ENGLISH MEDIUM

SCIENCE

GRADE 7

Heat and Temperature

UNIT 14

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Heat and Temperature

What is temperature

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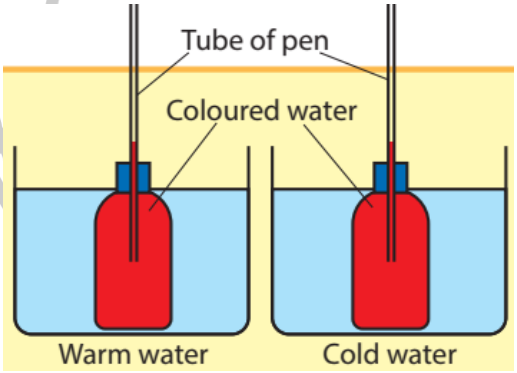
- Temperature of a substance decreases (cools) because of losing heat from that substance.
- We feel warm when a heated object is being touched, because heat transfers from that object to our hand. Coldness is felt when a piece of ice is touched, because heat transfers from our hand to the piece of ice.

Activity 14.2

Method

1. Fill the small glass bottles with coloured water and fix the empty tubes of ballpoint pens.
2. Place one bottle in a beaker filled with warm water.
3. Place the other bottle in a beaker filled with cold water.
4. Observe what happens (take care when using hot water).



Observations:

- The liquid column in the tube of the bottle kept in **warm water** rises up.
- The liquid column in the tube of the bottle kept in **cold water** falls down.

Explanation:

- Heat transfers from warm water in the beaker to the water in the bottle.
- The volume of water in the bottle increases and rises up along the tube.
- In cold water, the liquid cools and contracts, decreasing its volume.
- The liquid column in the tube of that bottle falls down.

Definition:

- Increase of the volume of a liquid by gaining heat is called the **expansion of the liquid**.
- This property of expansion is used in making thermometers.

Thermometers

Making a simple thermometer

- Fill a small glass bottle with coloured water.
- Fix the empty tube of a ballpoint pen into the bottle.
- Glue a paper strip (with a marked scale) to the tube.
- Dip the bottle into a beaker of water and heat slowly.

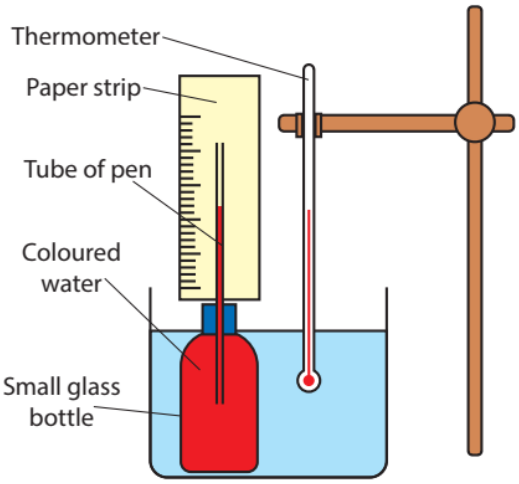


Figure 14.3

Observation

- As water is heated, the temperature rises → coloured water column in the tube goes up.
- Mark the upper end of the water column on the paper strip for each temperature reading.
- By marking several points, a simple scale is formed.

Use

- This "water-bottle thermometer" can measure unknown temperatures within a short range.
- It only gives approximate values.

Note

- Most thermometers today use mercury.
- Some use alcohol (coloured for easy observation).

Scales of Thermometers

Types of scales used:

- Celsius scale (°C)
- Fahrenheit scale (°F)
- Kelvin scale (K)

Units:

- Celsius → °C
- Fahrenheit → °F
- Kelvin → K (SI unit of temperature)

The equivalence between principal temperature scales

Temperature	Celsius scale (°C)	Farenheit scale (°F)	Kelvin scale (K)
Boiling point of water	100	212	373
Freezing point of water	0	32	273
Mean temperature of human body	36.9	98.4	309.9

Melting point

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Absorbing heat

Ice (solid) → Water (liquid)

Activity 14.3

Method

1. Put some ice pieces into the glass funnel.
2. Place the bulb of the thermometer in the ice.
3. Keep the funnel on the beaker.
4. Find the temperature of melting ice.

