THEME 6

NATURAL PHENOMENA

ACTIVITY 47

What we have to do?

Study how shadows are formed.

What do we need?

A torch (source of light), a circular piece of wood, a sheet of butter paper/tracing paper, a transparent glass sheet/cellophane sheet and a white screen(any white sheet can also be used as a screen).

How do we proceed?

1. Take the circular piece of wood.
2. Place a screen on one side of the wooden piece or position the wooden piece in front of a wall.
3. Throw light on the wooden piece with the help of a torch. The surface of the wooden piece must be parallel to the surface of the screen/wall (Fig. 47.1).

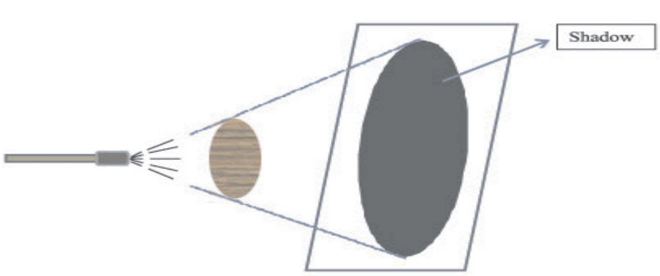


Figure 47.1

4. What do you find on the screen?
   (i) Do you see a dark patch?
   (ii) Is the light from the torch reaching on every part of the screen?
   (iii) If not then on which area is the light getting blocked and what is blocking the light?
   (iv) Is there any shape being formed on the screen?
5. Now switch off the light. Can you still see the dark patch on the screen?
6. Now switch on the torch but remove the screen.
7. Do you still see the dark patch on the screen?
8. Repeat the above steps, first using a sheet of tracing paper and then a transparent glass sheet in place of the wooden disc and record your observations.
9. Compare the observations made by you in all the three cases.

WHAT DO WE OBSERVE

- When the light is thrown on the wooden piece with a screen behind it, whole of the screen does not light up.
- The circular wooden piece is blocking the light from falling on a certain area on the screen, hence forming a dark circular patch on the screen.
- If the torch is switched off the dark patch disappears provided there is no other light in the room.
- If the screen is removed no dark patch is seen.
- When a tracing paper is used a hazy patch is formed.
- When a transparent glass sheet is used in place of the wooden block, no clear patch can be obtained on the screen (Fig. 47.2).

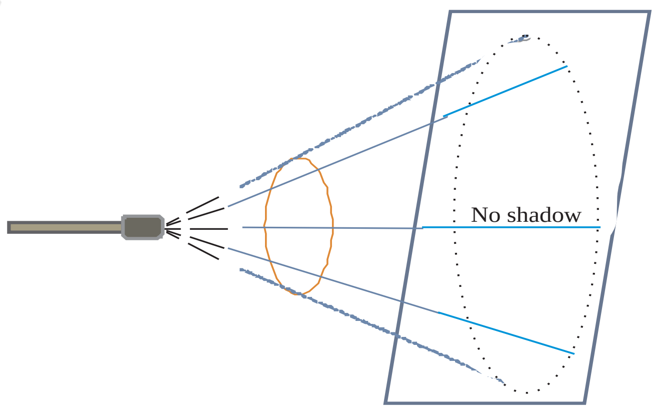


Figure 47.2
A Shadow formed by a transparent object.

What do we conclude?

- The dark circular patch formed on the screen is because the wooden disc is blocking light in that circular region. This region is called a shadow.
- The essential requirements for obtaining a shadow are a source of light, an opaque object and the presence of a screen.
- A transparent glass sheet allows most of the light to pass through it hence no clear shadow is formed.

Let us answer

1 When the screen is removed no shadow is seen. Does the absence of shadow imply that the light is not being blocked by the wooden piece.

2 What will happen to the size of the shadow when
   (i) the torch is moved closer to the wooden piece without changing the distance between the wooden piece and the screen,
   (ii) the torch is moved away from the wooden piece without changing the distance between the wooden piece and the screen, and
   (iii) when the wooden piece is moved closer to the screen or the wooden piece is moved away from the screen, keeping the distance between the torch and the wooden piece constant?

