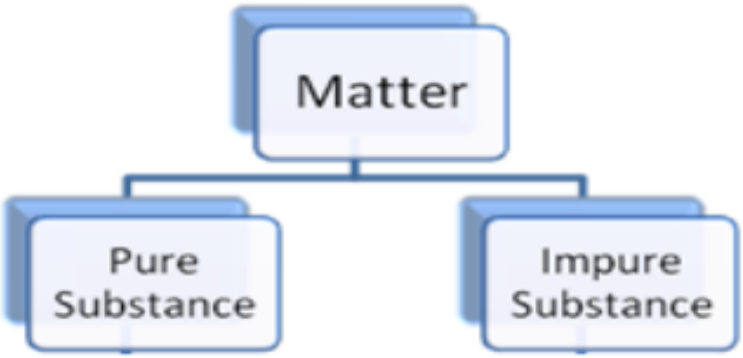
Class - 9th

Subject - Science

Substance

Anything that cannot be broken into further particles by applying any physical processes is called a Substance.

Substance can be classified into two types of substances – Pure substances and Mixtures



Pure substance

A substance that consists of only one type of particle is called a Pure Substance. For Example, Diamond, Salt, Sulfur, Tin.

Mixture

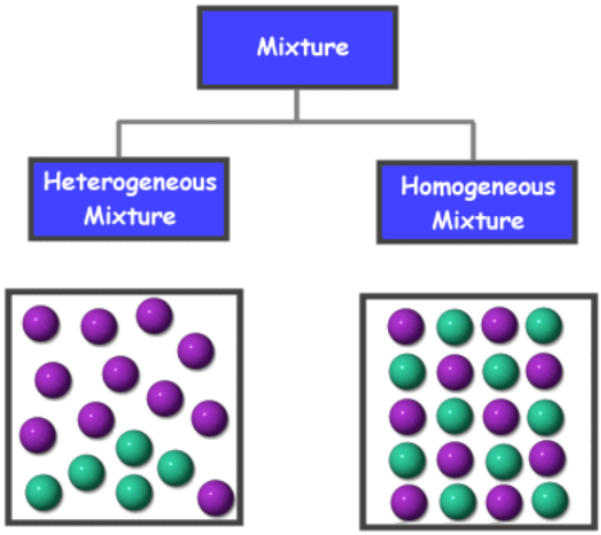
When we combine different substances into each other a mixture is formed. For Example, Lemonade is a mixture of three substances, Lemon Juice, Sugar and Water.

Mixture – Chocolate cake, Soil, Air

Pure substance – Water, Copper, Hydrogen

Types of Mixtures

There are two categories of mixtures: Homogeneous Mixtures and Heterogeneous Mixtures



Homogenous Mixtures

When we add sugar, water and lemon juice together they all uniformly mix with each other. Now it is no possible to separate these substances from the mixture. Such mixtures in which the components mix with each other uniformly are called Homogenous Mixtures.

The ratio of compositions of homogeneous mixtures can be different. For Example, one may add two spoons of sugar in lemonade while someone else may add only one spoon of sugar in their lemonade. Still, lemonade is a homogeneous mixture.

