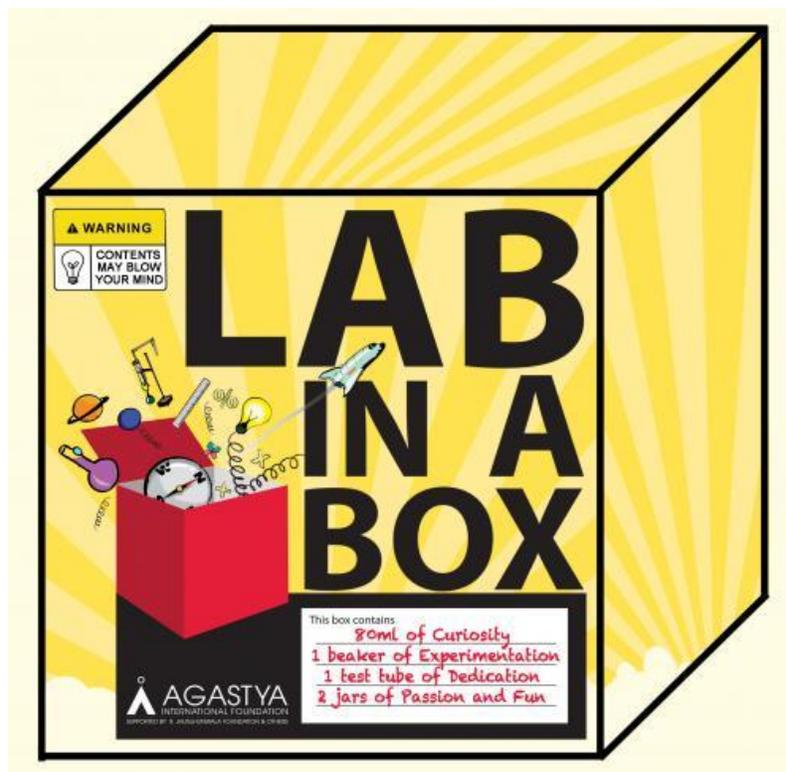


A . HEAT

B . SOUND



Inventory

Sl. No.	Description	Quantity
Glass wares		
1	Flat bottomed conical flask	1
2	Glass beaker	2
3	glass tube	2
4	Plastic beaker	1
5	Spirit lamp	2
6	Test tube	4
Models		
7	Radiometer	1
8	Sound reflection model	1
9	Sound needs medium for propagation – bell gar model	1
10	Slinky spring	1
11	Ring and ball model	1
Equipment's		
12	china dish	2
13	wire mesh	2
14	one holed rubber cork	2
15	rubber pad	1
16	test tube holder	2
17	Test tube cork	2
18	tuning fork set	1
19	Tripod stand	2
20	Thermometer.	1
21	Convex lens	1
Consumables		
22	balloon pkt	1
23	chalk piece	3
24	cooking oil	150 ml
25	cycle spoke	1
26	Ink bottle	1
27	Ink filler	1
28	Ink refill	2
29	match box	1
30	pin box	1
31	Scissors	4

32	spirit bottle	1
33	Straw pkt	1
34	A ₄ – size sheets	10
35	thread bundle	1
36	wax bottle	1
37		2

Index

Sl. No.	Topic	Experiment/ activity	Page
	A. Heat		
1		Introduction	5
1.1		Difference between heat and temperature	7
1.2		Effects of heat	9
1.2.1		Change in temperature	9
1.2.2		Change in size of substance on heating	11
1.2.3		Change in state of matter	15
1.3		Heat Transfer	17
1.3.1		Heat transfer in solids	18
1.3.2		Heat transfer in liquid	19
1.3.3		Heat transfer in gas	20
1.4		Radiometer	21
1.5		Principal of calorimetry	23
1.6		Specific heat of water and oil	24
1.7		Demonstration of specific heat of solids	25
	B. Sound		
2		Sound Produce	26
2.1		Sound needs medium for propagation	27
2.2		Pitch and frequency	28
2.3		How sound reaches our ear	30
2.4		Reflection of sound	32
3	C. Do it yourself		
3.1		Sound of a ball	33
3.2		Paper tub	34
3.3		Sun is a source of heat energy	35

A. HEAT

1.INTRODUCTION

Often, heat and temperature are used to mean the same thing. However, there is a subtle difference. Although the temperature of the sparks in a sparkle exceeds 2000°C , the heat they impart when striking our skin is very small. This illustrates that temperature and heat are different entities.