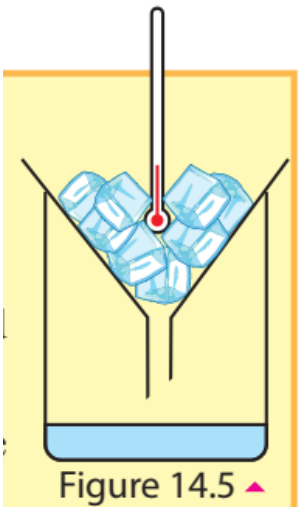

Figure 14.5

Observation

- The temperature at which ice melts is **0 °C**.
- This constant temperature is called the **melting point of ice**.

Melting points of some substances are given in Table

Substance	Melting point (°C) at 1 atm
Ice	0
Paraffin wax	60
Lead	317
Iron	1539

Boiling point

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Activity 14.4

Method

1. Take some water into a boiling tube and set up the apparatus as shown in the figure.
2. Heat the water for a few minutes until it boils.
3. Record the reading of the thermometer.

Observation

- The temperature at which water boils (with bubbles and steam) is **100 °C**.
- This is the exact temperature of **boiling water**.

Boiling point of some substances

Substance	Boiling point (°C) at 1 atm
Alcohol	77
Paraffin wax	370
Water	100
Lead	1744
Iron	2900

Using thermometer correctly

1. Thermometer should be held vertically. So, that the bulb of the thermometer is well in contact with the substance / liquid of which the temperature should be measured.
2. When taking the readings the thermometer should be adjusted to the eye level.
3. Eye should be kept in line with the mercury column when reading the thermometer.
4. Observing from above or below the column gives an incorrect reading.

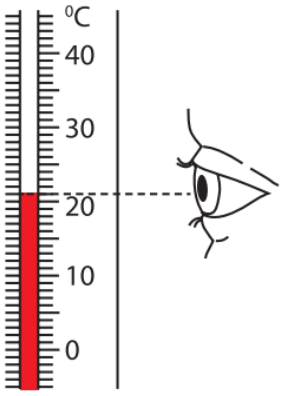

Figure 14.7

For the protection of the thermometer, it should be selected in such a way that the measuring temperature should be within the temperature range of that thermometer.

Soil temperature can be measured by the soil thermometer, in the natural environment

Clinical Thermometer

Special features of a clinical thermometer

- There is a fine bend in the capillary tube containing mercury.
- The temperature range is short (35 °C – 43 °C).
- Clinical thermometer is used to measure the body temperature.

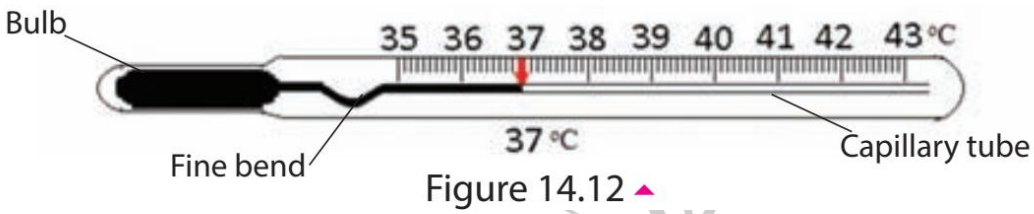

Figure 14.12

Measuring body temperature by using clinical thermometer

- First wash the bulb of the thermometer with an antiseptic solution.
- Keep the bulb of the thermometer under the tongue of the patient for about two minutes as shown in Figure 14.13.
- Remove the thermometer from the mouth and take the reading accurately while holding it vertically.

Note

- Body temperature of small babies can be measured by keeping the bulb of the thermometer under their armpits for a few minutes.

