CHAPTER: HEAT

Grade: **7**
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. Heat is being introduced to students for the first time. This chapter in grade 7 lays foundation for the stem of chemistry chapters in the middle years. In further grades it evolves into combustion, flame and fuel of grade 8.
2. This chapter introduces the terms like heat, temperature, conduction, convection, radiation. The chapter describe different standard unit of measurement of heat. It also explain modes of heat transfer through conduction, convection and radiation. The chapter then moves to the second segment where it define temperate and helps the learner to distinguish between heat and temperature. In this chapter different temperature scales have been identified and then they are compared with each other. The chapter ends with interconverting temperature between the scales. Clarity of these concepts will strengthen student's concepts for further learning in chemistry.
3. Since the central idea of the chapter is discussing in detail heat and temperature and interconverting temperature between the scales.

2.

LEARNING OUTCOMES

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

1. Define heat
2. State the standard unit of measurement of heat
3. Define temperature
4. Explain how to measure
5. Distinguish between heat and temperature
6. Identify different temperature scales
7. Compare the three temperature scales
8. Interconvert temperature between the scales
9. Classify thermometer into different types
10. Explain modes of heat transfer – conduction
11. Discuss modes of heat transfer – convection and radiation
12. State the applications of conduction, convection and radiation
13. Relate the kind of clothes we wear with weather condition

3. KEYWORDS

Definitions of some terms used in the chapter:

Thermal: related to heat

Joules: unit to measure heat

Temperature: degree of hotness or coldness of an object/body

Scale: something to describe with accuracy the proper measurement

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

Heat

1. Define heat
2. State the standard unit of measurement of heat

Teacher Activity

1. Take students to the ground.
2. Ask them to touch all the metallic objects that are found around them,
3. Tell students to share, how they feel?
4. Conclude by saying that we feel warm/hot as the object has gained energy from its surroundings. This is known as heat or thermal energy. Thermal energy is the energy produced by flow of heat. It always flow from object with high thermal energy to object with low thermal energy.
5. Ask students can they guess, how heat can be measured. Appreciate all responses.
6. Inform students that the SI unit of heat is joules and the CGS unit is erg.
7. 1 joule = 107 erg
8. Tell students that apart from this there are other units of heat, these are calorie or kilocalorie.
9. Ask students if they have heard about this unit before. If yes, where.
10. Conclude by showing wrapper of some packed food items where calories is mention. Tell students that here calories means amount of heat released when this food item is completely oxidized in presence of air inside our cell through respiration.

Check your Understanding

a. Name the different units of heat.
b. Convert 1 joule into erg.

Resources Suggested

Wrapper of packed food items

Subtopic and Learning Objective #2

Temperature

1. Define temperature
2. Explain how to measure temperature Distinguish between heat and temperature

Teacher Activity

1. Perform Activity 1 to know how to measure temperature.
2. Ask the volunteers do both the hand get the same feeling when dip in bucket C.
3. Prompt volunteers to think that the answer will be negative.
4. Conclude by saying that sometime our sense of touch unable to decide, so we need an accurate instrument/device to measure it.
5. Ask students can they guess, appreciate all responses and tell that it is thermometer.
6. Show a thermometer to the class.
7. Inform students that it was invented by Daniel Gabriel Fahrenheit.
8. Dip the thermometer in a bucket containing hot water. Before dipping show the level of mercury in the thermometer.
9. Instruct student to observe carefully the rise in temperature.
10. Conclude by saying that thermometer works on the principle that when a substance is heated, it expands. Thus rise is mercury is caused due to expansion by heating.

11. Remove the thermometer from the bucket, the mercury dips downs, tell students that when it is cooled it contract, so mercury fall.
12. Distinguish between heat and temperature.

Heat	Temperature
Heat is the amount of energy in a body	Measure of degree of hotness or coldness of an object
Flow from hotter to colder object	Rise when heated and falls when cooled
Unit joules	Unit kelvin
Device - calorimeter	Device – thermometer

Check your Understanding

a. Name 5 object that feel hot and 5 object that feel cold.
b. Name the device to measure heat and temperature.

Resources Suggested

Three buckets, hot water, cold water and luke warm water, Thermometer

Activity 1

Name of the activity – hot or cold
Type of activity – class
Use it for – measuring of temperature
Materials – Three bucket, hot water, cold water and luke warm water

Procedure –

1. Pour different water in different bucket.
2. Label them as A – hot water, B- cold water, C – luke warm water.
3. Call 3 student volunteers and ask them to dip their hand as instructed.
4. Dip your left hand in bucket A, right hand in bucket B.
5. After keeping the hands in two buckets for 2-3 minutes.
6. Now put both the hands simultaneously in bucket C.
7. Repeat steps 4-6 with rest of the two volunteers.

