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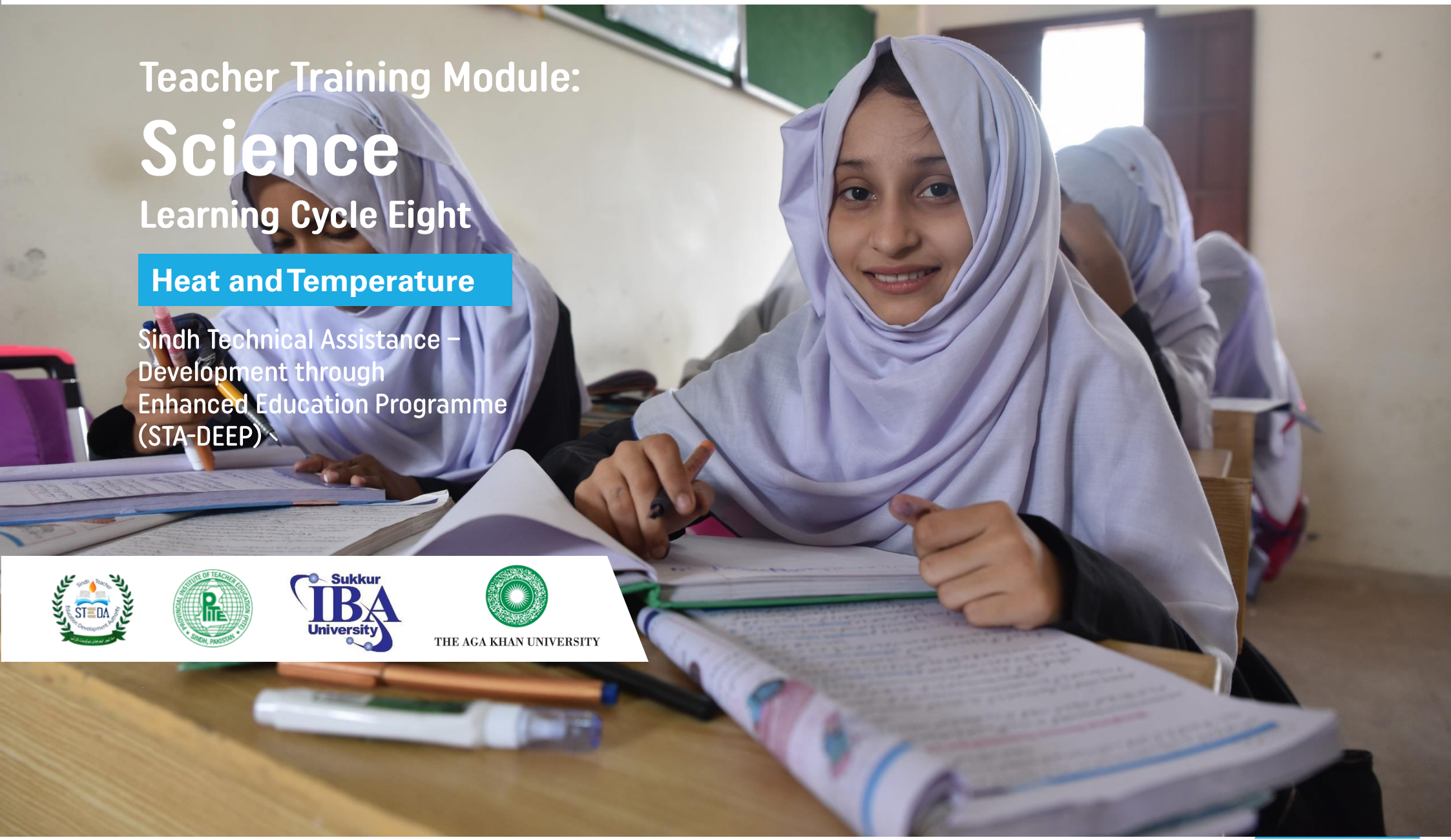
Teacher Training Module:

Science

Learning Cycle Eight

Heat and Temperature

Sindh Technical Assistance – Development through Enhanced Education Programme (STA-DEEP)



STEDA

PITE Sindh

Sukkur IBA University

THE AGA KHAN UNIVERSITY

Introduction and Rationale of the Training

Dear Teachers!