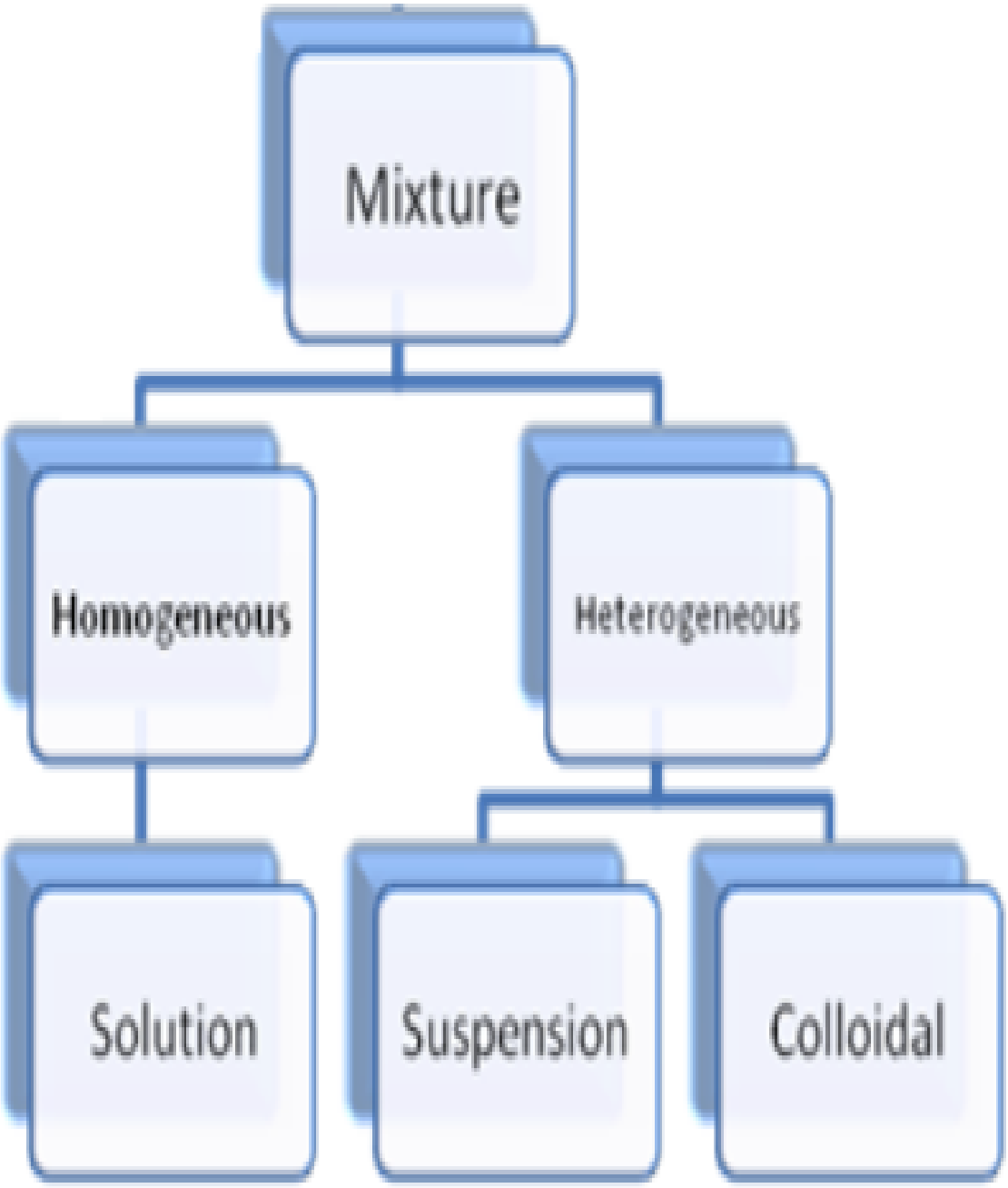
Heterogeneous Mixtures

The components in a heterogeneous mixture do not completely dissolve in each other and we can separate them by physical means. In other words, the composition of such mixtures is not uniform.

For Example, If we mix sand in water the sand settles down in water after some time and we can separate it by filtration.

Solution

A solution is nothing but a uniform mixture of two or more substances. Homogenous Mixtures are solutions



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Solutions of -

- ★ Liquid into liquid: Water and Ink.
- ★ Solid into solid: Alloys
- ★ Gas into gas: Air

- ★ Solid into liquid: Sugar and Water
- ★ Solid into gas: Hydrogen and Metals
- ★ Liquid into gas: Carbon Dioxide and Water

Alloy

An alloy is a mixture of different metals or non-metals and metals that cannot be separated from each other using physical methods. For Example:Brass – Copper with up to 50% zinc

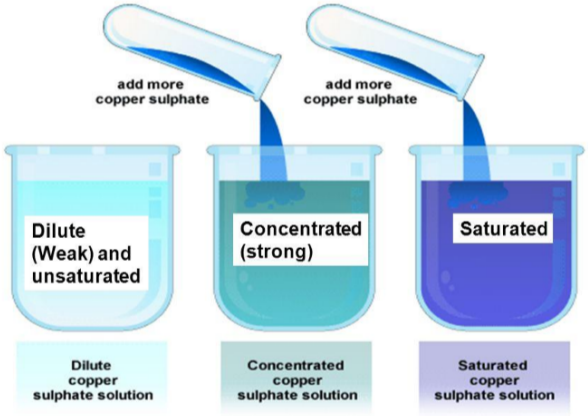
Bronze – Copper with up to 12%

- Solution constitutes of two types of substances, a solute and a solvent.
- Solution = Solute + Solvent
- Solvent – The substance in which another substance is mixed is called the Solvent. For Example, Water is a solvent in which we can mix different substances such as salt or sugar.
- Solute – The substance that is added to the solvent to form a solution is called a Solute. For Example, Salt, when mixed in water, acts as a solute for the mixture.
- Properties of a Solution:
- A solution is a homogenous mixture.
- We cannot see the particles of a solution through naked eyes as they as are small as 1 nanometer in diameter.
- The path of light is not visible through the solution. The particles of a solution do not scatter light through them as they are extremely small.
- We cannot separate the particles of a solution by methods of filtration.
- What is a stable solution?