Subtopic and Learning Objective #3

Temperature scales

1. Identify different temperature scales
2. Compare the three temperature scales

Teacher Activity

1. Ask students to share based on their previous knowledge to name the device used to measure temperature and its unit.
2. Conclude by saying that the SI unit of temperature is kelvin (K), but degree Celsius is the most commonly used unit of measuring temperature.
3. Ask students to guess the name of different scales to measure temperature.
4. Inform students that the most commonly used temperature scales are Fahrenheit scale, Celsius scale and Kelvin scale.

Check for understanding:

a. What is the degree unit for each scale?
b. Who invented each scale?

Fahrenheit scale	Celsius scale	Kelvin scale
This scale was developed by Daniel Gabriel Fahrenheit.	This scale was developed by Anders Celsius.	It was designed by William Thomson (also known as Lord Kelvin
Upper fixed point is 212^0F – lower fixed point is 32^0F	Two fixed points are 0 and 100 degrees	
Degree unit =- ^{0}F	Degree unit – ^{0}C	Degree unit - K
Boiling point -212^0F, Freezing point -32^0F	Boiling point - 100 ^{0}C, Freezing point - 0^0C	Boiling point -373K, Freezing point – 273K
So each part corresponds to 1°F	Each part is equal to 1°C	

Resources Suggested

Textbook

Subtopic and Learning Objective #4

Interconversion

1. Interconvert temperature between the scales

Teacher Activity

1. Ask students can we do interconversion between the scales.
2. Appreciate all responses.
3. Conclude the activity by saying that turmeric is an indicator
4. Solve few problems related to interconversion.

From	To Kelvin	To Celsius	To Fahrenheit
Fahrenheit	{(F-32) ×59 } +273.15	(F-32) ×59	Nil
Celsius	C + 273.15	Nil	(c×95)+32
Kelvin	Nil	K – 273.15	{(K-273.15) 95} + 32

Check for understanding:

a. Convert boiling point of water in Celsius to Kelvin scale.
b. What is the formula to convert to convert Fahrenheit to kelvin and Celsius scale?

Resources Suggested

Textbook

Subtopic and Learning Objective #5

Thermometer

1. Classify thermometer into different types

Teacher Activity

1. Ask students when they have fever, which type of thermometer is used to measure their body heat.
2. Show all the three thermometer to them.
3. Students may come up with clinical and digital thermometer.
4. Ask students do they know the name of both these.
5. Introduce to them all the three types of thermometer.
6. Call a small group of student at a time and show them all the three thermometer.
7. Circulate the thermometers to rest of the groups and ask them to draw it. In case a thermometer is not available use pictures given in Resource 1
8. Discuss the features of all the thermometer to the group whom you are showing the thermometers.

9. Repeat instruct 7 and 9 with rest of the groups.
10. Once done, discuss with students to guess why we use mercury in the thermometer.
11. Conclude by saying that mercury is non – adhesive, shiny, low melting and boiling point. It expands equally.

Check for understanding:

a. Which thermometer do not use mercury?
b. How do we use a clinical thermometer to check body temperature?

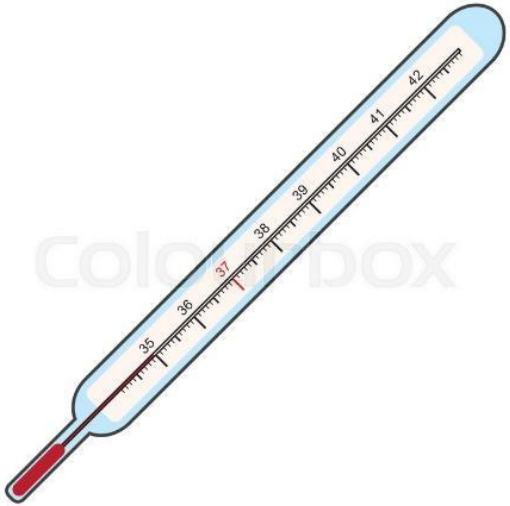
Resources Suggested

Clinical, laboratory and digital thermometer, Picture of all three thermometer or Resource 1

Resource 1



Laboratory thermometer



Clinical Thermometer



Digital thermometer:

Subtopic and Learning Objective #6

Heat transfer

1. Explain modes of heat transfer – conduction

Teacher Activity

1. Ask students to recall the instances when they have felt warm in their fingers even though they are not in direct contact with the fire or flame.
2. Appreciate all such responses.
3. Conclude by doing Activity 2 to demonstrate flow of heat.
4. Ask students to observe the demonstration carefully.
5. What happen after 10 minutes? Slowly the wax pieces start to melt and fall down.
6. Ask student that why did the wax melt and fall down. What make the wax to melt?
7. Conclude by saying that iron is a good conductor of heat as a result heat flow in the rod so the pieces of wax melts and fall down.

