Vision Empower & XRCVC

Teacher Instruction KIT

Heat

Syllabus: NCERT
Subject: Science
Grade: 7
Textbook Name: NCERT- Science Textbook for class VII
Chapter Number & Name: 4. Heat

1. OVERVIEW

1.1 OBJECTIVES AND PREREQUISITES

Objectives

- Concept of hot and cold - temperature
- Method and precautions while using a thermometer – clinical thermometer and laboratory thermometer.
- Transfer of heat in objects - conduction
- Conductors and insulators
- Transfer of heat in air and water - Convection

Prerequisite Concept

- Conductors and insulators
  Grade 6, chapter 12 Electricity and circuits
- Change in state of matter
  Grade 5, chapter 11 States of Matter

Content Index

*Kindly Note: Activities marked with * are mandatory*

Thermometer

Activity 3: Functioning of a thermometer

Conduction

Activity 4: Transfer of heat- conduction

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Convection of heat through air

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4.1 EXERCISES & REINFORCEMENT

Reinforcement

Activity 10: Conduction, convection and radiation

4.2 IMPORTANT GUIDELINES*

Exercise Reading

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2. LEARN

2.1 KEY POINTS

A reliable measure of the hotness of an object is its temperature. Temperature is measured by a device called a thermometer.

The thermometer that measures our body temperature is called a clinical thermometer. It consists of a long, narrow, uniform glass tube. It has a bulb at one end. This bulb contains mercury. Outside the bulb, a small shining thread of mercury can be seen.

The normal temperature of the human body is 37°C. Note that the temperature is stated with its unit.

The process by which heat is transferred from the hotter end to the colder end of an object is known as conduction.

The materials which allow heat to pass through them easily are conductors of heat. For example, aluminum, iron and copper. The materials which do not allow heat to pass through them easily are poor conductors of heat such as plastic and wood. Poor conductors are known as insulators. The water and air are poor conductors of heat.
In solids, generally, the heat is transferred by conduction. In liquids and gases the heat is transferred by convection. No medium is required for transfer of heat by radiation.

2.2 LEARN MORE
None

3. ENGAGE

3.1 INTEREST GENERATION ACTIVITY

Interest generation activity

Activity 1: Hot and cold objects

Materials Required: None

Prerequisite: None

Activity Flow:

- Ask the students to list some hot and cold objects in our environment.
    - Hot – tea/coffee, fire, frying pan from the stove, hot food from the stove, spoon in a hot vessels, hot iron
    - Cold – Ice, ice cream, cold drinks.
- How do you know which items are hot or cold?
    - By our sense of touch
- Is it safe to touch very hot items?

NOTE: Discuss the safety and precautions with regards touching a hot iron or flame or any other hot object if the student is unaware.

3.2 CONCEPT INTRODUCTION ACTIVITIES

Temperature

Activity 2: Concept of temperature and use of a thermometer

Materials Required: hot water, cold water, 3 containers (large)

Prerequisite: None

Activity Flow:

- The facilitator will ask the student to dip one hand in the container with hot water (container 1) and the other in the container with cold water (container 2) for 2-3 minutes.
- Ask the student about the feeling of hot and cold on dipping their hands

- Now dip both hands in the third container with the mix of hot and cold water(container 3)
- Ask the student whether both the hands get the same feeling on dipping in container 3.
- Relate the observations of hot and cold water to thermometer readings by explaining that hot water is at about 60 degree celsius whereas cold water is at about 20 degree celsius.
- INFERENCE: The hand dipped in container 2 implies the water is cold in container 3 whereas the hand dipped in container 1 implies the water is hot. We get different results with both hands however the water in container 3 is neither hot nor cold.
- With this example, explaining to the child that sense of touch cannot always be a reliable measure of deciding whether the substance is hot or cold.
- Introduce the concept of temperature and the use of a thermometer.