- The clinical thermometer has a **fine bend** in the capillary tube.
- This bend prevents the mercury column from rising or falling before taking measurements.
- As a result, the reading remains **unchanged** even after the thermometer is removed from the patient's mouth.
- Before reusing, the thermometer should be **shaken well** to send the mercury column down the bend.

EXTRA KNOWLEDGE

• Body temperature of a healthy person is 36.9°C or 98.4 °F
• New types of thermometers are invented for measuring body temperature accurately.

Heat transfer

- Heat is a type of **energy**.
- The **sun** is the largest heat source.
- Solar heat reaches Earth quickly, even though the sun is millions of kilometres away.
- We feel warm near a fire even from a few metres away.
- Touching a hot object (e.g., cup of tea) can burn the hand.

Definition

- Travelling of heat from one place to another is called **heat transfer**.

Methods of Heat Transfer

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Conduction

This method of transferring heat from particle to paricle without the motion of particles through a solid, is known as conduction of heat

Activity 14.8

Method

1. Fix pins on the metal rod at 2 cm intervals using candle wax (as shown in Figure 14.19).
2. Heat one end of the rod using a candle.
3. Record your observations after some time.

Observation

- Pins drop gradually, starting from the heated end.
- This happens because the wax melts as heat travels through the rod.
- Heat is transferred through **particles of the rod**, from one particle to another.

Conclusion

- Heat transfer in solids occurs by **conduction**.

- Most of the metals conduct heat well. They are known as heat conductors.
  e.g.:- Iron, Copper, Aluminium, Gold, Silver

- Substances that do not conduct heat well are known as heat insulators.
  e.g.:- glass, wood, plastic, cloth, air, water

People living in cold countries use woolen clothes to maintain their body temperature (in winter). As woolen clothes are good heat insulators, they prevent losing body heat to the environment

Convection

- Twigs of trees above a large fire wave due to hot air movement.
- **Heated air** near the fire rises upward.
- **Cool air** flows downwards towards the fire.
- Rising heated air currents are called **convectional currents**.
- When these currents strike twigs of trees, they wave.

Activity 14.9

Method

1. Cut the cardboard to the shape shown in the figure.
2. Place the cardboard in the middle of the beaker to divide it into two chambers.
3. Place a lighted candle in side B of the beaker.
4. Light some joss sticks and hold them at the mouth of side A of the beaker.
5. Observe what happens.
6. Blow out the candle and hold the joss sticks in side A again.
7. Observe what happens.

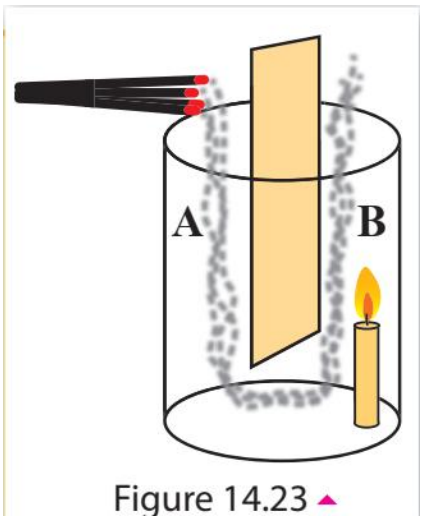

Figure 14.23

Observation

- Smoke of joss sticks enters the beaker from side A and comes out from side B.
- Heated air rises in chamber B (with the candle).
- Cool air flows into chamber A, carrying the smoke along with it.
- This shows that heat travels through air as **convectional currents**.

Activity 14.10

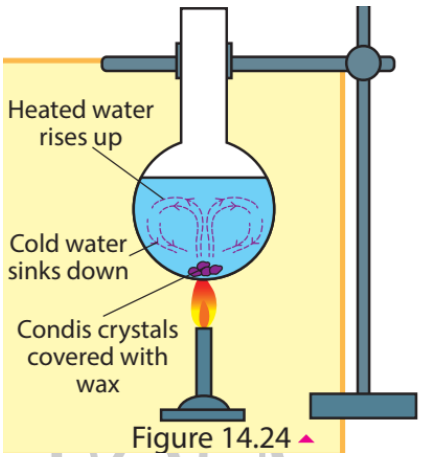

Figure 14.24

Method

1. Place condis crystals at the bottom of the flask and cover them with wax.
2. Pour water into the flask and heat it.
3. Observe what happens.

