CHAPTER: IS MATTER AROUND US PURE?

Grade: **9**
Board: **CBSE**
Book: **NCERT**

1. CHAPTER SUMMARY AND PLACEMENT

<Read through the following to understand how this chapter is connected with the previous and next grades and also the important concepts covered in it.>

1. In this chapter, students will be introduced to pure substances, mixtures, types of mixtures (Solutions, Suspension and Colloidal solution), their properties.
2. This chapter also explains the ways of separating the components of a mixture. Further the chapter explains the physical and chemical changes and the types of pure substances - Elements and Compounds.
3. Since the chapter is focussed on different types of substances, hence either the images or the substances are used as resource for teaching this lesson.

2. LEARNING OUTCOMES

<On completion of the chapter, students will be able to:>

1. Identify pure substances.
2. Understand mixture and its types.
3. Understand the meaning of a solution and its properties.
4. Define Concentration of a Solution.
5. Define Suspension.
6. Define Colloidal Solution.
7. Understand different ways to separate the components of a mixture
8. Differentiate between Physical and Chemical changes
9. Identify types of pure substances - Elements and Compounds

3. KEYWORDS

Definitions of some terms used in the chapter:

Solution: A homogeneous mixture of two or more substances
Suspension: A heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium.
Tyndall effect: The scattering of a beam of light.
Element: A basic form of matter that cannot be broken down into simpler substances by chemical reactions.
Compound: A substance composed of two or more elements combined together in a fixed proportion.

3. TEACHING PLAN

Follow this section for getting ideas on teaching the content covered in the chapter. The subtopic given in the first column with the matching learning outcome can be explained using instructions and resources listed subsequently

Subtopic and Learning Objective #1

What Is a Mixture, Types of Mixtures

1. Identify pure substances.
2. Understand mixture and its types.

Teacher Activity

1. Perform Activity 1 and give clarity to students about pure substances.
2. Discuss with students that pure substances are the ones which are made up of single type of particles, while the impure substances are the ones which are made up of more than one type of particles.
3. Perform Activity 2 to introduce students to different types of mixtures (Homogenous and Heterogenous mixtures)

Check your Understanding

a. Name one example of a homogenous mixture. How is it different from a salty solution?
b. What are pure substances?

Resources Suggested

Blackboard, chalk

Activity 1

Name of the activity – Identifying Pure substances and mixtures
Type of activity – Group/Individual Demonstration
Use it for – Identification of different types of mixtures
Materials – Salt, Salty water, Milk, Sugar, Soft drink (You can also show images)

Procedure –

1. Show all these materials to students and tell them about pure and impure substances.
2. Discuss with them that if a substance is made up of only one kind of particles like sugar or salt, then it is a pure substance. And if the substance is made up of more than one kind of particles like salty water (made up of salt and water particles), milk (made up of water, fat, protein), soft drink (made up of sugar, flavoured drink), then it is an impure substance or a mixture of two or more pure substances

Conclude the activity by introducing the students about homogeneous and heterogeneous mixtures

Activity 2

Name of the activity – Identifying types of mixtures
Type of activity – Group/Individual Demonstration
Use it for – Understanding two types of mixtures
Materials – Mixture of salt and water, Mixture of sodium chloride and iron filings, Mixture of oil and water.

Procedure –

1. Divide the class into groups of four or five according to the class size.
2. Show different mixtures to each group and ask them if they can see the particles of the components in each of the mixture.
3. If they can see the particles of components in a mixture or the mixture is non-uniform throughout, then it is a heterogeneous mixture. (Eg: salt and water)
4. If they cannot see the particles of components in a mixture or the mixture is uniform throughout, then it is a homogeneous mixture. (Eg: sodium chloride and iron filings; oil and water)

Conclude the activity by introducing the students about homogeneous and heterogeneous mixtures.

Subtopic and Learning Objective #2

What Is a Solution, Concentration of a Solution

1. Understand the meaning of a solution and its properties.
2. Define Concentration of a Solution.

Teacher Activity

1. Discuss with students that a solution is a homogeneous mixture.
2. Categorize the solutions as solid solutions (eg. alloys) and gaseous solutions (air). Show Resource 1.
3. Also discuss about solutions where a solid (solute) is dissolved in a liquid (solvent).
4. Discuss various properties of a solution as shown in Resource 1.
5. Tell students about types of solutions - saturated, unsaturated and supersaturated solutions.
6. Mention the three ways of expressing the concentration of a solution. (Mass by Mass%; Mass by volume%, Volume by volume %). Do an example based on these formulas

Check your Understanding

a. Give two properties of a solution.
b. How do you express the concentration of a solution by way of mass by mass percentage of a solution?