Thermometer

Activity 3: Functioning of a thermometer

Materials Required: clinical thermometer, laboratory thermometer and talking thermometer (if available)

Prerequisite: None

Activity Flow:

- The facilitator is to use the concept of touch and feel for the student to observe the thermometer and its parts.
- The facilitator will then explain the various precautions and reading procedures regarding the thermometer.
- Use the thermometer to teach the student how to take his/her temperature.
- Explain the readings orally and further introduce the concept of laboratory thermometers.
- And if a talking thermometer is available, that should be shown as well.

Conduction

Activity 4: Transfer of heat- conduction

Materials Required: cold water, hot water, 2 plastic bottles, iron or aluminum rod, two bricks, candle.

Prerequisite: None

Activity Flow:

- The following questions should be asked about the heat transfer in order to activate the preliminary knowledge of the students before the activity:
    - Why does a cup of hot tea cool after a while?
    - How do thick clothes that we wear in winter help maintain our body temperature?
- The facilitator will fill one bottle with hot water and the other with cold water
- Help the student to hold warm water with one hand and cold water with the other and feel it for 2 minutes.
- Discuss why one of the hands is getting cooler and the other warmer.
- INFERENCE: During the activity it is emphasized that heat is an energy transferred from the warm substance to the cold substance due to the temperature difference between them. As the bottle with hot water has higher temperature, the heat energy gets transferred to our hand which has a lower temperature and it feels warm. Similarly, while holding a bottle of cold water, the heat energy from our hands gets transferred to the bottle and our hand feels cold.
- Also explain the activity 4.6 (textbook activity) to the students:
    - Take an iron or aluminum rod or flat strip and fix a few pieces of wax at nearly equal distances from each other.
    - Have the student touch and note the wax pieces stuck along the length of the metal rod or strip.
    - Next, clamp the rod between the stand or in between two bricks.
    - Now place a candle on a stand at the end of the rod and have the student touch and observe the entire set up before you light the candle.
    - Ask the students if they can guess what would happen to the wax pieces if heated one end of the rod?
    - Would they begin to melt and fall?
    - Which wax pieces would fall first?
    - Tell the students to find out and confirm what happens?
    - Tell the student that they are going to light the candle and heat up one end of the rod and observe what happens.
    - Informing the student light the candle for the student.
    - Holding the student's hand and while informing him what they are doing guide the student's finger to touch the melted wax that has fallen in the table closest to the candle stand, then the next fallen melted wax, the next and so on.
    - Activity Discussion:
      Discuss with the student how in this case as well heat was transferred from the hottest end of the rod to the coldest end which caused each wax bit one after the other to melt.

Convection of heat in water

Activity 5: Convection of heat in water

Materials Required: deep vessel, gram/chickpeas, tactile diagram showing the direction of transfer of heat

Prerequisite: None

Activity Flow:

- To show the mechanism of heat getting transferred in boiling water.
- Present a deep vessel filled with gram / chickpeas to the student.
- Ask the student to dip his/her hands deep into the centre of the bowl, pull out the gram from the bottom of the vessel at the center and bring them to the top.
- Ask the students if they can feel and observe that as they pull the grams from the bottom to the top the vessel the grams from both sides slide/fall to the bottom to fill up the now vacant space.
- Let the students repeat this and try it out many times to understand what is happening.
- Discuss with the student that this is similar to what happens when they boil water. The water from the bottom of the vessel rises up and the water from the sides takes its place at the bottom, and that continues till the entire water is heated.
- Tell the student that this mode of heat transfer is called Convection.
- But obviously we cannot touch and see this happen in boiling water hence we used the analogy of the grams to understand what is actually happening in boiling water.

  Activity:
- The activity to view the convection in water by boiling water in a glass beaker or flask and placing a piece of potassium permanganate at the bottom of the flask to watch the colored portion of the water rise up and make way for the water from the sides to enter and so on; can be verbally described to the student.
- A tactile diagram with arrows showing the direction of the heat transfer in water can be shown to the students. Tell the student that we are now going to look more closely how heat travels in air.

Convection of heat through air

Activity 6: Convection of heat through air

Materials Required: candle, tactile diagram representing the flow of hot air and cold air above the sea and land.