- A stable solution is a solution in whose particles do not settle down if we leave the solution undisturbed for some time. This is because the particles of a stable solution are homogeneously spread.stable solution is a solution in whose particles do not settle down if we leave the solution undisturbed for some time. This is because the particles of a stable solution are homogeneously spread.

Different Types of Solutions

- **Dilute** – A solution in which the concentration of the solute is much less than that of the solvent. For Example, If we mix 1gm of salt in 500 ml of water, the salt solution thus obtained will be diluted. If we keep on adding the solute in a solution there comes a point when no more solute dissolves in the solution. This is called the Saturation Point of a Solution.
- **Unsaturated Solution** – A solution, in which we can add more amount of solute as it has not achieved its saturation level yet, is called an Unsaturated Solution. A dilute solution can be called as an Unsaturated Solution.
- **Concentrated Solution** – A solution with a large amount of solvent is called a Concentrated Solution.
- **Saturated Solution** – A solution in which no more solute can be added since it has already dissolved the maximum amount of solute it can is called a Saturated Solution.



concentration

- Concentration refers to the amount of a substance per defined space or can be defined as the ratio of solute in a solution to either solvent or total solution.
- To calculate the concentration consider the formulae below:
- Percent by Mass = (Mass of solute / Mass of solution) X 100
- Percent by Volume = (Volume of solute / Volume of solution) X 100
- Molarity (M) = Number of moles of solute / Volume of Solution in litres
- Where, Moles of solute = Given mass / molar mass
- Molality (m) = Moles of solute / weight of solvent in kg
- Normality (N) = Number of mole equivalents/ volume of solution in litres

- = Mass of solute / (equivalent mass * volume of solution in Litres)
- ppm (Parts Per Million) = (Mass of Solute / Mass of Solvent) * 106
- Mole FractionSOLUTE = Moles of Solute / Total Moles of Solution
- Mole FractionSOLVENT = Moles of Solvent / Total Moles of Solution
- Mole FractionSOLUTE + Mole FractionSOLVENT = 1

suspension

- A suspension is formed when two or more substances are mix in a non-uniform manner. Heterogeneous mixtures are suspensions. The solute does not mix with the solvent and can be viewed through naked eyes.

Properties of Suspensions:

- A suspension is a heterogeneous mixture.

- We can see the particles of suspensions through naked eyes.
- We can see the path of light through the particles of a suspension.
- The particles of suspension tend to settle down when left undisturbed. Then, they can be separated using filtration.

Colloid

- A colloidal solution or a colloid is a uniform solution of two or more substances. The particles are relatively very small that the solution appears as a homogeneous mixture but it is not.

- ## Properties of colloids:

- Colloids are heterogeneous in nature.
- The particles of a colloid cannot be seen through naked eyes.
- The particles scatter a beam of light passed through a colloid and produce Tyndall effect.
- Colloids are stable in nature. The particles of colloids do not settle down if left uninterrupted.
- We cannot separate the particles of a colloid through filtration. We use a method called Centrifugation to separate the particles of a colloid.
- Q. What are colloids or colloidal solution ?

- ## Tyndall Effect

- When a beam of light is passed through a colloid the particles of the colloid scatter the beam of light and we can see the path of light in the solution. For Example, when a ray of light enters a dark room it is scattered by the dust particles present in the air and we can see the path of light clearly.