Resources Suggested

Blackboard, chalk

Resource 1:

Types of solutions

State of solute	State of solvent	Examples of solution
solid	solid	Alloys ▪Bronze (tin dissolved in copper) ▪Steel (iron, carbon + others) ▪Brass (zinc dissolved in copper)
gas	gas	Air (oxygen, carbon dioxide, noble gases dissolve in nitrogen)

Properties of a Solution

- They do not separate into layers over time.
- If they are poured through a filter, none of the substances will get trapped.
- Light passes through them.

All of the particles in a solution are too small to become separated, filter out, or scatter light.

SATURATED, UNSATURATED & SUPERSATURATED SOLUTIONS

- SATURATED SOLUTION:
  - CONTAINS THE MAXIMUM AMOUNT OF SOLUTE FOR A GIVEN AMOUNT OF SOLVENT AT A CONSTANT TEMPERATURE
  - THE RATE OF DISSOLVING AND CRYSTALLIZATION ARE EQUAL
  - YOU CAN NOT ADD MORE SOLUTE WITHOUT IT FORMING A CRYSTALLIZED SOLID
- UNSATURATED SOLUTION:
  - CONTAINS LESS SOLUTE THAN A SATURATED SOLUTION
  - YOU CAN STILL ADD MORE SOLUTE WITHOUT A CRYSTALLIZED SOLID FORMING
- SUPERSATURATED SOLUTION:
  - CONTAINS MORE SOLUTE THAN IT CAN THEORETICALLY HOLD AT A GIVEN TEMPERATURE
  - THERE IS A NOTICEABLE AMOUNT OF CRYSTALLIZED SOLID FORMED

Percentage Concentration

- % (w/w) = $\frac{mass\ solute(g)}{mass\ solution(g)} \times 100$
  - W is weight same as mass
- % (w/v) = $\frac{mass\ solute(g)}{volume\ solution(mL)} \times 100$
- % (v/v) = $\frac{volume\ solute(mL)}{volume\ solution(mL)} \times 100$

Subtopic and Learning Objective #3

What Is a Suspension?, What Is a Colloidal Solution?

1. Define Suspension.
2. Define Colloidal Solution.

Teacher Activity

1. Perform Activity 3 to discuss about a suspension and a colloidal solution. Also compare their properties with that of a solution. Refer Resource 2

Check your Understanding

a. Give two properties of a colloidal solution.
b. What do you mean by Tyndall effect?

Resources Suggested

Blackboard, chalk, Resource 2.

Activity 3

Name of the activity – Identifying Suspension and a Colloidal Solution
Type of activity – Group/Individual Demonstration
Use it for – Understanding two types of solutions - Suspension and Colloidal solutions
Materials – Mixture of chalk and water, Mixture of milk and water

Procedure –

1. Divide the class into groups of four or five according to the class size.
2. Show the two types of mixtures to each group, mix them with a stirrer and ask them if they can see the difference in between them.
3. Ask certain question with respect to the properties of the mixtures - Can the particles be seen by a naked eye?, In which of these mixtures do the particles settle down when left undisturbed?, Can the particles of a mixture scatter a beam of light passing through it (Tyndall effect)?

Conclude the activity by explaining the answer to the above questions and thus listing the properties of suspension and colloidal solution.

Resource 2:

Sol. (colloid)	Solution	Suspension
1. Size of solute particles between 1 nm to 100 nm.	Size of solute particles less than 1 nm (10^{-9} m)	Size of solute particles is more than 100 nm.
2. It is stable.	Stable.	Unstable.
3. It scatters a beam of light.	It does not scatter light.	It scatters a beam of light.
4. Solute particles pass through filter paper.	Solute particles pass through filter paper.	Solute particles do not pass through filter paper.