- **Temperature**

The temperature of a body indicates how hot or cold that body is. The temperature of a material is a measure of the average translational kinetic energy of the molecules of that material.

- **Heat**

The total translational kinetic energy of the molecules in that material is called heat. Heat is the energy in transfer. It is the only form of energy that can be transferred from one body to the other and it is measured in Joules.

- **Thermometers.**

It is an instrument used to measure the degree of hotness of the body .Two thermometers in use are discussed below

1. Celsius thermometer:

This thermometer has a scale range 0°C to 110°C or more. 0°C corresponds to melting temperature of ice and 100°C corresponds to the boiling temperature of water at sea level.

2. Fahrenheit thermometer:

This thermometer has a scale range from 32°F to 212°F . Here 32°F is the melting point of ice and 212°F is the boiling point of water at sea level.

A 100°C range temperature on Celsius scale is equal to 180°F temperature range on Fahrenheit heat scale.

$$180^{\circ}\text{F} = 100^{\circ}\text{C}$$

$$1^{\circ}\text{F} = \frac{5}{9}^{\circ}\text{C} \quad \text{or} \quad 1^{\circ}\text{C} = \frac{9}{5}^{\circ}\text{F}$$

1. Conversion of °C to °F

$$t^{\circ}\text{C} \times 9/5 + 32 = t^{\circ}\text{F}$$

$$(t^{\circ}\text{F} - 32) \times 5/9 = t^{\circ}\text{C}$$

1.1 Difference between heat and temperature

Aim

To understand difference between heat and temperature

Materials

Beaker-3, ink bottle, ink filler, water.

Procedure

Let us assume the quantity of ink as heat and intensity of color as temperature.



Case – 1

Take equal amounts of water in three beakers. Add equal quantities of ink to the water in each beaker and observe the intensity of color.

Observation

It is same in all beakers.

Inference

If you add same quantity of heat to equal mass of water in to three beakers of equal mass and of same substance, the rise in temperature is also equal.

Case – 2

Take equal amounts of water in three beakers. Add two, four and six drops of ink in 1st, 2nd and 3rd beaker respectively. What happens?

Observation

The intensity of colour increases as the quantity of the ink added increases.



Inference

Adding more heat leads to a larger increase in temperature.

Case – 3

Take 100 ml of water in one beaker and 600 ml of water in another beaker. Add two drops of ink to 1st beaker and four drops to the 2nd beaker. Observe the color.



Observation

Intensity of color (temperature) in the 1st beaker (100 ml of water) is more than that in the 2nd beaker (600ml of water), though the quantity of ink (heat) added is more in the 2nd beaker.

Inference

This is because the average amount of ink per ml of water is less in the 2nd beaker as compared to that in the first beaker.

You may replace ink with hot water and perform the experiments to confirm your observations.

Note: To measure the temperature of hot water, use thermometers in the box. And also you can explain the types of thermometer.

1.2 Effects of heat

1.2.1 Change in Temperature

Aim

To understand what happens when we heat the substance

Materials required

Glass beaker, water, tripod stand, wire mesh, spirit lamp and match box

Procedure



Step 1

Take around 150 ml of water in a beaker.

Step 2

Keep the thermometer in water and measure the temperature.

Step 3

Heat the beaker containing water for five minutes with the spirit lamp.

Step 4

Measure its temperature again. Note down the temperatures measured.

Step 5

Take about 150 ml of oil in a beaker and heat it like water for 5 min and record its temperature

Observation

Temperature of water increases on heating.

Temperature of oil also increases but increase in temperature of oil is more than the increase in temperature of water though they are heated at same time.

Inference

When a substance is heated, its temperature increases. The rise in temperature is different for different material though they are heated under identical conditions. The rise in temperature depends on the heat supplied, the mass and its nature.

Note: addition of heat produces a rise in temperature in all the three states of matter.

1.2.2 Change in size of substance on heating

Aim

To see whether substances change size on getting heated

Materials

Ring and ball, water, test tube, ink refill, flat bottomed conical flask, tripod stand, test tube holder, wire mesh, one holed rubber cork, balloon packet, glass tube and match box.

Case 1:

Procedure

Step 1

Take a metal ball and pass it through the metal ring. Did it pass through the ring?



Step 2

Take the ball out and heat it for about 3 minutes using spirit lamp.

Step 3

Now try passing the ball through the metal ring. Did it go through?

