9. Heat

Observe and discuss.

What are the causes of what you see happening in the pictures below? Write in the boxes.

6CVVVN

9.1 Various events

Try this.

Rub your palms against each other and put them on your cheeks. What do you feel?

We come to know some properties of heat energy from the examples in the pictures and the above activity. The sun's heat has many effects and uses. How does the solar heat reach the earth? Why does the heat in the water heated to boiling slowly decrease once it is taken off the flame? Where does this heat go? The moisture in the air cools down due to the ice cubes in the glass and collects on the outside of the glass. A thermometer is used to measure the temperature of a substance. We have already studied the changes in the state of matter, caused by heat.

Transfer of heat

Can you tell ?

1. Why does the *halwai* wrap up cloth around the end of his slotted spoon while stirring the boiling milk in his large *kadhai*?
2. Why do we hold a steel glass in a handkerchief while drinking hot milk from it?

What are other examples of this kind? Make a note of them.

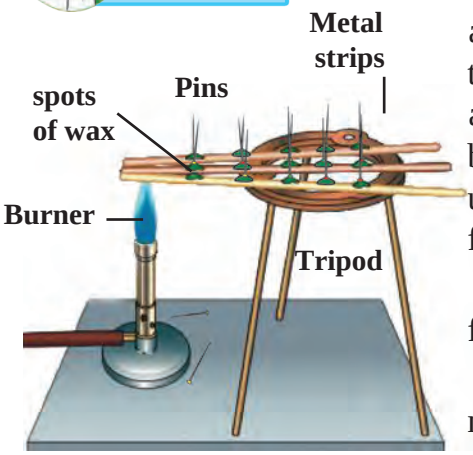
When we take a hot object in the vicinity of a cold one, the cold object becomes warm and the hot one becomes cooler. From this, we can infer that heat is transferred from a hot body to a cold body.

Transfer of heat means the flow of heat from one place to another.

Use your brain power!

Why do we wear woollen clothes in winter?

Try this.



9.2 Conduction of heat

Apparatus : Bars of stainless steel, aluminium and copper, a candle, a burner, pins, etc.

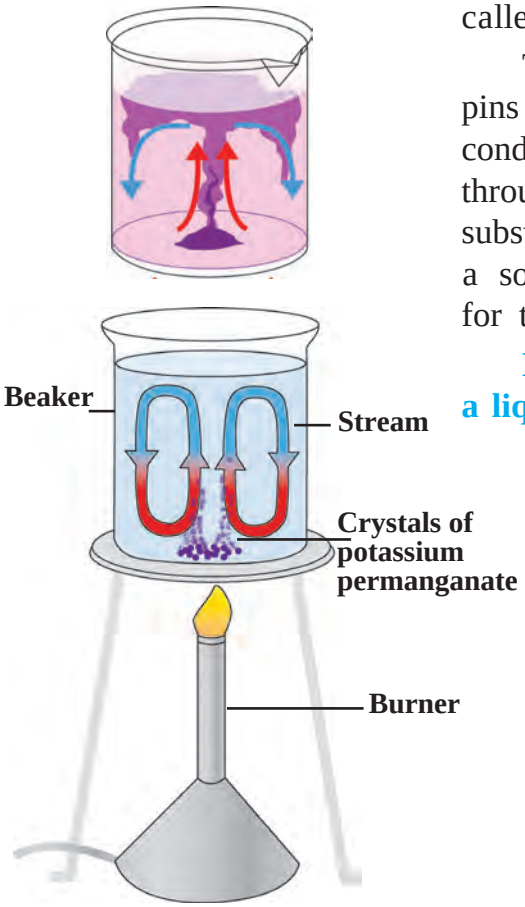
Procedure : Take stainless steel (or iron), copper and aluminium bars, each about 30 cm long and having the same shape. Apply wax spots with the help of candle at a distances of 2 cm from each other on all the three bars. Stick a pin in each of these spots so that it is upright. Now insert the ends of all three bars into a flame at the same time. Observe for a while.

What do you see? From which bar do the pins start falling first? Why?

Pins fall starting from the end near the burner. It means that transfer of heat takes place from the hot end of the bar to the cold end. This transfer of heat from the hot part of an object to the cold part, is called **conduction** of heat.