3 Why can't we see the shadow of a bird flying high in the sky?

4 Suppose there is a lot of dust on the piece of transparent glass. Will a shadow be formed on a screen when light falls on it? Explain.

5 Can the shadow of a circular object be of any other shape than that of a circle? Give example to explain your answer.

What more can we do?

- Opaque objects form dark shadows. Use opaque objects of different colours to cast shadows. Does the shadow formed have any colour?
- When we stand in the Sun we get our shadow in the direction opposite to that of the Sun. Do we also get shadows when we stand in the shade of a tree? Discuss.

- Develop a script/story. Make cutouts of the characters and narrate the story through shadow puppets.

  Are eclipses or transits of Venus also shadows? Make a report on eclipses or transits by collecting data.

Note for the teacher

- This activity can be done in pairs or groups of four children each. The teacher should encourage students to observe keenly, respond to every question, and record observations individually.
- Encourage them also to discuss their observations. The teacher may facilitate the discussion and help the students to arrive at the desired results.
- The teacher may explain that eclipses are the shadows of the moon on the earth (Solar Eclipse) or of the earth on the moon (Lunar Eclipse). Also explain what happens during transit of Venus. She can also explain why we do not see transit of Saturn or Jupiter.

Notes

ACTIVITY 48

What we have to do?

Show that air exerts pressure.

What do we need?

Plastic bottle, hot and cold water.

How do we proceed?

1. Take a soft plastic bottle.
2. Fill it half with hot water.
3. Empty it and immediately cap the bottle tightly.
4. Now pour ice cold water over this bottle.
5. What do you observe?

What do we observe?

The plastic bottle gets deformed when cold water is poured over it (Fig.48.1).

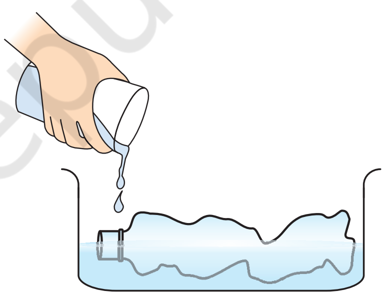


Figure 48.1

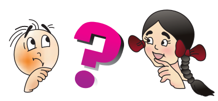
What do we conclude?

When we fill the bottle with hot water and empty it, the air inside the bottle becomes hot. When cold water is poured over it, this hot air becomes cold and pressure inside the bottle decreases. The pressure of air outside being higher, crushes the bottle.

Let us answer

1. In the above activity, if the bottle is not capped immediately after the hot water is emptied, will the same effect be seen? Explain.
2. Mention two more examples which show that air exerts pressure.

3. A plastic bottle filled half with water is placed inside a refrigerator for an hour. When it is taken out it is observed that the bottle is slightly deformed. When left outside the refrigerator for a few minutes the bottle recovers its shape. Explain.



What more can we do?

Encourage children to perform some activity which shows that the boiling point of water depends on air pressure.

Suggested Activity:

Take a conical flask and fill it half with water. Boil this water. Once the water starts boiling, remove the conical flask from the heat and cap it tightly. Once the boiling stops, pour some cold water on the conical flask. What do you observe?

Note for the teacher

- Any activity involving heating must be done in your presence or in the presence of an elder person.
- Used cans of soft drinks can also be used to demonstrate that air exerts pressure. The metallic can need to be heated for doing this activity.
- Students must be encouraged to cite many examples showing the presence of air pressure.
- Use good quality conical flask for the suggested activity.
- When cold water is poured over the flask containing hot water, some steam gets condensed and the pressure inside decreases. At lower pressure, water boils at lower temperature. If the temperature of water is still higher than its decreased boiling point, the water will start boiling again.

ACTIVITY 49

WHAT WE HAVE TO DO?

Observe that air expands on heating.

WHAT DO WE NEED?

Two plastic mugs, an empty plastic bottle (1/2 litre or 200 mL), a balloon, cold and hot water.