COMPARISON OF THE PROPERTIES OF SOLUTION, COLLOID AND SUSPENSION

PROPERTY	SOLUTION	COLLOID	SUSPENSION
Particle size	Less than 1 nm	1 to 100 nm	More than 100 nm
Appearance	clear	cloudy	Cloudy
Separation	Does not separate	Does not separate	Separates or settles
Filterability	Passes through the filter paper	Passes through the filter paper	Particles do not pass through filter paper
Effect of beam of light	Light can pass through	Scatters light	Light cannot pass through
Example	Salt solution	mayonnaise	Muddy water

Subtopic and Learning Objective #4

Separating the Components of a Mixture

1. Understand different ways to separate the components of a mixture

Teacher Activity

1. Make students recall that about separating the components of a mixture which they have studied in lower classes. (Handpicking, sieving, winnowing, evaporation, sedimentation, condensation etc.)
2. Explain certain special techniques to separate the components of a mixture along with their principles - Evaporation, Using separating funnel, Sublimation, Chromatography, Distillation etc. Use Resource 4.

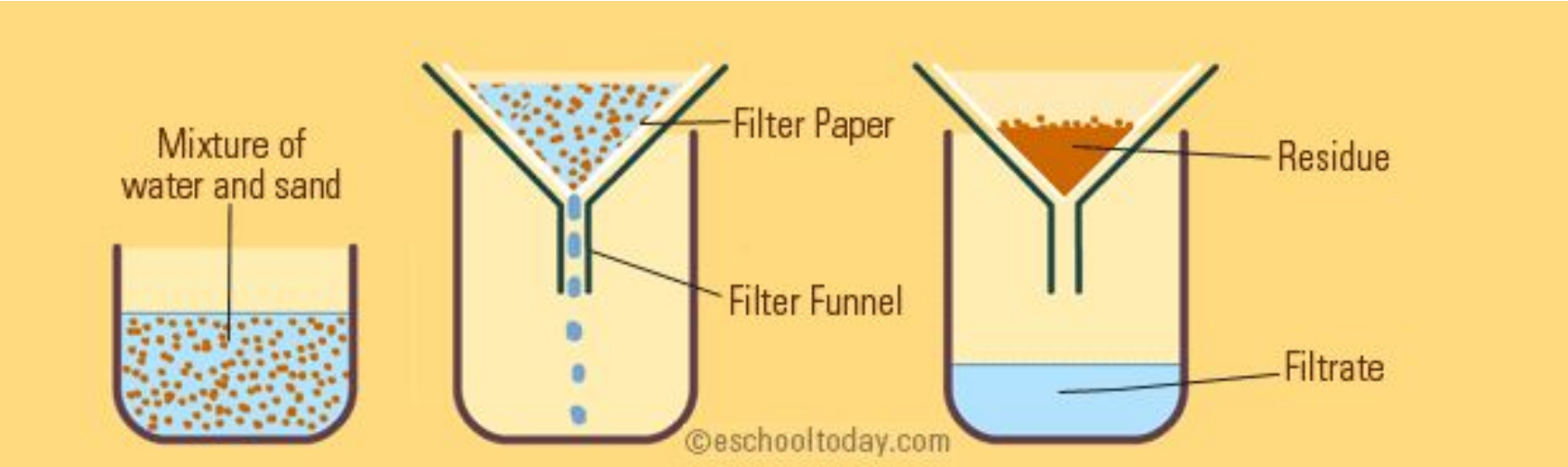
Check your Understanding

a. What is the principle of the process of chromatography?
b. How can you obtain pure copper sulphate from an impure sample?

Resources Suggested

Blackboard, chalk, Resource 4.

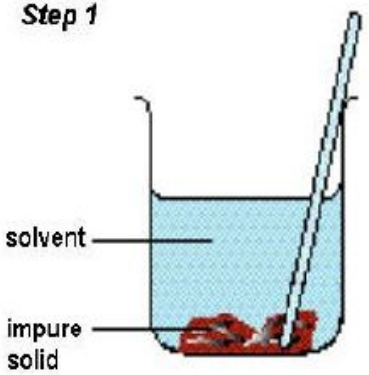
Resource 3:



Filtration

CRYSTALLISATION

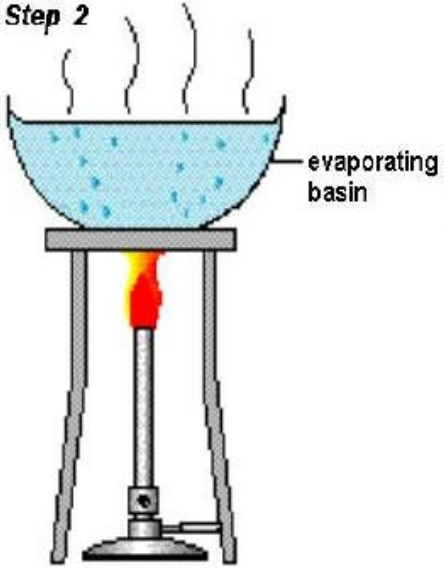
Step 1



stir to dissolve solid

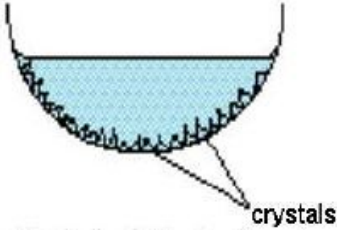
The impure solid is dissolved in a solvent.