Observation

The metal ball that passed through the ring earlier did not pass through after heating. When a solid is heated the molecules gain thermal energy and vibrate with larger amplitude. This causes an increase in volume. For a rod we can notice an increase in length, for a plate we can notice an increase in area and for a metal ball we can notice an increase in volume, when heated.

Inference:

Solids expand on heating.

Case 2:

Procedure

Step 1

Take coloured water in a test tube. And fill completely

Step 2

Insert an empty refill of ball-point pen in its rubber lid.

Step 3

Observe the water level in the refill.

Step 4

Heat the test tube with a spirit lamp.

What happens?

Observation

Water level rises in refill.

Inference

Liquids expand on heating. When a liquid is heated the molecules absorb the thermal energy and gain more freedom to move about. As a result the volume increases and results in the rise in the water level in the refill.



Case 3:



Normal Water



Cold Water



Hot Water

Procedure

Step 1

Tie a balloon to the mouth of the plastic bottle.

Step 2

Place the bottle in water and observe.

Step 3

Place the bottle in hot water and observe.

Step 4

Place the bottle in cold water and observe.

Observation and Explanation:

The balloon gets inflated when bottle is kept in hot water and gets deflated when kept in cold water. When kept in hot water bath the air molecules inside gain thermal energy and move with larger speeds. They exert a larger force on the inner wall of the balloon which expands. There is thus an increase in the volume of air.

Inference

Gas expands on heating and contracts on cooling.

Additional activity

- ⊗ If a group of people are just standing still, they can stay close together. They don't take up much space.
- ⊗ But if the people start to dance, then they take up more space-the group expands.
- ⊗ In the same way, if a substance is heated, the molecules start moving and take up more space so that the substance expands.
- ⊗ But, the molecules themselves do not get any bigger



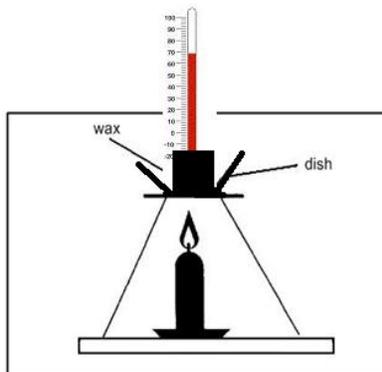
1.2.3 Change in state of matter

Aim:

To understand changes in state of matter

Materials:

China dish, spirit lamp, wax, tripod stand, match box and wire mesh.



Procedure

Step 1

Take a small amount of wax in the China dish.

Step 2

Place the China dish on a tripod stand as in figure. Insert a thermometer amidst the wax pieces

Step 3

Heat it gently with the spirit lamp. Observe the wax.

Observation and explanation.

Wax changes from solid to liquid. When it transforms into liquid the temperature does not change because all the heat absorbed is utilized to break the bonds between the molecules of the solids. When all the molecular bonding is broken the solid has completely transformed into a liquid.

Inference

On heating, a material changes from one state to another at certain temperature.

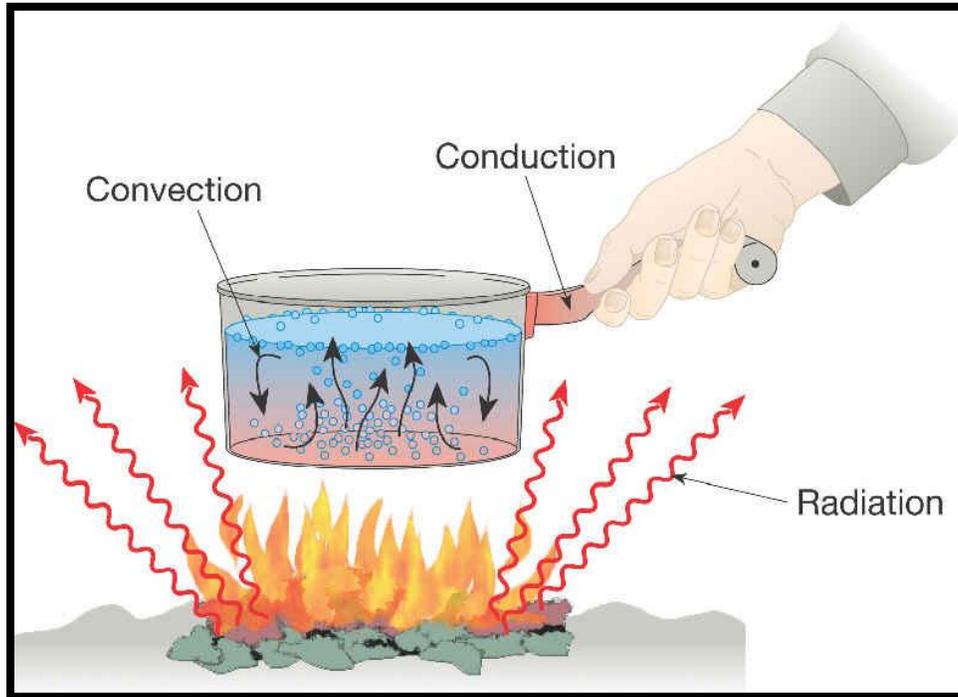
When solid wax changes to liquid the process is called melting. The temperature at which melting takes place is called melting point.