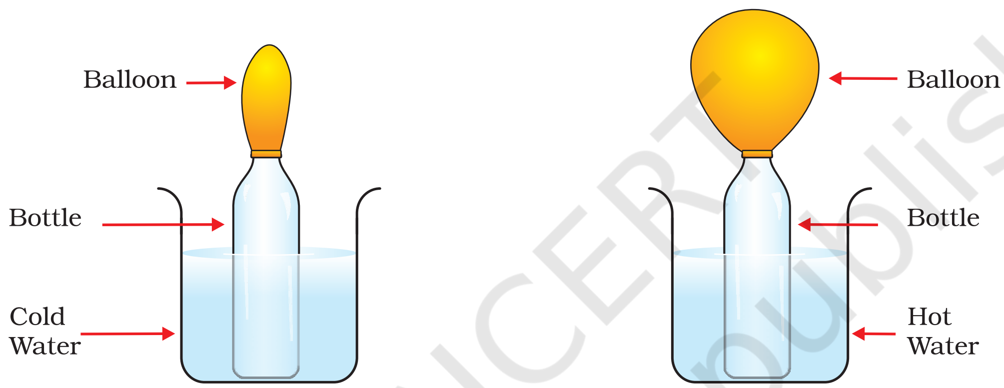


Figure 49.1

HOW DO WE PROCEED?

1. Inflate the balloon slightly and fix it on the mouth of the bottle tightly with a thread (Fig. 49.1). (It is advisable to inflate and deflate the balloon a few times.)
2. Pour hot water in one mug and cold water in the other mug.
3. Place the bottle with the balloon in cold water.
4. Observe the size of the balloon.
5. Transfer the bottle now to the mug containing hot water.
6. Observe again the size of the balloon.
7. Transfer the bottle back to cold water and observe the size of the balloon once again.

What do we observe?

- We observe that in cold water, the balloon gets deflated.
- We observe that in hot water, the balloon gets inflated.

What do we conclude?

- There is air inside the empty bottles. When the bottle is kept in hot water the air inside it gets heated. It expands and inflates the balloon.
- In cold water, the air in the bottle contracts and the balloon is deflated.
- In general, air expands on heating and contracts on cooling.

Let us answer

1. Abida is standing in front of a heater holding an inflated balloon. After some time the balloon explodes. Explain why it exploded.
2. John bought a bottle of a water. He drank about 2/3rd of that water and stored the remaining water in a refrigerator. He took the bottle out after 2 hours. He found that the bottle is deformed. Explain the reason.

What more can we do?

Take an empty plastic water bottle. Fill it with ice cold water. Empty it completely and fill it again with a little water. Make a solid paper ball and fit it in the mouth of the bottle. Keep the bottle in the sun for some time. Observe what happens. Explain your observations.

Note for the teacher

- The bottle should be kept stationary and vertical inside the mug by holding it properly.
- Handle hot water with care.

ACTIVITY 50

WHAT WE HAVE TO DO?

To observe the image of a candle flame formed by a concave mirror when the candle is placed at different distances from the mirror.

WHAT DO WE NEED?

A mirror stand, a concave mirror (focal length about 15-20 cm), a screen with a stand (about 20 cm × 15 cm), a candle, match box, a scale for measuring distances.

HOW DO WE PROCEED?

1. Find the approximate focal length of the concave mirror by focussing sun light on a sheet of paper.
2. Fix the concave mirror on the stand and place it on a table.
3. Keep a lighted candle on the table at a distance of about thrice the focal length of the mirror (say at about 60 cm in front of the mirror if the mirror is of 20 cm focal length).
4. Also, keep the screen on the table. Ensure that the screen does not obstruct the light from the candle falling on the mirror.
5. Try to obtain the image of the flame on the screen. For this move the screen forward, backward and sideways till a sharp image of the flame is obtained.