Step 2



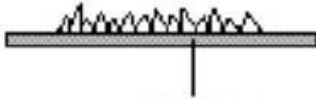
The solution is heated to evaporate most of the solvent.

Step 3

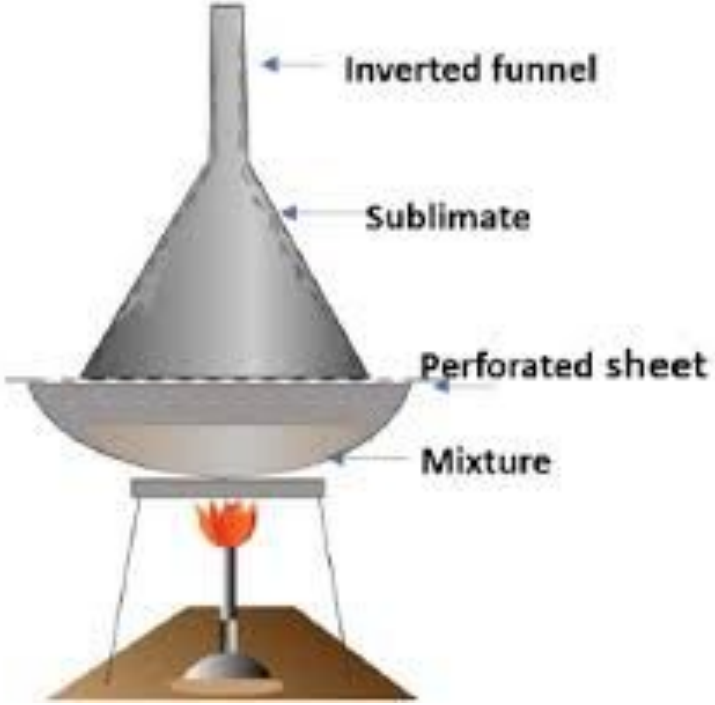


The hot solution is allowed to cool. The solid appears as pure crystals.