Welcome to the new phase of the Continuous Professional Development (CPD) Program. In the previous phase, we had focused on pedagogical skills that helped you to develop your skills to make classroom more interactive, participative, and joyful for our students. In the new phase, we will continue practicing those pedagogical skills and also learn about the introduced content knowledge and skills in Mathematics, Science, English, Urdu, and Sindhi. As a result, you will be better prepared to deal classroom situation using modern teaching strategies integrated with subject knowledge.

Our vision

Our common goal is to improve the quality of teaching in schools all over Sindh. We want students to become active and collaborative learners, problem solvers, and critical thinkers who approach tasks with creativity and confidence. They are conceptually clear about the subject content and have the skills to link this content with the world around them. To make this possible, we, as teachers, must be better prepared for the classroom demands in pedagogy and the subject content. Moreover, we aim to professionalize these trainings so that the CPD teacher training courses make an impact and substantially change student performance.

Our Teaching Philosophy

The CPD training sessions, including this training, follow a participatory teaching philosophy that engages participants to apply and practice active and collaborative learning, as well as engage in self and peer reflection to become community of practice. The objective is not only to improve the teaching practices but to help you understand the theory of the subject content and the strategies that help students apply the content in daily life with confidence and mastery.

Supporting You

The training module is designed to support you in your classroom teaching. It will introduce you to the subject content and some approaches for use in the classroom. This will make your teaching more manageable and help you grow as a skillful teacher.

Acknowledgement

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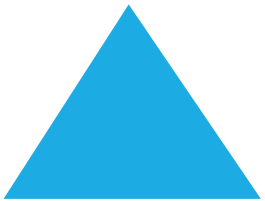


Learning Objectives: By the end of the session, the teachers will be able to:

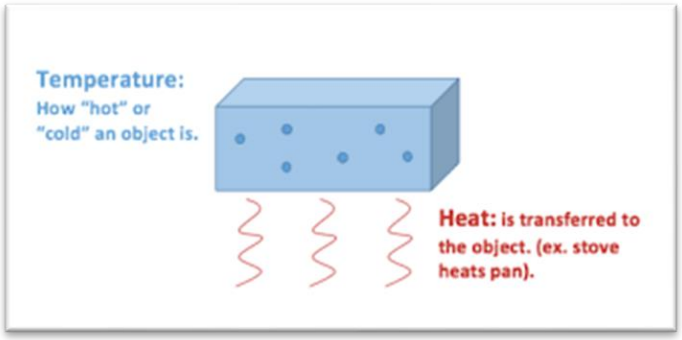
Differentiate between heat and temperature

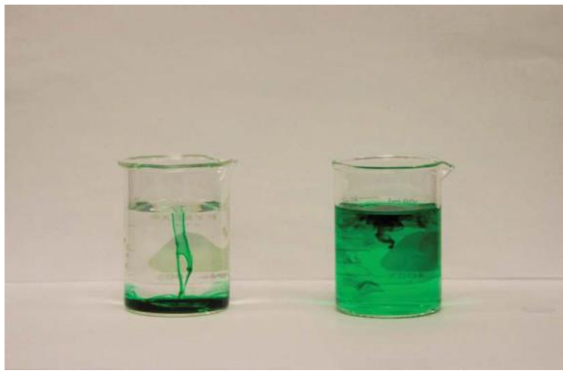
Apply the concept of heat and temperature to everyday phenomena

Session Plan

Instructional strategies/activities

Time	Objective/purpose of the activity	Activities/learning experiences	Materials/resources
10 mins	**Welcome** 1. Remind the rules of the workshop. 2. The facilitator will help teachers connect with their experience of the last learning cycle.	1. Quick recall of the rules of the workshop. 2. Ask each teacher to share one key takeaway from classroom implementation of the previous learning cycle “Forms of Energy”.	Sticky notes/paper chits
15 mins	**Warm-up** 1. The facilitator aims to trigger teachers understanding of the concept of heat	1. The facilitator will show three objects made up of different materials (Metal, plastic, and wood). Teachers will be asked to predict their heat conduction with reasons. 2. Facilitator will facilitate discussion around their ideas and reasoning around ‘Heat’	Any material (Metal, Wood, and plastic)
10 mins	**Input** 1 Facilitator will engage the teachers in the	1 The facilitator will elicit teachers' understanding of heat and temperature by showing figure 1:	Multimedia, Board, Marker