Prerequisite: None

Activity Flow:

- Have the student place an unlit candle on a stand on a table.
- Tell the student and light the candle.
- Now informing the student what you are doing, hold and guide the student's right hand at a safe distance above the flame, and the student's left hand at a safe distance at the side of the flame.
- Ask the students if both hands feel equally hot or if one hand feels hotter.
- Tell the student that convection of heat in air takes place similar to in water. And in which direction was that?
- Discuss how conduction of heat through air takes place.
- Discuss about sea breeze and land breeze phenomenon as per the content.
- Tactile arrows can be shown to the student to represent the flow of hot air and cold air above the sea and land.

Radiation

Activity 7: Radiation

Materials Required: None

Prerequisite: None

Activity Flow:

- Ask the student how far is the sun from us?
- How does the heat from the sun that is so far away reach us?
- Could it be conduction or convection?
- Discuss some examples of radiation as listed below and explain what is radiation?
    - Using an umbrella when going out in the sun
    - Sitting in front of a room heater
    - A hot vessel left to cool down

Conductors and Insulators

Activity 8: Conductors and Insulators

Materials Required: glass, water, steel spoon, scale (plastic or wooden), wooden pencil

Prerequisite: None

Activity Flow:

- Heat water in a small pan and pour it in a glass.(Note: the water should not be excessively heated)
- Dip one end of a spoon, scale and pencil in water and wait for a few minutes
- Now take out these objects and feel the end dipped in water for every object
- Ask the student which objects feel hot.

- INFERENCE: Objects such as the spoon allow heat to pass easily through them and are called conductors. The materials that do not allow heat to pass easily through them such as the scale and wooden pencil are called insulators.

Difference in conduction with different colours and materials

Activity 9: Difference in conduction with different colours and materials

Materials Required: black cloth, white cloth, woolen cloth (as per availability), 2 containers, and black paint.

Prerequisite: None

Activity Flow:

- The facilitator is to take the student outside with exposure to the sun and place a white cloth on one hand of the child and a black cloth on the other.
- Ask the student which hand feels warmer. After getting a response, explain to the student that one of the cloth was black and the other white.
- Similarly place a woolen cloth on one hand and the plain white cloth on the other. Repeat the same exercise and ask for responses.
- INFERENCE: Light colours reflect most of the heat that falls on them and dark colour clothes absorb it. In the case of woolen clothes, wool is a poor conductor of heat and air is trapped within the woolen fibres. This air prevents the flow of heat from our body to the cooler surroundings.
- Similarly, explain the activity 4.10 (textbook activity)
    - Take two identical tin cans. Paint the outer surface of one black and of the other white. Pour equal amounts of water in each and leave them in the mid-day sun for about an hour. Measure the temperature of water in both the cans. Do you find any difference in the temperatures?
    - The can with black surface will have water warmer. You can feel the difference even by touching water in the two cans.

3.3 LET'S DISCUSS: RELATE TO DAILY LIFE*

- Pan becomes hot when kept on a flame – heat transfer from flame to pan
- Discuss with the student how heat gets from the sun to the earth.
- Cooling yourself with the fan as an example of convection.

4. EXERCISES & REINFORCEMENT

4.1 EXERCISES & REINFORCEMENT

Reinforcement

Activity 10: Conduction, convection and radiation

Materials Required: None

Prerequisite: Conduction, convection and radiation

Activity Flow

- Ask these two questions to the children and let them engage in the discussion:
  -What are some real-world examples of conduction, convection, and radiation?
  -How are conduction, convection and radiation similar and different?

4.2 IMPORTANT GUIDELINES*

Exercise Reading

It is very important that the children practice their learnings as well as their reading. Hence have the children read out the newly learned concepts from their textbooks or other available resources.

Perform Textbook Activity

It is good practice to have the children perform the textbook activities. Your textbook activities might not be accessible hence go through this resource to learn how to make textbook content accessible

Provide Homework

To evaluate their understanding and to help the student revise and implement the new learnt concept ensure to provide them with homework. Students should perform one or two of the questions mentioned above or from the textbook exercises with the teacher in Class and the remaining may be given for homework. Also, ensure that the student knows their special skills linked to independently using their accessible books as it will be critical to doing homework independently

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