The pins on the copper bar start falling first. The pins on the steel bar fall comparatively late. Heat is conducted quickly through copper. Conduction of heat through a substance depends on the property of that substance. That conduction of heat takes place through a solid substance, shows that a medium is required for the conduction of heat.

How does the transfer of heat take place through a liquid?



9.3 Convection of heat

Apparatus : a beaker, potassium permanganate crystals, a burner, water, etc.

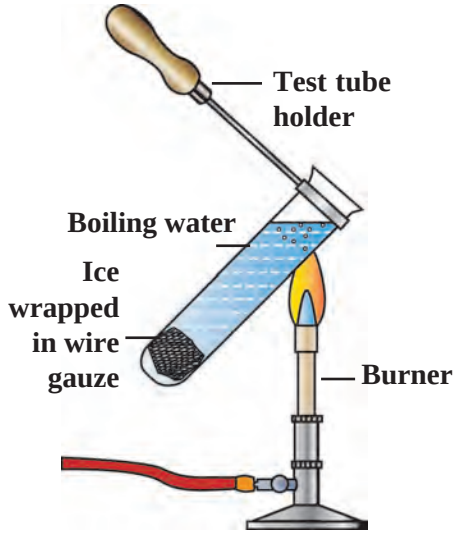
Procedure : Take some water in a beaker. Heat the beaker slowly on a gas burner. Drop a few crystals of potassium permanganate into the water. Now watch the water in the beaker carefully. What do you see?

You will see streams of water going upwards and coming back to the bottom. Due to the potassium permanganate, these magenta coloured streams can be identified easily. When heating begins, the water near the bottom becomes warm and its density decreases. As a result, it moves upwards and is replaced by cold water coming from above. In this manner, heat is transferred by means of currents, called convection currents.This process is called **convection of heat**.

Convection can occur in liquid and gaseous substances. Convection needs a medium.

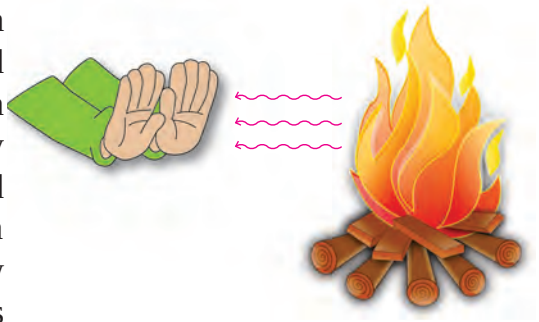
Apparatus : a test tube, a piece of ice, wire gauze, a burner, a candle, etc.

Procedure : Take some water in a test tube. Wrap a piece of ice in a wire gauze and drop it in the test tube. It will sink to the bottom. Now, using a test tube holder, hold the test tube at a slant, as shown in the figure. Heat the upper part of test tube. Stop heating when the water starts boiling. Observe the piece of ice at the bottom. The heat does not reach the bottom even though the upper part is heated. How does this happen? The density of water decreases due to heating. Therefore, it cannot sink and the process of convection does not occur.



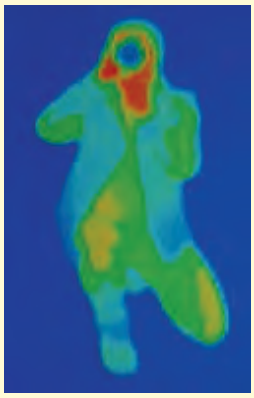
9.4 The relation between density and convection

Procedure : Light a candle and stand it upright. Hold your hands on its two sides at some distance from the candle. Bring them closer. What do you feel? Have you warmed yourself near a bonfire or in the morning sun in winter? The sun is millions of kilometres away from us. There is no air between the sun and the earth and the earth's atmosphere is only a thin layer of air close to the earth. Then, how does the heat of the sun reach us? This heat is transferred in the absence of any medium. The transfer of heat that takes place in this way, without a medium, is called radiation. In the two examples above, heat reaches us mainly by **radiation**.



9.5 Radiation

A wonder of science : Radiation of heat takes place from many objects in nature such as trees, mountains, stones and roads. A camera has been developed which uses these radiations to make our surroundings visible at night. It is called an infrared camera. Using this camera, it is possible to keep a watch on the movements of the enemy during the night.