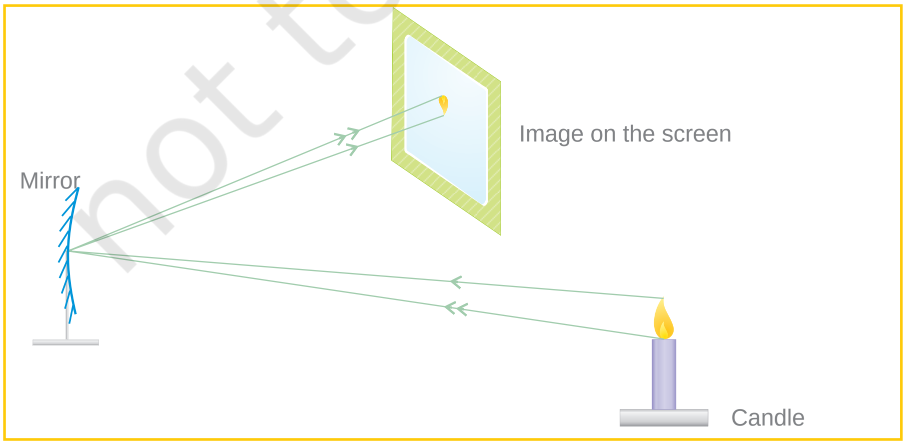


Figure 50.1

What do we observe?

- Observe the size of the image in each case.
- Is the image of the same size as the flame?
- Is the image larger or smaller than the flame?
- Can you get the image on the screen in all cases?
- Measure the distances of the candle and the image of the candle flame from the mirror.
- Now move the candle towards the mirror and place it at distances mentioned in Table 50.1. In each case try to obtain the image of the candle flame on the screen. For this you may have to change the position of the screen (Fig. 50.2).

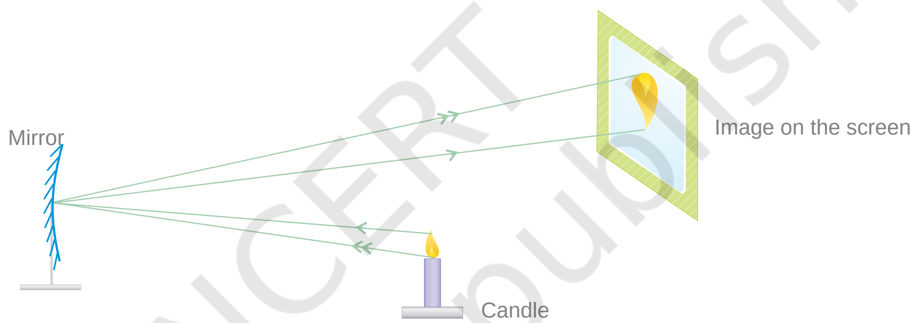


Figure 50.2

Table 50.1

Image formed by a concave mirror for an object placed at various distances from it

Distance of the object from the mirror	Distance of the image from the mirror	Image smaller/	Character of the image larger than the object
			Inverted/erect
60 cm			
40 cm			
30 cm			
20 cm			
10 cm			

What do we conclude?

- We conclude that the image formed by a concave mirror can be smaller or larger in size than the object.
- As the object is moved towards the mirror. The image moves away from the mirror.
- We also see that when the candle flame is too close to the mirror (at distances lesser than the focal length) its image is erect and larger in size than the candle flame itself. This image is however not formed on a screen. It is a virtual image. We therefore conclude that the image formed by a concave mirror may be real or virtual.

Let us answer

1. Place a lighted candle at a distance of 50 cm in front of a concave mirror of focal length 15 cm. Will the image formed be larger, smaller or of the same size as the candle flame?
2. Is it possible to obtain the image of a candle flame on the screen when the candle is too close to the mirror? Try.
3. What in the nature and size of the image when an object is placed too close to the mirror?

What more can we do?

- Repeat the above activity using a convex mirror in the place of a concave mirror. Record your observations in a Table similar to Table 50.1.
- List the uses of concave and convex mirrors in your everyday life.

Note for the teacher

- Help the students to recognize mirrors used as side mirrors in scooters, reflectors in torches and the mirrors used by dentists.
- If you do not have a mirror stand, you can make one from a piece of the thermocole or from clay or plasticine. In a similar manner you can make a stand for the screen.
- If the object is placed at the focus of the mirror, then the image is formed at infinity. In this situation you will simply see a patch of light on the screen.