Daily life example

Ice cube on heating becomes water. Water on heating becomes steam.

1.3 Heat transfer

There are three ways in which heat is transferred.- convection ,conduction and radiation.



Conduction: It is a process by which heat is transported from hotter to colder regions with the help of the particles of the intervening medium. the particles simply vibrate about their positions and transfer energy without being permanently displaced

Convection: It is a process by which heat is transported from hotter to colder regions with the help of the particles of the intervening medium. On gaining energy the particles are permanently displaced

Radiation: It is the process in which heat is given out by a hot body to its surroundings in the form of the electromagnetic radiations. This radiation does not require any medium for propagation.

1.3.1 Heat transfer in solids

Aim

To understand mode of heat transfer in solids – conduction.

Materials

Cycle spoke (insulated at one end), wax, pins and spirit lamp

Procedure

Step 1

Take the cycle spoke and attach pins to it using wax as shown here.



Step 2

Heat one end of the cycle spoke for sufficient time.

What do you observe?

Observation and Explanation:

Pins fall one after the other. The first pin to fall is close to the flame. That flows from hot end to cold end the temperature decreases from hot end to cold end gradually heat is transferred from hotter part to the colder part along the metal without the actual movement of particles of the medium. This process is called conduction. It is predominant in solids.

Inference:

Heat flows through solids due to conduction.

1.3.2 Heat transfer in liquid - convection

Aim

To understand the phenomenon of heat transfer in liquid - convection

Materials required

Chalk pieces, water, and beaker

Procedure

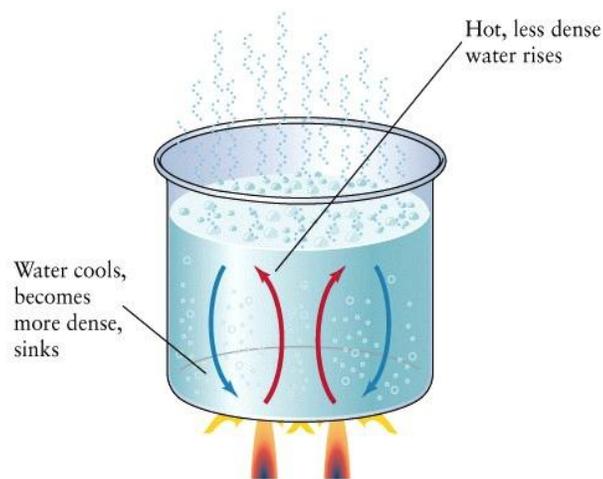
Step 1

Put chalk dust into the beaker containing water.

Step 2

Keep the beaker on a tripod stand and heat it with a spirit lamp for sufficient time.

Observe what happens?



Observation and explanation

The chalk particles start moving from bottom to top. When heated water at the bottom absorbs heat energy. The hotter water molecules become less dense and raise upward the colder water being more dense moves to the bottom where it is heated again and rises. The process repeats and the water in the beaker gets heated throughout.

Inference

Warm water rises up pushing the chalk particles and cold water being heavier moves to the bottom, where it gets heated and the process repeats. This process is called convection.

1.3.3 Heat transfer in gas- convection

Aim

To demonstrate that hot air moves up

Materials

Paper, Candle, Scissors and Thread

Procedure

Step 1

Draw a spiral on a paper. Cut the paper along the spiral line. Separate out the spiral paper.