Observation

- Purple colour from condis crystals rises as currents in water.
- The colour sinks down near the wall of the flask.
- Water at the bottom heats up → density decreases → rises.
- Cold water at the top sinks down → higher density.

Conclusion

- Rising heated water currents and sinking cold water currents are **convectional currents**.
- Water in the flask heats because of these convectional currents.

Application of convectional currents

Occuring of sea breeze and land breeze

Sea breeze

Wind that blows from the sea towards the land is known as sea breeze. Sea breeze occurs in day time.

During day time land area heats faster than the sea water because of the solar heat. This cause the layer of air contacted with the land to heat and rise up as convectional currents. To fill the low pressure area created on the land, air currents flow from the sea towards the land. This is known as sea breeze.

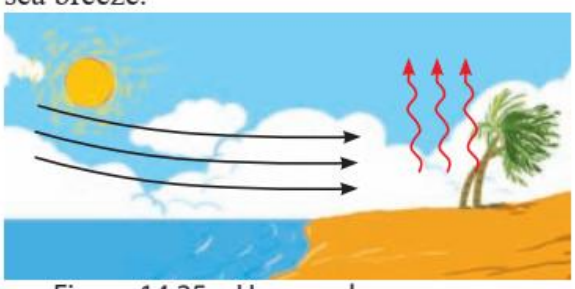
Figure 14.25 ▲ How sea breeze occurs

Land breeze

Wind that blows from land towards the sea is known as land breeze. Land breeze occurs at night.

During night time the temperature of land area decreases faster than the sea water. Therefore, land area cools faster. Because of the high temperature of sea water, the layers of air contacted with sea water get heated and rise up as convectional currents. To fill the low pressure area created on the sea, air currents flow from the land towards the sea. This is known as land breeze.


Figure 14.26 ▲ How land breeze occurs

It is with the support of the land breeze that fishermen launch their sail boats to the sea in the night time. They return back to the shore in day time with the support of sea breeze.

Radiation

Definition

- Heat transfer **without the participation of a medium's particles** is called **radiation**.
- Example: Heat from the **sun to the earth**.

Examples

- Feeling warm near a fire.
- Heated objects radiate heat.

IMPORTANT

- Black surfaces absorb and lose heat quickly.
- Shiny polished surfaces absorb and lose heat slowly (can keep hot water warm longer).
- In hot countries (e.g., Sri Lanka), **light colours** are better for painting house exteriors as they absorb less radiation.

Key Idea

- **Radiation depends on surface colour and texture.**

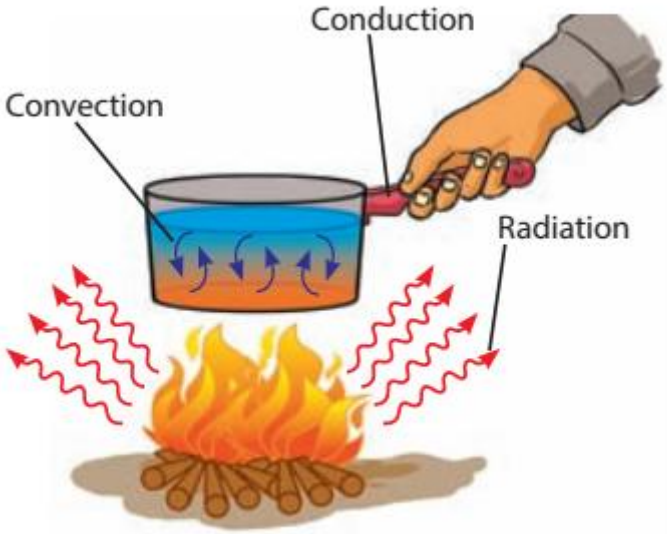

Figure 14.29 ▲ Methods of heat transfer