When heat rays fall on an object, a part of the heat is absorbed by the object and a part of it is reflected. The ability of a substance to absorb heat radiation depends on its colour and also its intrinsic properties.

Let's try this.

Apparatus : Two aluminium tins of the same size, two small glasses, water, thermometers, black paint, etc.

Procedure : Paint the outer surface of one tin with black paint, and let it dry. Then in both tins, place one glass, each filled with water at the same temperature. Cover the tins with lids. Keep them in the sun for two hours. Now measure the temperature of the water in the glasses in the two tins. What is the reason for the difference in the temperature?

Good and bad conductors of heat

Place a steel spoon, a copper strip or rod, a divider from your compass box, a pencil and a plastic ruler in a glass beaker. Pour hot water (heated upto 60^0-70^0C) into the beaker. Wait for a while. Then touch the outer end of each of the objects. Record your observations in the table below.

Object	How hot is the outer end? (very hot, hot, warm, as cool as the atmosphere)

What inference will you draw from this?

Some substances are good conductors of heat while some are bad conductors of heat. Heat is easily conducted through a copper strip or pot, but not through plastic or wood.

We can hold a glass tumbler or china cup full of hot tea easily in our hand, but not so a steel or copper cup if the same tea is poured into them.

Use your brain power!

Why do we use white clothes in summer and dark or black clothes in winter?

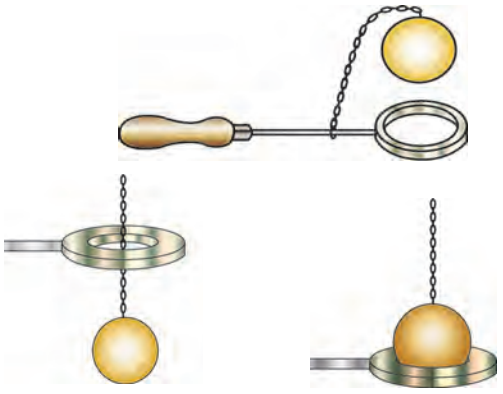
Expansion and contraction of a solid substance due to heat

Let's try this.

Apparatus : a metal ring, a metal ball, a burner, etc.

Activity : Take a metal ring and metal ball of such size that the ball just passes through the ring. Heat the ball and check whether it passes through the ring. Now let the ball cool down, and check whether it passes through the ring.

The above experiment tells us that metals expand on heating and contract on cooling. Solids expand due to heat and come back to the original state if heat is removed. However, the extent to which different solids expand is different.



9.6 Expansion and contraction of a solid substance

Use your brain power!

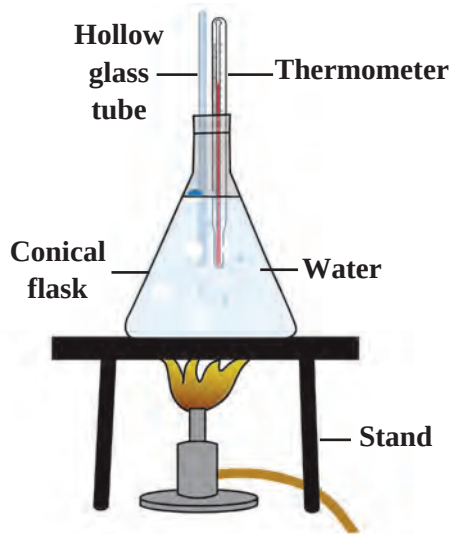
Why is there a gap at the joints of rails and of cement concrete bridges?

Expansion and contraction of liquids due to heat

Apparatus : 500 ml conical flask, two-holed rubber stopper, glass tube, measuring ruler, thermometer, stand, wire gauze, burner, graph paper, etc.

Procedure : Fill the conical flask completely with water. Insert the glass tube and the thermometer in the two holes of the stopper and fit it to the conical flask. Heat the water and with the help of the ruler, record the water level in the glass tube after every 2°C rise in temperature. Take about 10 readings. Observe what happens when heating is stopped. Draw a graph to show the change in water level as the temperature rises.

When a liquid is heated the distances between its particles increase and its volume too increases. This is called the expansion of liquids. When its temperature falls, the liquid contracts.



9.7 Expansion and contraction of a liquid

Use your brain power!