Step 2

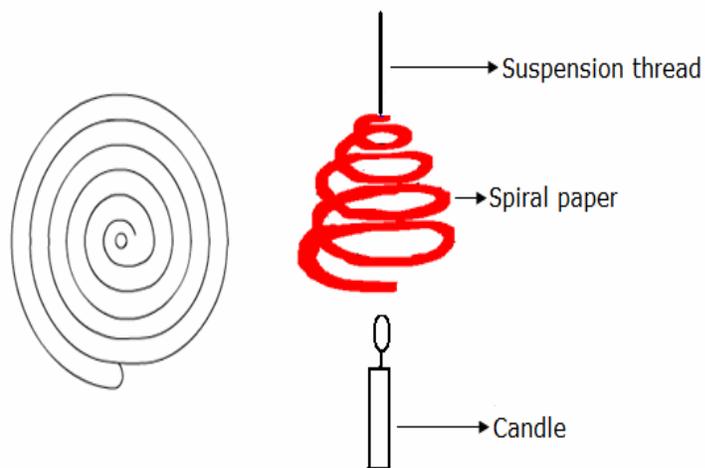
Tie a string to the center of the spiral paper and suspend it above the candle.

Step 3

Light the candle. Hold the spiral paper at a sufficient height above the candle flame.

Step 4

Bring down the paper above the candle flame to a safe height such that the paper does not burn. See what happens.



Observations

The hot air rotates the spiral paper continuously as long as it is held over the flame. It is observed that hot air passes through the spiral groove in the upward direction making the spiral to rotate.

Inference

When air is heated, it becomes lighter and moves upwards. This upward movement of hot air molecules leads to a convection current of air. Liquids and gases transfer heat by convection.

1.4 Radiometer

This process is illustrated very well in nature. The heat from the sun is being radiated in the form of electromagnetic radiation in all the directions. In space it travels through several kilometers of empty space and reaches the earth causing thermal change. It is the property of every hot body to radiate heat in the form of electromagnetic energy to its surroundings.

Aim

To demonstrate the working of a radiometer

Materials

A radiometer

Procedure

Step 1

Keep the radiometer in sunlight and observe the movement of the vanes.

Step 2

Then remove it from sunlight and observe the movement of the vanes.



Observation

When the radiometer is exposed to sunlight, the vanes start rotating with shiny side forward and black side trailing. Initially, it starts gaining speed but after sometime, it slows down and almost comes to a standstill.

Inference

When radiometer is exposed to sunlight, the darker side absorbs more radiation than the shiny side. As a result, the temperature of the black side and consequently the air molecules near it get heated up. The air molecules vibrate vigorously and collide with the vane. On the other hand, the brighter side of the vane gets heated to a lesser degree and the air near that is cooler than the air on the other side. Cooler air molecules exert less pressure on the brighter side. Thus the vane starts rotating with the shiny side forward and black side trailing. This functions only in

partial vacuum. If the vacuum is of a high order, sufficient air molecules are not available to cause the vanes to rotate.

Energy from the sun reaches us after travelling through space at the speed of light. When this energy hits an object, some of it is absorbed. This makes the molecules vibrate more and so the object becomes hot. The transfer of heat by this process is known as radiation.

1.5 Principle of calorimetry

Aim

To understand the Principle of calorimetry. It states that when two bodies at different temperatures are brought in contact the hot body loses heat and the cold body gains the heat till both attain common temperature.

Materials

Metal ball, water, match box and spirit lamp

Procedure

Step 1

Take about 100 ml of water in a beaker and measure its temperature. Note it down.

Step 2

Take 200 ml of water in another beaker and place the metal ball in it.

Step 3

Place a thermometer in the water.

Step 4

Heat the water in the beaker with the spirit lamp till the temperature of the thermometer reads around 80 to 90⁰ C. Note down this temperature.

Step 5

Remove the metal ball and quickly transfer it into the beaker containing 100 ml of water. Measure the temperature of mixture, keep stirring water slowly.

Observation and explanation

Temperature of cold water increases, reaches a steady value and then decreases. Water has gained the heat from hot metal ball. Temperature gradually increases. Hot ball loses heat and water gains heat. This continues till both water and ball attain same temperature. (Thereafter both lose heat to the surroundings by radiation)

Inference: we thus observe that hot body loses heat and cold body gains heat when brought in contact. Heat loss by hot body is equal to the heat gained by cold body.

1.6 Specific heat of water and oil

The specific heat is the amount of heat required to raise the temperature of a substance of mass 1 kg through 1 degree Celsius (1 Kelvin). Smaller value of specific heat means – it can be heated quickly.

$$Q = cm\Delta T$$

heat added specific heat mass change in temperature

$\Delta T \propto 1/C$ when m is same

Aim

Comparing the specific heat of oil and water

Materials

Beaker, water, oil, two-thermometers, tripod stand, wire mesh, match box, aluminum vessel and spirit lamp .