	discussion and reflect on the topic.	 **Figure 1.** Visual showing the concept of 'Heat and Temperature'. 2 Facilitator will also refer to the textbook *(Heat and temperature are two different quantities. The basic difference between heat and temperature is that Heat is the form of energy that transfers from a hot body to a cold body. Its unit is the joule. While the temperature is the degree of hotness and coldness of the body. Its SI unit is Kelvin)* and generates discussion to help participants differentiate between heat and temperature.	
45 mins	**Practice 1** 1 Facilitator will engage teachers n discussion, observation, and	The facilitator will distribute the teachers into two groups. Each group will be given a different task to perform. **GROUP-1** 1. **Step-1:** The group will be asked to discuss with group members:	**Group-1** 200-mL beaker (2) Food coloring (any

	explanation of the concepts of heat and temperature. 2 Teachers may refer to this article for further details: https://doi.org/10.1080/00368121.2015.1049580	a. What does it mean when something is hot? b. How do you know if something is hot? c. What does it mean when something is cold? d. How do you know if something is cold? 2. **Step 2:** The group is provided with two beakers of 200 ml each, a glass stirring rod, a pipette, and a small amount of food colouring. The teachers will fill both beakers with equal volumes of tap water at room temperature. Next, the teachers are asked to predict what they will observe when a drop of food colouring is added to the water and to record their predictions.  **Figure 2.** Non-stirred (left) and stirred water (right) with food coloring added. 3. **Step 3:** Next, the teachers will use the pipette to place a drop of food colouring into one of the beakers (see Figure 2). (Note: the food colouring should be dropped just above the water so that it gently breaks the surface and does not splash out.) The students will then	color) Glass stirring rod Plastic pipette Safety goggles Water (room temperature)

		observe the beaker for 5 min and record their observations in their science notebooks. Finally, the students will record this information in their notebooks. 4. **Step-4:** The above procedure is repeated for the second beaker (see Figure 2). However, the teachers will use the glass stirring rod to swirl the water in the beaker right before they add a drop of food colouring. Afterward, the whole group will lead toward discussion focusing on the observations of both experiments with reasons. **GROUP-2** 1. Discuss in the group: a. How is heat measured? b. How do you think a thermometer works? c. What is the difference between heat and temperature? 2. **Step-1:** The group members will add one to two drops of food colouring to a test tube, fill the test tube with water, and gently swirl the test tube to mix the food colouring. Next, they will insert a glass tube and stopper into the top of the test tube. The teachers will then place the test tube in a test tube clamp located near the top of a ring stand. Next, the teachers will position a hot plate on the base of the ring stand, place a 400-mL beaker on the hot plate, and add ~300 mL of chilled water to the beaker. The teachers will then lower the test tube clamp so that approximately one-half of the test tube is immersed in the chilled water. Finally, the teachers will use a permanent marker to	**Group-2** 30-cm glass tube, 2–3-mm bore size 400-mL beaker #2 cored rubber or cork stopper 30-mL test tube Hot plate Food coloring (any color) Permanent marker

mark the initial level of the water inside the thermometer (see Figure 3).

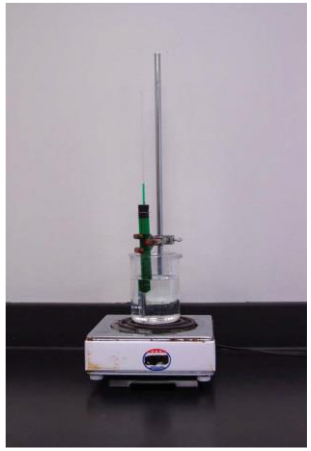


Figure 3. Thermometer setup

3. **Step 2:** The teachers will turn the hot plate on high and observe and record (a) what happens to the water in the beaker, (b) the relative heat of the water in the beaker. Next, they will mark the present height of the water on the side of the note card opposite the thermometer. The teachers will repeat this procedure until the water boils. Finally, when the students have completed all measurements, they will place the note card on a flat surface and measure the distance from each mark and starting point.
4. **Step 3:** Once the hot plate is turned off, the teachers' participants will discuss the following questions:

