

## Understanding Kinetic Theory of Matter through Activities

Grade IX

Estimated number of students: 24

Time: 45 minutes

### Objective:

- To show the process of diffusion in air.
- To show that particles are in constant motion and they spread in all directions through experiments.
- To illustrate the differences in diffusion rates at different temperatures.

### Learning Outcomes:

After the completion of this module, the students will be able to do the following:

- Understand that diffusion takes place due to the constant movement of particles and their subsequent spreading in the air.
- Infer that the rate of diffusion of particles increases with the increase in temperature of the medium.

### Prerequisite knowledge:

Before beginning with this module, the students must have a prior knowledge of the following:

- Matter is defined as anything that has mass and takes up space.
- The three different states of matter—solids, liquids, and gases—and the arrangement of atoms in them.
- Solids have a definite shape and volume, liquids have definite volume but no definite shape, gases have no definite shapes or volume.

### Pre-assessment test:

The students should be asked to distinguish between matter and non-matter through the exercise described below.

Identify the matters from the given elements.

Items for identification	Matter	Energy
Flower, bee, cloud, rainbow, leaf, fire, baby, torch light, smoke, heat coming from glowing coals, fog, sound coming from a drum, laser beam.		

### Elements of a Good Science Classroom

A good science classroom should have the following elements: science skills, a classroom culture, and a connection to life around. This year, we will be focusing on the following specific elements:

## 1. Science skills:

The students will understand, at their level, the following elements of the scientific method: generation of a hypothesis, experimentation, observation, analysis, and inference.

## 2. Classroom conducive for learning science:

Self-motivation, awareness, working in a team, and social/civic awareness and consciousness are key qualities for learning science. The students should be allowed to interact with each other and learn from each other to improve their communication skills through peer-learning.

## 3. Connection with the life around:

The students should be able to learn and apply the concepts in simple real-life situations.

## 4. Removal of gaps in learning:

The gaps in numeracy, literacy, and conceptual understanding of science should be addressed.

In the context of this module, the following elements of a good science classroom can be demonstrated:

Classroom Element	Specific Type	Context	Teacher's Actions	Students' Actions
Science Skills	Hypothesis	As temperature increases, the kinetic energy of particles also increases.	The teacher should ask the students to predict how a difference in the temperature will affect the process of diffusion.	The students should guess the effect of temperature on the movements of particles.
Science Skills	Observation	Observing diffusion in air and water.	The teacher should guide the students to observe the dispersion of color in water.	The students should observe the differences in the rate of motion of particles as the temperature differs.
Science Skills	Inference	The motion of particles increases with the increase in temperature.	The teacher should guide the students to understand the connection between particle energy and temperature.	The students will be able to infer the effect of temperature on the movement of particles.

**Materials Required:**

Material	Quantity
Hot water in a flask	1 liter
Ice cubes	30 pieces
KMnO <sub>4</sub>	5 grams
Beakers of 250 ml	24
Measuring cylinder	2
Incense sticks	4

**Activity 1: Teacher’s Demonstration**

Take two incense sticks and light them. Place them in a corner of the classroom. Make the students observe that the fragrance of the incense sticks spreads in the entire room after few minutes. Introduce the term diffusion, telling the students that it is a process where particles move from a higher concentration to a lower concentration.

**Observing the diffusion of particles in air by using incense sticks****Questions:**

Q: How much oxygen is there in the air?

A: The answers may vary. But, the teacher should get the students to say that it comprises nearly 20% (since this topic had been taught in the 8<sup>th</sup> grade).

Q: In our class, the benches, the desks, the blackboard, and the windows are all in a fixed place. Does oxygen or air stay in a fixed place?

A: The answers may vary. However, the teacher should highlight the answer that they are spread all over the place.

Q: If a student in the class uses a perfume, ask “Can everyone get the smell? How does the smell get everywhere?”

A: The answers may vary. But, the teacher should highlight the answer that the smell of perfume spreads all around the room.

Q: How does the smell spread all over the room?

A: The answers may vary. But, the teacher should highlight the answer that the air is in constant random motion.

**Activity 2: Effect of temperature on movement of matter****Procedure**

- Divide the students into groups of four and give 4 beakers to each group.
- Take two beakers—one with an ice cube and the other with 4 ice cubes—and let the ice melt in them for some time.
- Take one beaker containing normal water.
- Take one beaker containing lukewarm water (it can be carried from home in a thermos flask).
- Ask the students to predict the movement of the  $\text{KMnO}_4$  granules in the beakers and ask them to give reasons for their prediction.
- Allow the students to put few almost same amounts of  $\text{KMnO}_4$  granules in all four beakers and observe the diffusion of color in them.

**Worksheet for the students to fill during the procedure:**

Beaker	Time taken for spreading the color through out	Rate of diffusion (very slow/slow/fast/very fast)
Cold water with one ice cube		
Cold water with four ice cubes		
Normal water		
Hot water		

What did you observe with regard to the rate of diffusion as temperature increases?

**Post-class Assessment:****Marks 10****Time: 15 minutes****I. Choose the correct answer in the following questions:**

1. How do particles move in the process of diffusion?
  - a. From a higher concentration to a lower concentration
  - b. From a lower concentration to a higher concentration
  - c. From a higher temperature to a lower temperature
  - d. From a lower temperature to a higher temperature
  
2. Which of the following is **NOT** an example of diffusion?
  - a. Water freezing into ice cubes
  - b. Food coloring spreading out in water
  - c. Incense stick spreading smoke in the whole room
  - d. The smell of cookies in the whole house
  
3. Why is diffusion **NOT** often seen in solids?
  - a. Particles in solids are too big
  - b. Particles in solids are tightly packed
  - c. Particles in solids are too hot
  - d. Particles in solids are too small

**II. State whether the following statements are true or false.**

1. Diffusion is a process that occurs in liquid substances only.
2. Diffusion occurs in solid substances.
3. Diffusion is the movement of molecules from a region of low concentration to a region of low molecular concentration.

**III. Match the following appropriately (4)**

	Beaker	Temperature
1.		A. 27 °C
2.		B. 50 °C
3.		C. 10 °C
Reason: As temperature increases, the diffusion _____.		