Procedure

Step 1

Take two test tubes containing equal amount of water and oil.

Step 2

Place thermometers in them.

Step 3

Place the test tubes in a beaker containing water. Measure initial temperature and note it down.

Step 3

Heat water in beaker with the spirit lamp. Note down the temperatures in both the test tubes after about 5 minutes.

What do you observe?

Observation

Raise in temperature of oil is more than the raise in temperature of water.

Inference: Specific heat of oil is less than the specific heat of water.

1.7. Determination of Specific heat of a solid

Materials: metal ball, test tube, beaker, water in a vessel, spirit lamp, spring balance and match box.

Procedure:

- With the help of the spring balance find the mass of dry and empty test tube(w_1)
- fill 2/3 test tube with water and find the mass again (w_2)
- Insert a thermometer into the water in a test tube and note down the temperature (t_1)
- Find the mass of the given solid metal ball(w_3)
- Put the metal ball in to water in the beaker and start heating
- When the temperature is around 90° C, record the temperature and transfer the metal ball in to the water in the test tube.(t_2)
- Observe the temperature in the test tube and record the highest temperature of the mixture(t_3)
- C_g - Specific heat of Glass
- C_l – specific heat of water
-

Result

Calculate the specific heat of material of the ball using the formula

$$W_3 \times C_m \times (t_2 - t_3) = W_1 \times C_g \times (t_3 - t_1) + (W_2 - W_1) \times C_l \times (t_3 - t_1)$$

$$C_m = \frac{W_1 \times C_g \times (t_3 - t_1) + (W_2 - W_1) \times C_l \times (t_3 - t_1)}{W_3 \times (t_2 - t_3)}$$

Unit of the specific heat $\text{j/kg}^{\circ}\text{C}$

B. Sound

2. Production of sound

Sound is a form of energy. It is produced by the bodies in vibration and it requires a medium for propagation. It can travel through solids, liquids and gases. It has a velocity of about 340 m/s in air at room temperature. It moves faster in liquids and very much faster in solids. It travels as a wave. It is characterized by its wave length and frequency.

Aim

To understand how sound is produced

Materials

Plastic balls (small size), tuning fork, rubber pad and thread

Procedure

Step 1

Take the tuning fork and hit it on a rubber pad.

Step 2

Hold the tuning fork near your ear. Do you hear any sound?

Step 3

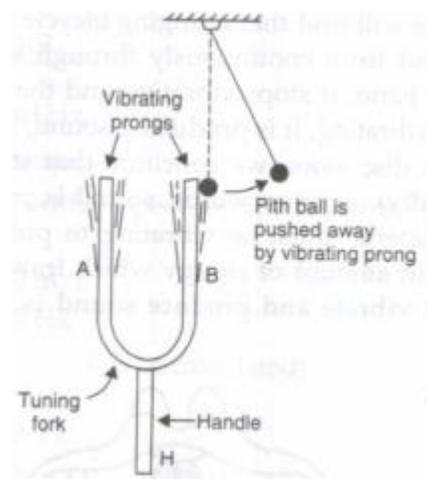
Can you see that the ends are vibrating?

Step 4

Suspend a plastic ball to a stand with the help of thread.

Step 5

Hold the vibrating tuning fork such that it touches suspended ball. What happens?



Observation

Plastic ball is pushed out from equilibrium position.

Inference

This experiment shows that sound is caused by vibrations.

2.1 Sound needs medium for propagation

Aim

To demonstrate that sound needs a medium for propagation

Materials

Electric bell Model

Procedure

Step 1

Suspend the electric bell inside the jar. Place the jar on the disc of a vacuum pump assembly. Pass the current.

What happens?

Step 2

Then gradually evacuate the air from inside the jar by operating the vacuum pump.

What happens?

Step 3

Now allow air into the jar.