8. Ask students if they substitute the iron rod with rubber rod will same thing happen. Conclude by saying that no, as it is an insulator and so heat does not flow through them.
9. Inform students that the process by which heat is transfer from hotter end to cooler end is called conduction.
10. If time permit conduct Activity 3 or else do the step of the activity before and leave it undisturbed for 15 minutes.
11. Discuss that only conductor helps in conduction like steel spoon and divider, while plastic and wood are insulator so does not support conduction.

Check for understanding:

a. Define conduction.
b. Distinguish between conductors and insulators.

Resources Suggested

3 wax pieces, candle, thin iron plank or rod, match stick, tong, two bricks, steel spoon, plastic scale, pencil, divider, beaker, hot water

Activity 2

Name of the activity –melting of wax
Type of activity – class
Use it for – flow of heat
Materials – 3 wax pieces, candle, thin iron plank or rod, match stick, tong, two bricks

Procedure –

1. Hold the wax piece with tong and melt one side of it.
2. leaving some blank space fix the wax pieces till the other end.
3. Quickly fix the wax piece on the iron rod/plank.
4. Repeat step 2 with rest of the wax pieces.
5. Once all wax get fixed.
6. Keep the iron rod/plank in between the brick with wax pieces hanging down.
7. Lit the candle at the end which does not have wax.
8. Allow it to get heated for 10 minutes.

Activity 3

Name of the activity –which is hot?
Type of activity – class
Use it for – conduction
Materials – steel spoon, plastic scale, pencil, divider, beaker, hot water

Procedure –

1. Fill half of the beaker with boiling water.
2. Put all the things inside in it.
3. Leave it undisturbed for some time (10 - 15 minutes).
4. Call few student volunteers to come.
5. Ask them to feel each object.
6. Tell them to share their observation with rest of the class.

Subtopic and Learning Objective #7

Convection & Radiation

1. Discuss modes of heat transfer – convection and radiation

Teacher Activity

1. Perform Activity 4, to show the phenomenon of convection.
2. Ask students to observe it carefully.
3. Discuss the observation that when the hot water from the bottom get heated it rises up which is demonstrated by rise of colour wave inside the flask and the surrounding colorless water occupying it space.
4. Conclude by saying that it is convection where heat is transfer from a hot body to cold body by the movement of gas or liquid molecule.
5. Share with students that we sit near the campfire during winter because by convection the air gets heated and we can feel the warm.
6. Discuss radiation as the process by which we can feel the warmth of the sun. Share example of sitting in front of a room heater and feeling the warmth.

Check for understanding:

a. Distinguish between convection and radiation

Resources Suggested

Round bottom flask, match stick, candle, tripod stand, wire gauze, potassium permanganate tablet

Activity 4

Name of the activity – color swirl
Type of activity – class
Use it for – convection
Materials – round bottom flask, match stick, candle, tripod stand, wire gauze, potassium permanganate tablet

Procedure –

1. Fill half of the flask with water.
2. Place it over the tripod stand.
3. Put the potassium permanganate tablet into the flask.
4. Lit the candle below the flask and allow water to boil.

Subtopic and Learning Objective #8

Conduction, Convection & Radiation

1. State the applications of conduction, convection and radiation
2. Relate the kind of clothes we wear with weather condition

Teacher Activity

Note: colour one can black. Perform this activity 4-6 hour before the class begins, so that observations can be made during the science period.

1. Perform Activity 5 to demonstrate that black colour absorb more heat.
2. Conclude by discussing the result of the activity.
3. Tell students that the water in black can is much warmer than in other. Because dark colour absorb more heat than light colour.
4. Discuss application of conduction.
5. Ask students to share based on their prior knowledge the phenomenon of sea and land breeze.
6. Conclude by discussing in detail the phenomenon.
7. Ask student to share the types of clothes they like to wear during summer and winter.
8. Conclude by saying that we wear light colour clothes during summer while we wear woolen clothes during winter.

Check for understanding:

a. List three application of radiation.

Resources Suggested

Black colour, two cans, brush, water, thermometer

Activity 5

Name of the activity – Black O Black
Type of activity – class
Use it for – radiation
Materials – black colour, two cans, brush, water, thermometer

Procedure –

1. Paint one can black.
2. Pour water in both the can.
3. Keep it outside under the sun for 4-6 hours.
4. Insert a thermometer and measure the temperature.