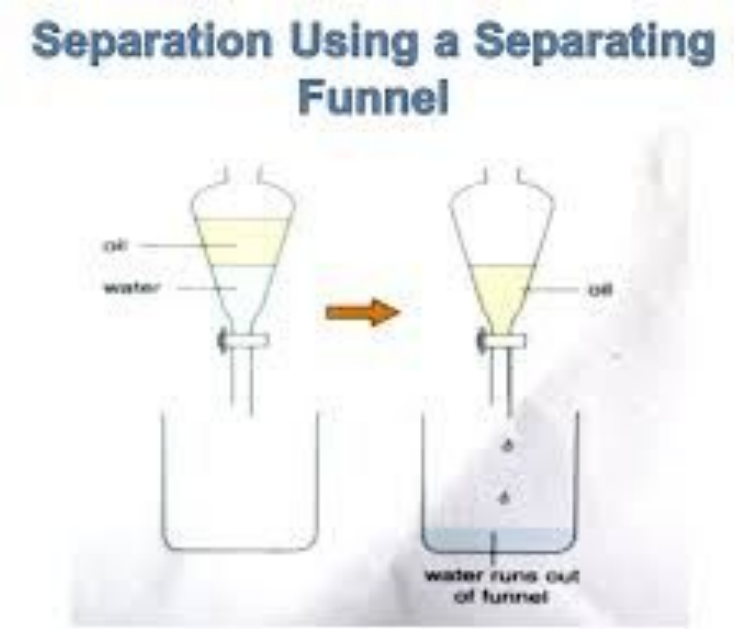
Step 4



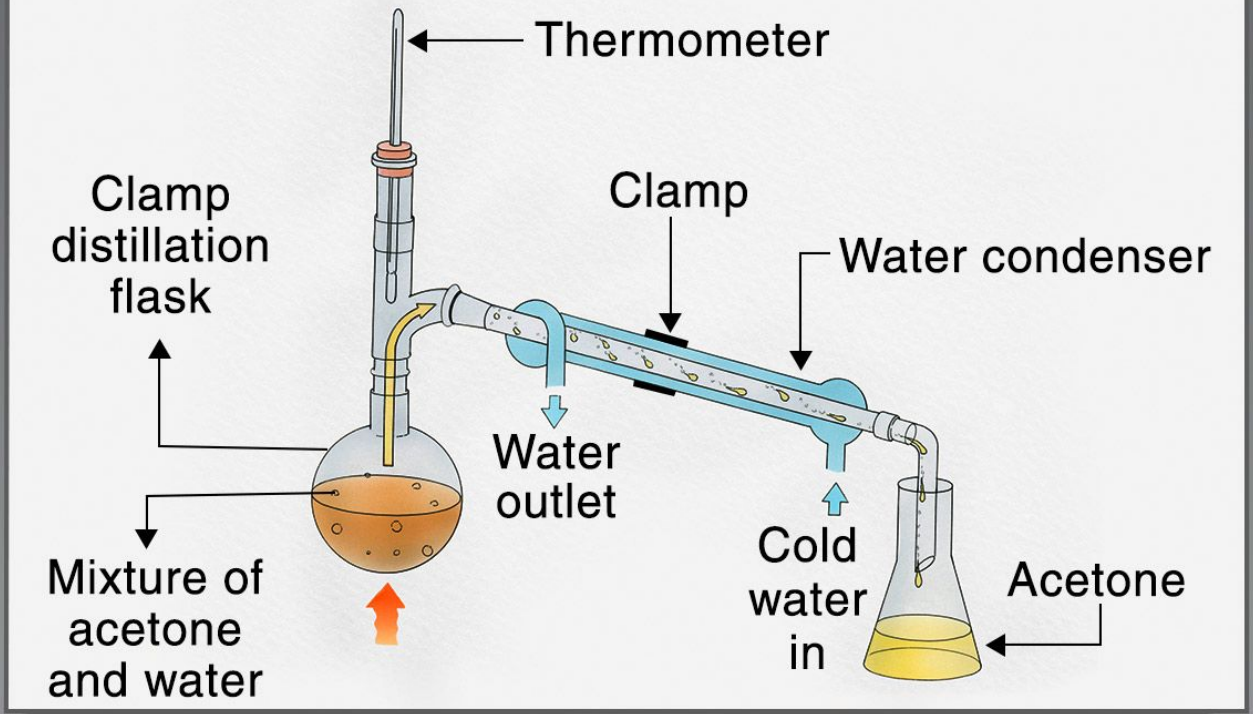
The cold solution is poured off to obtain the crystals. The crystals may be dried by pressing them between sheets of filter paper.



Sublimation



Simple Distillation



Buzzle.com

Subtopic and Learning Objective #5

Physical and Chemical Changes; What Are the Types of Pure Substances?

1. Differentiate between Physical and Chemical changes
2. Identify types of pure substances - Elements and Compounds

Teacher Activity

1. Make students recall about physical and chemical changes (studied in previous classes). Use Resource 4.
2. Explain to students the types of pure substances - Elements and Compounds.

Check your Understanding

a. Is non-metal a compound? Why or why not?
b. Give two points of differences between mixture and compound?

Resources Suggested

Blackboard, chalk, Resource 4.

Activity 4

Name of the activity – Identifying Elements and Compounds
Type of activity – Group/Individual Demonstration
Use it for – Understanding two types of pure substances - Elements and Compounds
Materials – Mixture of iron filings and sulphur, Mixture of iron filings and sulphur heated red hot and cooled, Magnet

Procedure –

1. Divide the class into groups of four or five according to the class size.
2. Demonstrate the experiment by putting two types of mixtures in two different containers and bring the magnet near both the mixture one by one to check if the substance is magnetic or not.
3. When magnet is brought near the mixture of iron filings and sulphur, iron filings get attracted to the magnet while when magnet is brought near the heated mixture of iron filings and sulphur, no such observation can be seen.

Conclude the activity by listing the properties of elements and compounds.