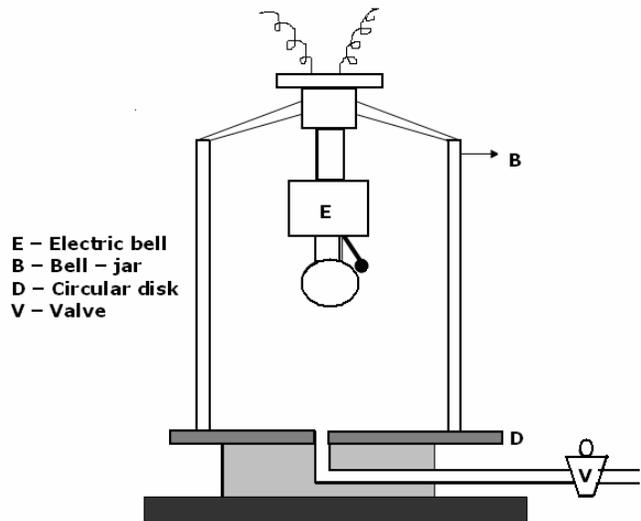
What happens?

Observation

The intensity of the sound decreases when air is gradually removed.

The sound cannot be heard when the bell jar is almost evacuated, even though you see the bell is still ringing.

When air is allowed into the jar, we hear the sound again.



Inference

A medium is required for the propagation of sound. When the air is removed from the jar, there is no medium to transfer the sound waves from the bell.

2.2 Pitch and frequency

Aim

To demonstrate sound production, its pitch and intensity

Materials

Straw, pair of scissors and funnel

Procedure

Step 1

Keep one end of the straw in your mouth and blow air.

Step 2

Flatten out one end of the straw, and cut this end into a V shape. Keep the other end in your mouth. Suck in air through it.

Step 3

Keep the pointed end in your mouth and blow air.

Step 4

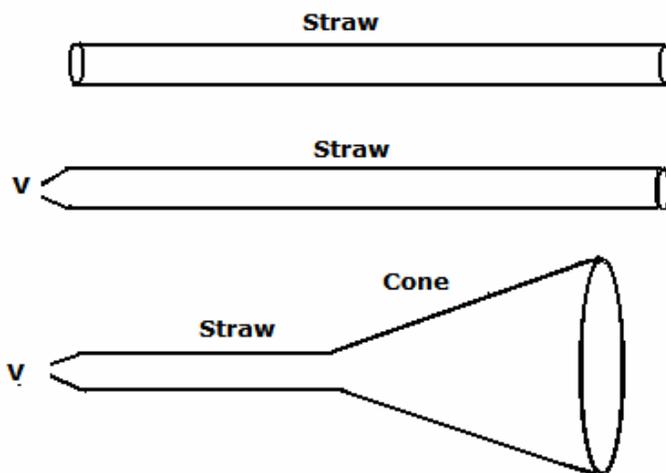
Keep blowing air and at the same time, cut the straw from the other end, bit by bit, 3 or 4 times.

Step 5

Take a funnel and insert the straw pipe in to other end of the funnel. Keep the pointed end in your mouth and blow air. Observe the change in sound at each stage.

Observation

1. In the first case, no sound is heard.
2. In the second case, sound is produced and the flaps at the pointed end vibrate.
3. Sound is also produced in the third case.
4. In the fourth case, the pitch of the sound is increased as the length of the straw is decreased.
5. In fifth case, the intensity of the sound is increased.



Inference

When we blow air, the flaps at the pointed end vibrate to generate sound. This supplies the energy necessary to maintain the vibrations in the air column inside the straw. When the length of the straw is more, sound of low pitch (grave sound) is produced. When the length of the straw is decreased, the length of vibrating air column is also decreased. So, sound of high pitch (shrill sound) is produced. When the cone is attached, it concentrates the sound in a desired direction. Therefore, the intensity of the sound is increased. Pitch is a quality of sound, which depends on the frequency of its source.

Inference:

Pitch and frequency depends on length of vibrating air column.

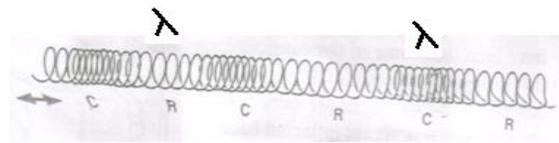
2.3 propagation of sound in air

Aim

To demonstrate how sound reaches our ear

Materials

Slinky spring



Procedure

Step 1

Take a slinky spring.

Step 2

Stretch it along a smooth surface of table.

Step 3

Vibrate one end to and fro along the length of the spring to send longitudinal waves down the spring.

Observation

If you look closely at the spring you see that, at any instant, some parts of the spring are pushed closer together (compression) while some parts are pulled farther apart (rarefaction).