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- ## Classification of Colloids
- Dispersed Phase – The dispersed particles or the solute-like components in a colloid
- Dispersing Medium – The substance in which these solute-like particles are added Based on the state of the dispersing medium colloids are classified as:
- ## How to separate components of a mixture?
- We can separate the heterogeneous mixtures into their constituents by means of physical methods like:

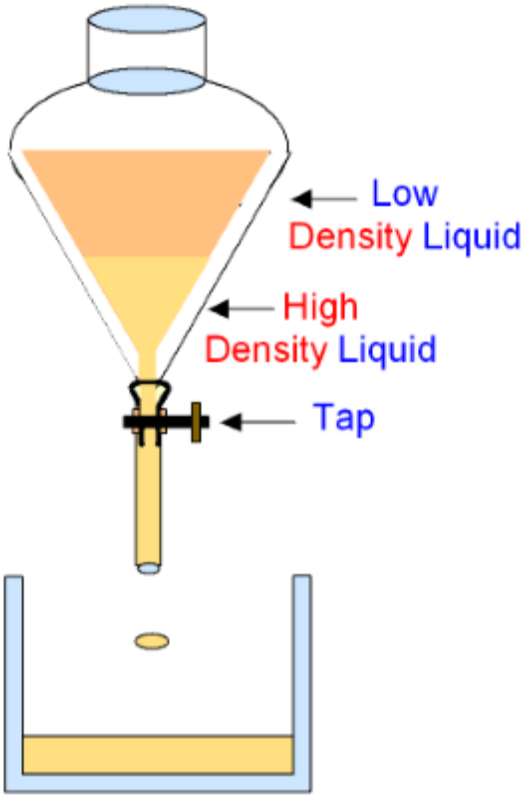
- Filtration
- Hand-picking
- Sieving

- The components of a mixture can be separated from each other using several other techniques like:

- Evaporation
- Centrifugation
- Sublimation
- Chromatography
- Distillation
- 1. Evaporation – For separating a mixture of a non-volatile and a volatile substance

- Applications:
- Separating coloured component from the ink
- Salt from water
- Sugar from Water
- Method:
- Mix some ink into water and heat it. After some time the water will evaporate leaving behind the coloured substance.
- 2. Centrifugation – Separating dense particles from lighter particles

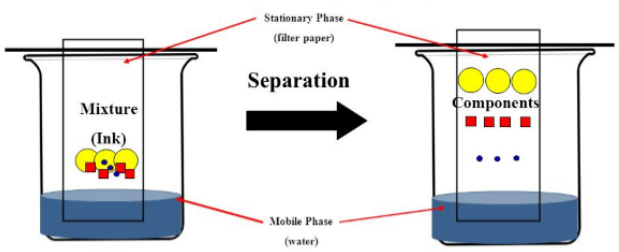
- Applications:
- Separating milk from cream
- Separating butter from cream
- Squeezing out water from wet clothes
- Method:
- Milk is put in a centrifuging machine or milk churner and the cream thus separates from milk.
- 3. Using a Separating funnel – To separate two immiscible liquids



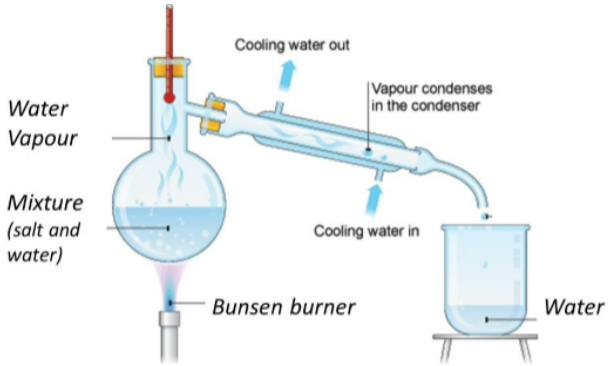
- Applications:
- Oil from water
- Iron and iron ore
- Method:
- The immiscible liquids are allowed to settle in the funnel. They soon form separate layers due to varying densities. The first liquid is allowed to flow out of the funnel and as soon as it is completely poured out, the stopcock is closed thereby separating the two liquids from each other.
- 4. Sublimation – To separate a sublimable component from a non-sublimable component
- Applications:
- Ammonium chloride / camphor / naphthalene and salt
- Method:
- Heat the mixture in an inverted funnel so that the sublimable component sublimes in the

air and settles over the walls of the funnel and the non-sublimable component, on the other hand, is left behind.