ACTIVITY 51

What we have to do?

Observe the image of a candle flame formed by a convex lens when the candle is placed at different distances from the lens.

What do we need?

A lens stand, a convex lens (focal length of about 15-20 cm), a screen with a stand (about 20 cm × 15 cm), a candle, match box, a scale for measuring distances.

How do we proceed?

1. Find the approximate focal length of the convex lens by focusing sun light on a sheet of paper.
2. Fix the convex lens on a stand and place it on a table.
3. Keep a lighted candle on the table at a distance of about thrice the focal length of the lens (say at about 60 cm in front of the lens if the lens is of 20 cm focal length).
4. Try to obtain the image of the candle flame on the screen placed on the other side of the lens. For this move the screen forward, backward or sideways till a sharp image of the flame is obtained.

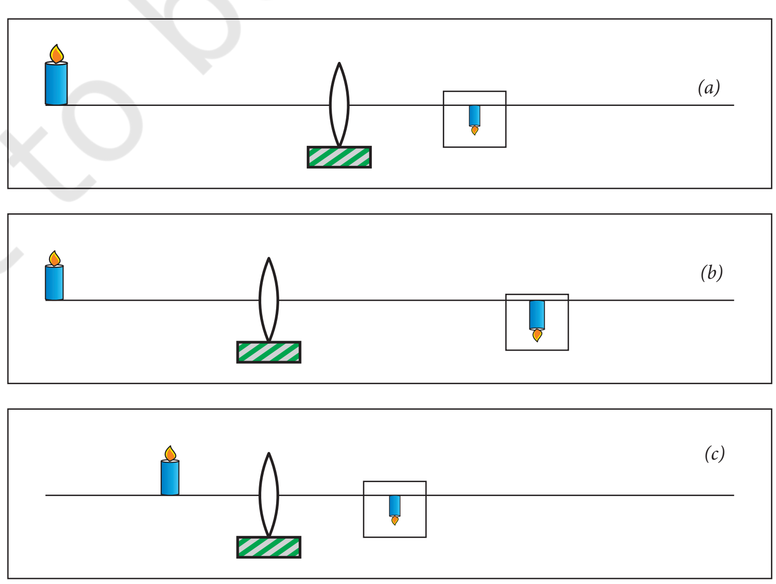


Figure 51.1

5. Measure the distances of the candle flame and its image from the lens.
6. Now move the candle towards the lens and place it at distances mentioned in Table 51.1. In each case try to obtain the image of the candle flame on the screen. For this change the position of screen (Fig. 51.1(b) and (c)) as necessary.

Table 51.1

Image formed by a convex lens for an object placed at various distances from it

Distance of the object from the lens	Distance of the image from the lens	Image smaller/ larger than the object	Character of the image larger than the object	
			Inverted/ erect	Real/Virtual
60 cm				
40 cm				
30 cm				
20 cm				
10 cm				

- Did you get in any position of the object an image which was erect and magnified? Could this image be obtained on the screen? Is this image real or virtual? This case is shown in Fig. 51.2.

Virtual image formed by the convex lens

Figure 51.2

What do we observe?

- For the first three cases an inverted image is obtained on the screen.
- The image of the flame becomes bigger as the candle is moved towards the lens.

What do we conclude?

- As the object moves towards the lens the image moves away from the lens.
- The image formed by a convex lens can be smaller or larger in size than the object.
- We also see that when the candle flame is too close to the lens (say at distances lesser then the focal length) its image is erect and larger in size than the candle flame itself. It is a virtual image. So, we conclude that the image formed by a convex lens may be real or virtual.

Let us answer

1. Is it possible to obtain the image of a candle flame on the screen when the candle is too close to the lens? Try.
2. What is the nature and size of the image when an object is placed
   (i) Too close to the lens.
   (ii) Quite far from the lens, say at 70 cm.

What more can we do?

- Repeat the above activity using a concave lens in place of a convex lens. Record your observations in a Table similar to Table 51.1.
- List the uses of lenses in your day-to-day life.