Inference

Sound wave travels in air in a similar manner. In some places, the molecules of air are pushed together at slightly higher pressure (compression) and in some places molecules are farther apart at slightly lower pressure (rarefaction) These compressions and rarefactions produced alternately travel across the room to your ear. The “Wavelength” of sound wave is the distance between two successive compressions or rarefactions.

2.4 Reflection of sound

Aim

To demonstrate reflection of sound

Materials

Sound reflection model

Procedure

Step 1

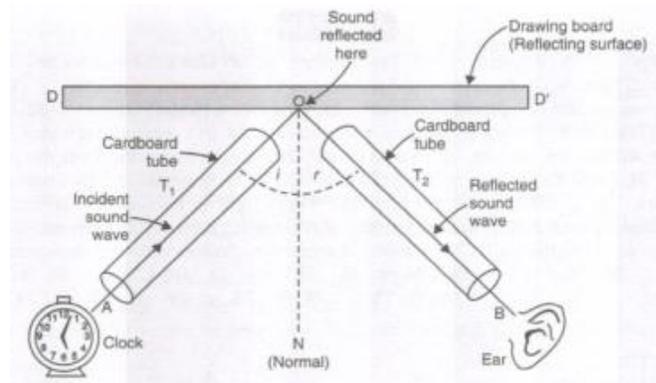
Keep a stop clock at the end of one tube as shown in the figure and try to hear its sound through the tube which is kept at the other side of the normal.

Step 2

You adjust the position of this tube such that you hear the sound made by the stop clock.

Step 3

Now measure the angles between the normal and position of each tube. What do you observe?



Observation

Both the angles are same.

Inference

We know that in optics, angle of incidence is equal to angle of reflection. In a similar manner, sound waves also follow laws of reflection.

C. Do it yourself

3.1 Sound of a Ball

Materials required

Thin string or thread, fork, knife, spoon

Procedure

Step 1

It is quite easy to make a very effective carillon from ordinary cutlery.

Step 2

Hang a knife, a fork and a spoon on a string or thread. Press the ends of the string against your ears with your fingers.

Step 3

Shake your head once OK twice-as though you were saying 'No'. The knife, fork, and spoon strike against each other and begin to vibrate. The vibrations are transmitted along the string to your ears, whereupon you find that the sound is very like a loudly chiming carillon. Your carillon will sound purer if you get somebody to strike the metal objects with a pencil. Of course you can enlarge the carillon with several more forks, spoons and knives of different sizes.

3.2 Paper tub

Materials required

Paper trough, Spirit lamp and Tripod stand

Procedure

Step 1

Fill the paper-trough with water and place it on the tripod stand.

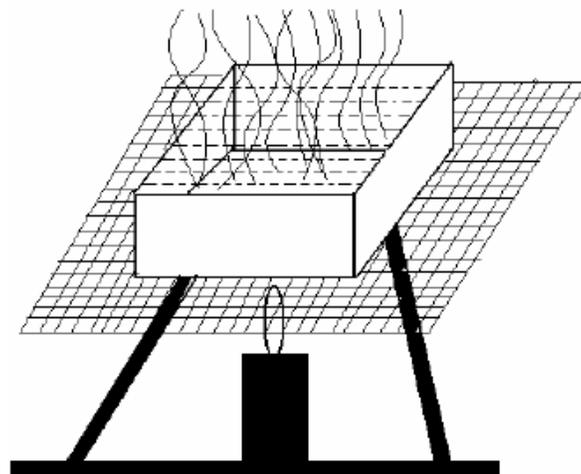
Step 2

Heat the paper trough with the spirit lamp.
Wait till water starts boiling.

Step 3

Remove the spirit lamp. Touch the paper to feel its temperature.

The paper trough does not catch fire as the water in the paper cup absorbs the heat supplied by the spirit lamp through the paper. The paper is thin enough for the heat to pass through it. The temperature of the paper does not become high enough to catch fire.



3.3 Sun is a source of heat energy

Materials Required

Paper, magnifying lens

Procedure

Step 1

Take the students outside the classroom.

Step 2

Hold the magnifying glass such that it is facing the sun.

Step 3

Move a piece of paper back and forth on the other side to get a sharp bright spot on the paper.

Step 4

Hold the paper for some time in the same position and observe.

The paper is at the focal point of the lens. All the rays passing through the lens after refraction converge at the focal point. The energy density of radiation is greatest at the focal point. Due to this, paper starts to burn. This proves that the sun is a source of heat energy.