- **5. Chromatography** – To separate solutes that can dissolve in the same solvent



- Applications:
- Separating colour components of a dye
- Drugs from blood
- Method:
- Take a filter paper or a blotting paper and place a drop of ink at the rear end. Dip the end in water. Since ink is a mixture of two or more colors, the component of ink which is soluble in water mixes into it and then separates quickly from the other components that are less soluble in water.
- **6. Distillation** – To separate miscible liquids (the boiling points of the liquids must be sufficiently different)

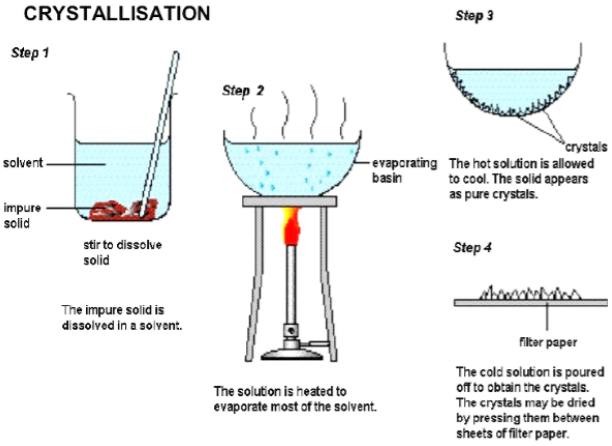


- Applications:
- Acetone and water
- Method:

- **Distillation** - The one substance with lower boiling point evaporates first, condenses and gets separated from the one with a higher boiling point.
- **Simple Distillation** – when the miscible liquids have a satisfactory difference in their boiling points
- **Fractional Distillation** – when the difference between the boiling points of the liquids is less than 25 K
- Separating different Gases from the Air
- **Method** – Fractional Distillation
- Compress and cool the air by increasing the temperature and decreasing the pressure. The air turns to liquid air.
- Liquid air is warmed up slowly in a fractional distillation apparatus
- The several components of air get separated and are collected at various heights on the basis of their boiling points
- Purifying Solids

Crystallization

- In the crystallization method, we can obtain a pure solid in the form of crystals from its solution



- **Applications**:
- Salt from sea water
- Purification of copper sulphate

- Method:
- The impurities of a substance are filtered out.
- Water is evaporated to obtain a saturated solution.
- The solution is covered with filter paper and left as it is.
- After some time, the crystals of pure solid are formed.

Physical Change and Chemical Change

- Physical Property of a Substance:
- Properties of a substance such as rigidity, colour, fluidity, boiling point, melting point, density and hardness which we can observe are called as Physical Properties.
- Physical Change:
- When physical properties of a substance change it is known as a Physical Change. When we convert a substance from one state to another, such as a solid into a liquid or vice-versa, it is also a physical change as only the physical nature of the substance changes without affecting its chemical nature.
- For Example, Change of ice into water. The chemical properties of water remain the same.
- Chemical Property of a Substance:
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- Change:
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- Chemical Property of a Substance:
- The chemical nature of a substance is known as its Chemical Property such as its odour or its chemical composition.
- Chemical Change:
- When the chemical properties or chemical composition of a substance gets altered it is called a chemical change. It is also called as a Chemical Reaction.
- For Example, Burning of paper
- Types of Pure Substances
- Pure substances are classified as elements and compounds

Element

- An element is the simplest form of matter. Elements cannot be broken down into further elements by chemical reactions. Elements are further characterized as Metals, Non-Metals and Metalloids

Metals – Silver, Mercury, Copper, Gold

1. Metals are lustrous (shiny)
2. Metals conduct heat and electricity
3. Metals have a silver-grey or gold-yellow colour
4. We can hammer metals and form thin sheets (Malleability)
5. We can convert metals into wires (Ductility)
6. Metals always produce a ringing sound if they are hit (Sonorous)

Non-Metals – Carbon, Iodine, Chlorine, Oxygen, Hydrogen

1. Non-Metals do not conduct heat and electricity
2. Non-Metals are not sonorous, lustrous or ductile
3. Non-Metals have varied colours

Metalloids – Silicon, Germanium

They show some properties of metals and some of the non-metals.

Quick Facts –

- ★ There are 100 elements known to us
- ★ 92 elements out of them occur naturally
- ★ Rest, 8 are man-made elements
- ★ Most of the elements are solid in nature
- ★ At room temperature, 11 elements exist in the gaseous state
- ★ At room temperature, 2 elements exist in the liquid state – bromine and mercury
- ★ At a temperature slightly higher than room temperature, 2 elements exist in the liquid state – calcium and gallium.

Answer the following questions :

Q 1 Define the following : a) substance b) Pure substance c) Alloy

Q.2 Different between chemical and physical change?

Q.3.What are mixture and solution? And it's type .

Q.4 Which of these is a mixture or a pure substance?

Water, Copper, Chocolate cake, Hydrogen, Soil, Air

Q.5 Explain the different types of separation Technics.

Q.6. what are metal and non metal .

Q.7 What is the Tyndall Effect.