		5. Explain any differences in the appearance of the water in the beaker and the thermometer at the beginning, midpoint, and end of the activity. 6. **Facilitator Input:** The facilitator will ask both groups to share the outcome of their inquiry with the help of evidence/data gathered. See the sample below: 7. ***Probable outcome of Group** 1:* The students will develop an understanding of why food colouring diffuses at a faster rate in water that is stirred compared to water that is not stirred. The purpose of this activity is to help the teachers to think about and explain motion at the particle level. 8. ***The probable outcome of Group 2:*** The teachers will solidify their ideas about the connection between heat and particle motion and use their particle models to explain the differences between heat and temperature.	
10 mins	**TEA BREAK**		
 45 mins	**Practice 2** Teachers will be engaged in various applications of the concept of 'heat and temperature'	1. The session will start with sharing the concept of POE (Predict, Observe, and Explain). 2. The facilitator will divide the teachers into three groups. Each group will be assigned a different task to predict, observe and explain (POE).	

		Group-1: Expansion and Contraction a) Teachers will be asked to fill the sheet of prediction and then observe the process of expansion and then contraction through STBB, Class VIII, p.124 practical set up in the classroom at station-A. b) Teachers will be asked to share the observation in front of the whole class regarding the thermal expansion and contraction process in the gaseous state. **Group-2: Exothermic and Endothermic Reaction** a) Teachers will be asked to observe the process of Exo-thermic and Endo thermic reactions by following the steps as mentioned in STBB, Class VIII p. 64. Share the learning process with the whole class. **Group-3: Pulse Rate** a) Teachers are required to go to the school ground, measure the pulse rate of each group member and note it down in the notebook. b) Teachers are required to walk in the school ground for 3 minutes, after walking, observe the pulse rate of each group member. Follow these steps to measure your pulse rate (or someone else's. • Take the pads/tips of your index (pointer) finger and middle finger.	

		• Press them gently against the side of your neck (just under your jawline). Or press on the inside of your wrist, below the base of your thumb. • Count the number of beats you feel for 15 seconds. Use a stopwatch or other timing device to track the seconds accurately. c) Make a pulse rate chart of each group member in the card sheet. d) Make a graph and compare each one's pulse rate. e) Present the whole process of learning. 3. **Facilitator Input:** The facilitator will ask all three groups to share the outcome of their application tasks and help them connect back to the core concept of 'Heat and Temperature'.	
 30 mins	**Reflection for Action** 1. This will support the teachers to apply their experience of the workshop and create a plan for their classrooms (Individual task).	Facilitator will guide participants to reflect forward and plan for their classroom implementation: 1. Level of Inquiry: _____ 2. Plan Grade level:_____ Topic:_____ SLO:_____ Demonstration/POE/visuals used:_____	

		Procedure:_____	
	**Conclusion** 1. The facilitator will provide guiding prompts to teachers to summarize their learning.	1. The facilitator will provide guiding prompts to teachers to summarize their learning: a) why colour diffuse more by stirring the water? what is the connection of a hot plate for understanding the concept of heat and temperature? b) Explain heat in terms of particle motion. c) Compare heat and temperature. d) Do you think there would be any difference in the motion of the water molecules as you experienced in activity-1 of colour diffusion in water? Why? e) Sarah places a tea bag in a cup of water at room temperature. She notices some of the tea is diffusing out of the bag but very slowly. She uses a spoon to stir the water (without touching the tea bag), and the tea diffuses out of the tea bag more quickly. Explain why the tea diffuses out of the tea bag faster when the water is stirred. f) Why does pulse rate change after walking and running?	Sticky notes/paper chits

Additional Resources

https://energyeducation.ca/encyclopedia/Heat_vs_temperature#:~:text=Heat%20is%20a%20measure%20of,%2C%20or%20Rankine%20(R).

https://www.physicsclassroom.com/Class/thermalP/u18l1d.cfm

https://www.emsisd.com/cms/lib/TX21000533/Centricity/ModuleInstance/5507/Heat_is_different_from_temperature.pdf

https://www.middleschoolchemistry.com/lessonplans/chapter2/lesson1