NOTE FOR THE TEACHER

- Help the students to observe the uses of lenses in microscopes, telescope, spectacles and other optical instruments.
- If you do not have a lens stand, you can make one from a piece of thermocole or from clay or plasticine. In a similar manner you can make a stand for the screen.
- If the obsect is placed at the focus of the lens, then the image is formed at infinity. In this situation you will simply see a patch of light on the screen.

NOTES

ACTIVITY 52

WHAT WE HAVE TO DO?

To burn a candle in a glass full of water. (Fun game)

WHAT DO WE NEED?

A small shoe box, a small candle, a match box, a clear glass sheet (about 25 cm × 20 cm), a glass tumbler full of water, a wooden or thermocole stand to keep the glass sheet in vertical position.

HOW DO WE PROCEED?

1. Take a shoe box open on one side.
2. Place a small lighted candle in the shoe box as shown in Fig. 52.1.
3. Place the glass sheet in front of this candle in a vertical position facing the open end of the shoe box.
4. Stand in front of the glass sheet on the side of the shoe box.
5. Try to locate the image of the candle behind the glass sheet.
6. Place a glass full of water at the position of the image of the candle.

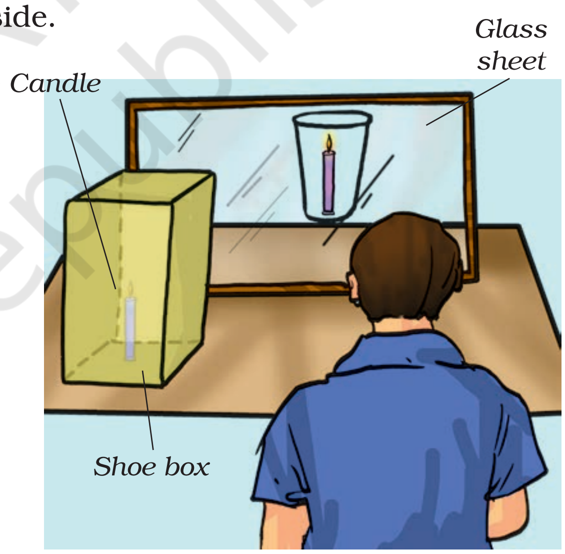


Fig. 52.1
Candle burning in water

7. Do you observe the candle burning inside water?
8. Measure the distances of the candle and the glass tumbler of water from the glass plate.
9. Try obtaining the image of the candle on a screen.

What do we observe?

- You will be surprised to see the candle burning in water.
- We could not get the image of the candle on the screen.

What do we conclude?

- We find that the image of the candle is at the same distance behind the glass plate as that of the candle in front of it.
- Here, the glass plate partially acts as a plane mirror. Therefore, we conclude that the image formed by a plane mirror is at the same distance behind the mirror as the object is in front of it.

Let us answer

1. State any two characteristics of the image of the candle formed by the glass sheet.
2. How does the candle appear burning in water?
3. Can we use a plane mirror sheet instead of plane glass sheet to perform this activity?

What more can we do?

- We can use a clear plastic sheet instead of a glass plate. Try this activity with a plastic sheet or a thick transparency sheet.
- Try this activity with a doll. Can you see the image of the doll through the glass plate? Now throw light on the doll with the help of a torch. Can you see the image of the doll now? Explain your observation. Discuss with your friends and teacher.

Note for the teacher

- Teachers should explain to the students how a clear glass sheet behaves as a plane mirror. Instruct children to clean the glass sheet properly.
- Discuss with the students why we can't use a plane mirror to perform this activity.
- Explain to children that the burning candle seen in water is an optical illusion.

Notes

ACTIVITY 53

What we have to do?

To verify the laws of reflection.

What do we need?

A plane mirror strip, a few knitting needles/bicycle spokes, a few sheets of chart paper.

How do we proceed?

1. Take two small rectangular pieces of thermocole. Make slits in them and fix a plane mirror. Make sure that the mirror is vertical (Fig. 53.1).