Why is mercury or alcohol used in a thermometer?

Expansion and contraction of gases due to heat

Apparatus : Glass bottle, balloon, hot water, etc.

Procedure : Fix a balloon on the mouth of a glass bottle. Hold this bottle in hot water. What happens?

The volume of a gas increases on heating. This is called expansion of the gas. On the other hand on removing heat, the volume of the gas decreases. This is called contraction of the gas.

Thermos flask (Dewar Flask)

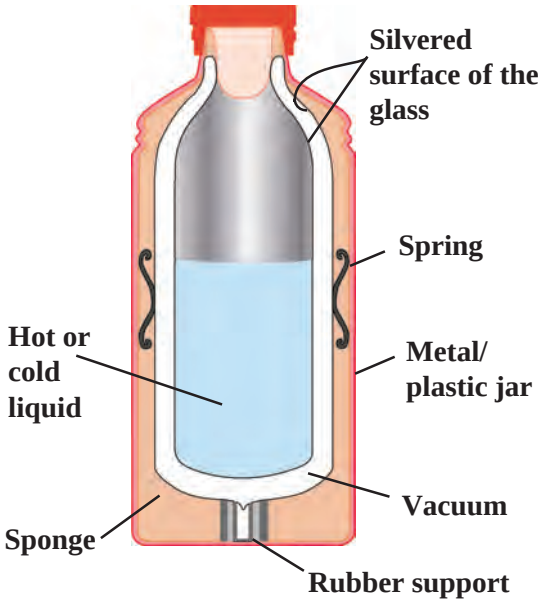
You might have seen a thermos flask used for keeping tea, coffee, milk, etc. hot or a sherbet cold for a long time. What is its structure and how does it function?

This is a double-walled flask. Its consists of two glass tubes, one inside the other with the gap between them sealed. The surfaces of both the tubes are made shiny by a silver coating. The air between the two tubes is removed to create a vacuum. There is a protective jar of metal or plastic outside the tubes. For the protection of the flask, pieces of sponge or rubber are fixed between the outer jar and the flask.

Great Scientists

Sir James Dewar was a Scottish scientist. He made the first thermos flask in 1892. That is why it is called Dewar flask. Even today, a Dewar flask is used for keeping a substance cold or hot.

Function of the thermos flask : When a hot substance is placed in a thermos flask, the heat going out gets reflected due to the shining surface of the inner tube. Hence, heat is not radiated. Neither conduction nor convection of the heat occurs because of the vacuum. As a result, heat is not transferred to the outer cooler region and is retained inside for a long time. Still, a little heat is lost from around the lid and by a small amount of conduction through the glass. Therefore, the hot substance does not remain as hot after two or three hours.



9.8 Thermos flask

Find out. What is meant by thermoware?

Exercise

1. Fill in the blanks with the proper word from the brackets.

(radiation, white, conduction, blue, convection, bad conductor, good conductor, black, reflection)

(a) Maximum heat is absorbed by a …….. coloured object.

(b) …… of heat does not require a medium.

(c) Conduction of heat takes place through a ……. substance.

(d) The shining surface in a thermos flask decreases the outgoing heat by ..... .

(e) Cooking utensils are made from metals due to their property of …….

(f) The earth receives heat from the sun by ..... .

2. What will absorb heat?

Steel spoon, wooden board, glass vessel, iron griddle (*tava*), glass, wooden spoon, plastic plate, soil, water, wax

3. Write answers to the following questions.

(a) How does a fever get lowered by putting a cold compress on the forehead of a patient?

(b) Why are the houses in Rajasthan painted white?

(c) What are the modes of heat transfer?

(d) Explain which mode of heat transfer causes sea breezes and land breezes.

(e) Why is the outer coat of the penguins of Antarctica black?

(f) Why are heaters fitted near the floor and air conditioners, near the ceiling of a room?

4. Give scientific reasons.

(a) An ordinary glass bottle cracks when boiling water is poured into it, but a borosil glass bottle does not.

(b) The telephone wires which sag in summer become straight in winter.

(c) Dew drops form on the grass, in winter.

(d) In winter, why does an iron pillar feel colder than a wooden pole?

Project :

Make a note of the various examples of heat transfer seen in day-to-day life.

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