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 the chapter is complete, homework

Answer the following questions in brief:

1. Distinguish between Celsius, kelvin and Fahrenheit scale.
2. List 5 applications of radiation
3. Why coastal regions have moderate temperature?
4. Why do we use mercury in the thermometer?
5. Write difference between heat and temperature.

Worksheet 2

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

Multiple choice questions:

1. In which of the thermometer mercury is not used?

a) Clinical thermometer
b) Digital thermometer
c) Laboratory thermometer
d) All of these

2. Which of the following statements is true?

Statement 1: Heat energy travels through vacuum also.
Statement 2: Thermal radiation is partly absorbed and partly reflected by the surface on which it falls

a. Both the statements are true.
b. Both the statements are false.
c. Only Statement 1 is true.
d. Only Statement 2 is true.

3. 10 Kcal = _____.
a. 10000 cal
b. 1000 cal
c. 103 cal
d. 105 cal

4. Which of the following is a NOT the application of convection?
a. Warming of nearby air by campfire
b. Sea breeze
c. Central heating of hotels
d. Radiation

5. The body temperature is 98.60F. Which of the following is correct?
a. 37°C
b. 303.15 K
c. 236K
d. 37°F

Worksheet 3

Choose the odd one out:

1. Radiation, reflection, conduction, convection
2. Clinical thermometer, laboratory thermometer, speedometer, digital thermometer
3. 0C, K, 0F, j
4. Copper, brick, plastics, rubber
5. J, cal, erg, cm

5. SOLUTIONS

This section gives you sample answers for questions in worksheets listed above.

Worksheet 1

1.

Fahrenheit scale	Celsius scale	Kelvin scale
This scale was developed by Daniel Gabriel Fahrenheit.	This scale was developed by Anders Celsius.	It was designed by William Thomson (also known as Lord Kelvin
Upper fixed point is 212^0F – lower fixed point is 32^0F	Two fixed points are 0 and 100 degrees	
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Boiling point -212^0F, Freezing point -32^0F	Boiling point - 100 ^{0}C, Freezing point - 0^0C	Boiling point -373K, Freezing point – 273K
So each part corresponds to 1°F	Each part is equal to 1°C	

2. Applications of radiation.
    a. Radiators of cars and air conditioners are painted black to radiate more heat and give cooling effect.
    b. The base of a cooking vessel is painted black so that it absorbs more heat and cooks the food in less time.
    c. Solar panels are covered with black sheet to enhance the absorption of solar radiation.
    d. Electric heaters are fitted with mirrors behind the heating coil to reflect the radiated heat in the forward direction, thereby, minimising the loss of heat.
    e. In hilly areas where the climate is mostly cold, the outer walls of the houses are painted dark to increase the absorption of heat received from the sun.
3. Coastal regions are surrounded by seas or ocean. The sea or ocean water takes much longer to heat as compared to land. It also takes more time to cool down. This give rise to convection currents flowing from sea towards land during day time and from land towards sea during night time. This is why coastal regions have a moderate temperature.

4. Mercury is used in thermometers for the following reasons:
   a. For every degree of rise in temperature, it expands equally.
   b. It is non-adhesive, that is, it does not stick to the walls of the thermometer.
   c. It is shiny and therefore, can be easily seen in the tube.
   d. It has very low melting point and very high boiling point, thereby making it ideal to measure a vast range of temperature.

5.

Heat	Temperature
Heat is the amount of energy in a body	Measure of degree of hotness or coldness of an object
Flow from hotter to colder object	Rise when heated and falls when cooled
Unit joules	Unit kelvin
Device - calorimeter	Device – thermometer

Worksheet 2

1. B- Digital thermometer
2. A– both Statement are correct
3. A - 10000 cal
4. D – radiation
5. A - 37°C

Worksheet 3

1. Reflection is associated with light, rest all are associated with heat transfer
2. Speedometer is used to measure speed, rest all are type of thermometer
3. J is the joule is the SI unit to measure heat
4. Copper is a good conductor rest all are insulator
5. Cm is the unit for length rest all are the unit to measure heat

6. EXTRA RESOURCES

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

1. **Video Links:**

a) Convection:
https://www.youtube.com/watch?v=xq1Q5DwfVNU

b) Application of convection:
https://www.youtube.com/watch?v=7MOW7TouBJ0

2. **Extension involving more concepts:**
Purpose: Link to age old methods
Find out natural methods by which you can keep your house warm or cold during winter and summer season.