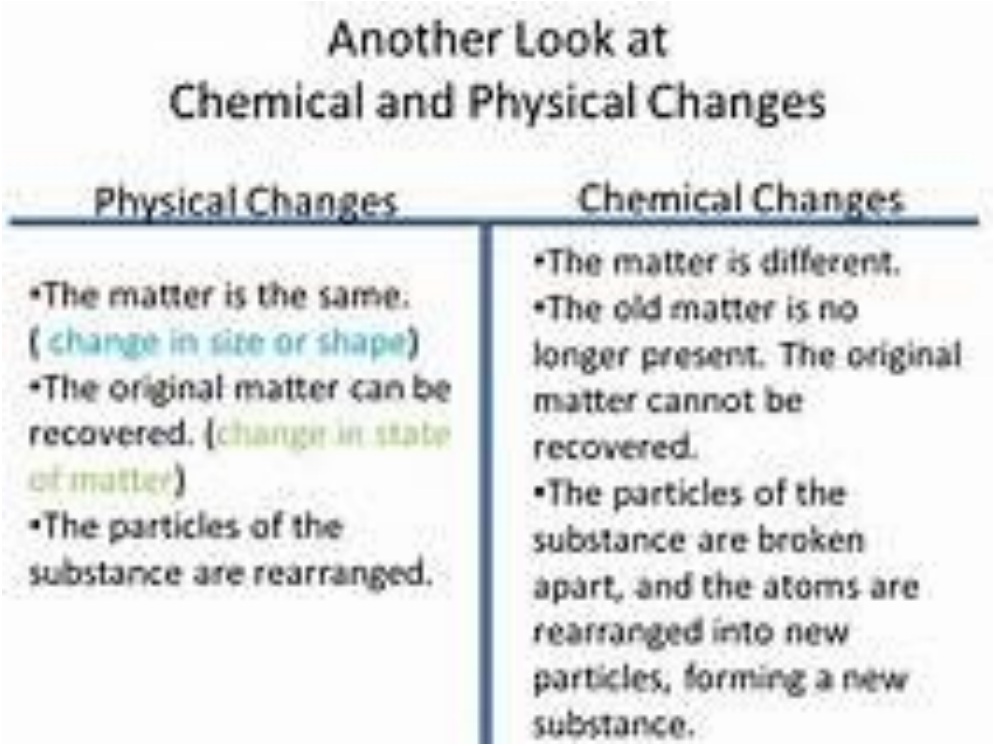
Element vs. Compound

- Simplest form of matter
- Can NOT be separated into simpler substances by chemical means
- Building blocks of other substances
- Examples: oxygen, hydrogen, etc

- 2 or more elements combined
- Substance that can be separated into simpler substances by chemical means
- H_2O

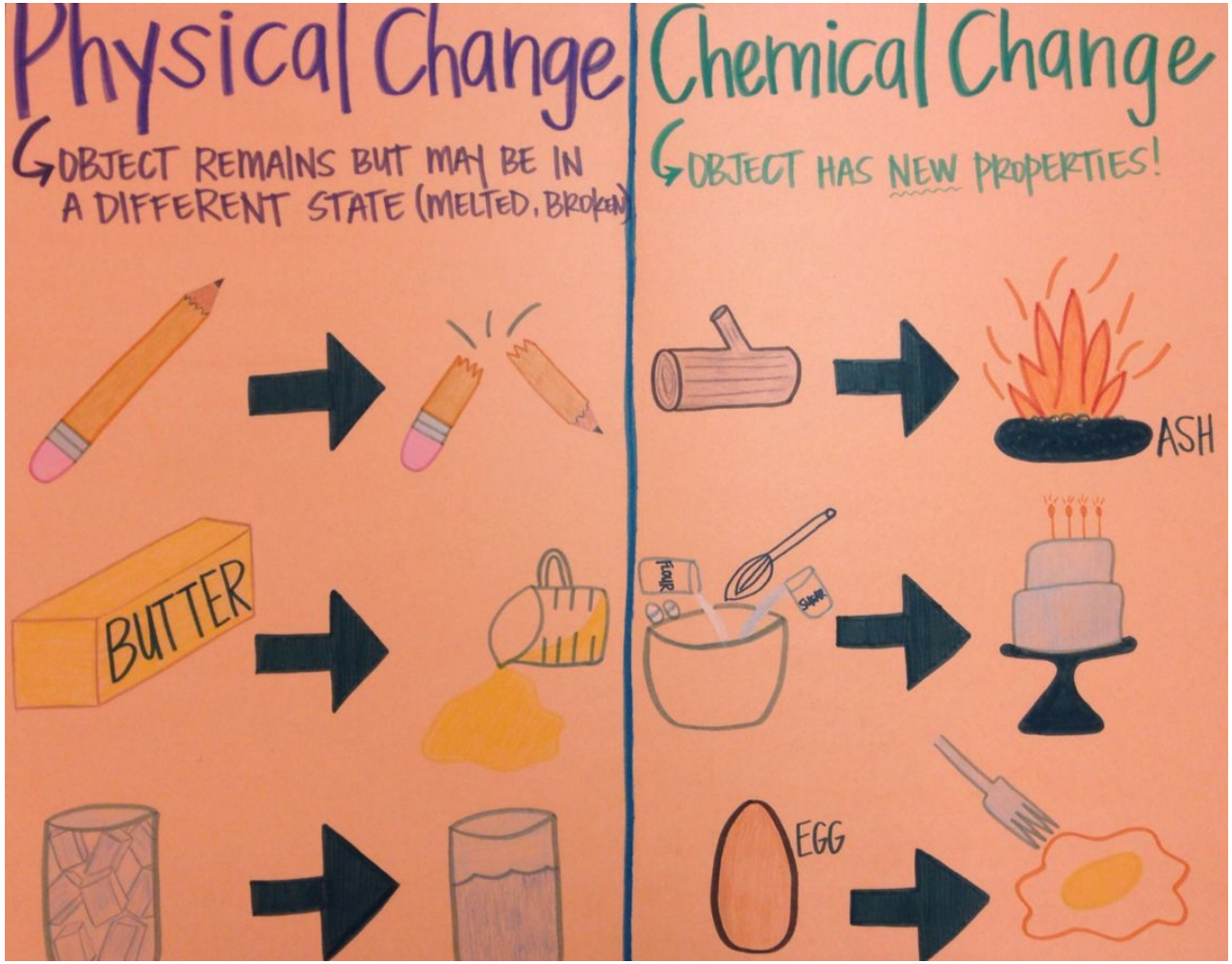


Resource 4:



Another Look at
Chemical and Physical Changes

Physical Changes	Chemical Changes
•The matter is the same. (change in size or shape) •The original matter can be recovered. (change in state of matter) •The particles of the substance are rearranged.	•The matter is different. •The old matter is no longer present. The original matter cannot be recovered. •The particles of the substance are broken apart, and the atoms are rearranged into new particles, forming a new substance.


Physical Change
OBJECT REMAINS BUT MAY BE IN A DIFFERENT STATE (MELTED, BROKEN)
BUTTER
Chemical Change
OBJECT HAS NEW PROPERTIES!
ASH
FLOUR
SUGAR
EGG

4. WORKSHEETS

Print or copy the worksheet questions on the blackboard and ask the students to attempt them. They can be given as homework or a class test as well.

Worksheet 1

Use it like: test after introduction of photosynthesis, homework, class assignment

1. What is a solution?
2. What do you mean by a colloidal solution?
3. How will you separate a mixture of two miscible liquids?
4. What do you mean by sublimation?
5. Burning of candle is both a physical and chemical change. Explain.
6. Give one point of difference between an element and a compound.
7. How will you separate cream from milk?

Worksheet 2

Use it like: checking students understanding in class, oral test

Multiple choice questions:

1. Which of the following is an example of a suspension?

a) Milk
b) Muddy water
c) Sugar syrup
d) All of the above

2. Which of the following is an/are example(s) of an element?

a. Glucose
b. Iron
c. Sugar
d. All the above

3. Which of the following is an/are example(s) of a compound?
a. Water
b. Aluminium
c. Gold
d. All the above

4. State whether the following statement is true or false.
Air is a mixture of gases.
a. True
b. False

5. When naphthalene balls are kept in open, they change into its _____ state.
a. Liquid
b. Gaseous state
c. Both a and b
d. All the above

6. Two solutes that have different solubilities and can dissolve in same solvent can be separated by the process of _____.

a. Chromatography
b. Distillation
c. Centrifugation
d. Evaporation

7. Which of the following is an example of a colloid?

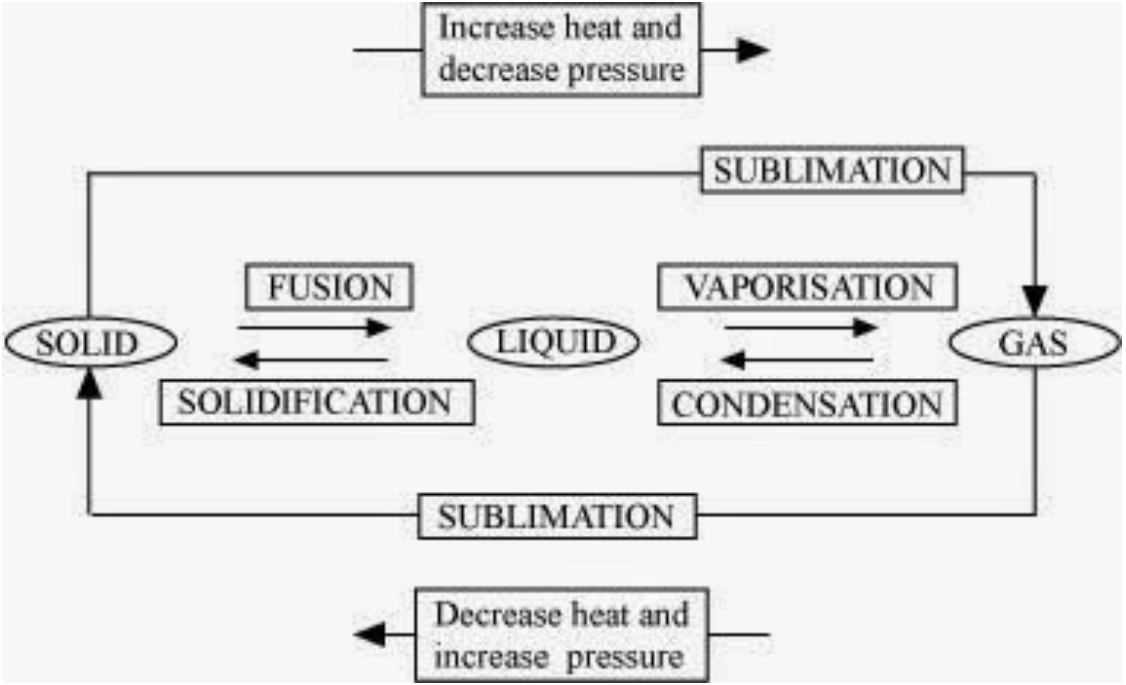
a. Sugar syrup
b. Mayonnaise
c. Muddy water
d. Both b and c

8. Melting of butter is an example of a _____.

a. Physical change
b. Chemical change
c. Slow change
d. All the above

Worksheet 3

Give example for all the processes mentioned in the diagram.



5. SOLUTIONS

This section gives you sample answers for activities and questions listed above.

Worksheet 1

1. A solution is a homogeneous mixture of two or more substances.
2. A colloidal solution is the one where the particles are uniformly spread throughout the solution.
3. A mixture of two miscible liquids is separated by the process of distillation.
4. Sublimation is the process of conversion of a solid substance to a vapour substance without passing through the liquid phase.
5. During burning of candle, wax melts which is a physical change as no new substance is formed and it is a reversible change. Burning of wick is a chemical change as it creates soot and smoke and carbon dioxide is also released.
6. Difference between an element and a compound is:

Element	Compound
It is the simplest form of matter that cannot be broken down into much simpler substances.	It is made up of two or more substances combined in a fixed proportion.

7. We can separate cream from milk by the process of centrifugation.

Worksheet 2

1. b. Muddy water
2. b. Iron
3. a. Water
4. A. True
5. B. Gaseous
6. A. Chromatography
7. B. Mayonnaise
8. B. Chemical change

Worksheet 3

Fusion - Melting of ice

Solidification - Freezing of ice

Vaporisation - Boiling of Water

Condensation - Water vapour into liquid water

Sublimation - Naphthalene balls converting int vapours

6. EXTRA RESOURCES

Carry out the following suggested activities/ tasks if you have the time and resources to do them

1. **Video Links:**

Show the following videos to the students on computer/ tablet/ screen:

a) Solution, Suspension, and Colloid
https://www.youtube.com/watch?v=XEAiLm2zuvc

b) Tyndall Effect
https://www.youtube.com/watch?v=qxlR7ZdgV7w

c) Types of osmotic solution:
https://www.youtube.com/watch?v=BGtLQSfFQsA

2. **Activities**

Students can be given different types of mixtures and ask them to identify the separation technique. They can be asked to suggest more mixtures which can be separated using the same technique