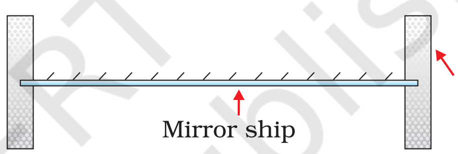


Figure53.1

2. Draw a line at an angle of about 45^0 to the mirror such as AO. Place a knitting needle on this line such that one of its ends touches the mirror (Fig.53.2).

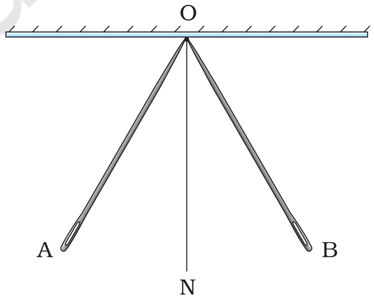


Figure 53.2

3. Look at the image of the knitting needle in the mirror. Place another needle in line with this image. At the end of this needle mark a poin such as B.
4. Remove the mirror and the needles and join point B with O.
5. At O draw a line ON perpendicular to the mirror. This is called the normal to the mirror.
6. Measure angle AON. This is called the angle of incidence.
7. Measure angle BON. This is called the angle of reflection.
8. Are they equal?
9. Repeat the activity twice by placing the needle at different angles.
10. Record your data in Table 53.1.

Obs. no.	Angle of incident $\angle i$	Angle of reflection $\angle r$	Is $\angle i = \angle r$?	
			Yes	No
1			☐	☐
2			☐	☐
3			☐	☐

What do we observe?

- We observe that the angle of incidence is equal to the the angle of reflection in each case.

What do we conclude?

- The knitting needle placed on the line AO represents the incident ray.
- The knitting needle placed on line BO represents the reflected ray.
- Angle of incidence is equal to the angle of reflection.

Let us answer

1 If the incident ray is along the normal, what would be the angle of reflection.

2 The reflected ray is at an angle of 80^0. What would be the angle of incidence?

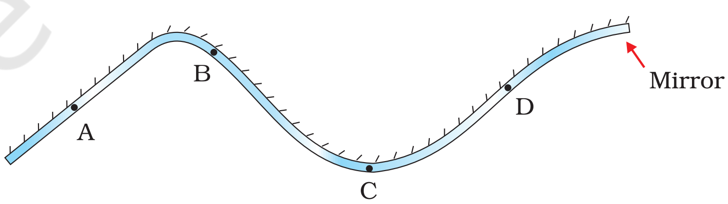


Figure 53.3

3. The surface of a mirror is distorted as shown in Fig. 53.3. Name the points on it where the law of reflection will be valid.

4 In Fig. 53.4. find the angle of reflection

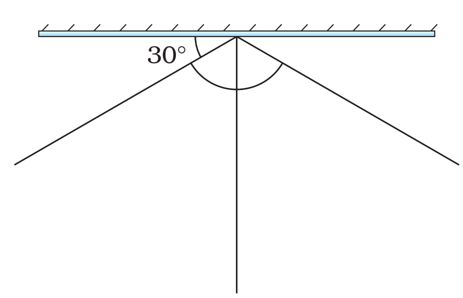


Figure 53.4

What more can we do?

- In Fig. 53.2, place the needle initially along BO and find the reflected ray.
- Show that anyone of AO or BO can be considered as the incident ray. The other then becomes the reflected ray.
- Perform this Activity with pencils instead of the knitting needles (Fig. 53.5). Describe the problems faced by you and how you solved them.

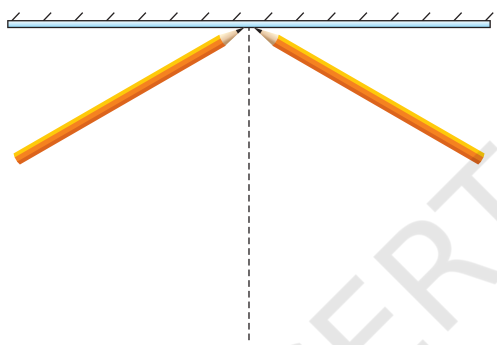


Figure 53.5

Note for the teacher

- The path of light is completely reversible. Therefore, any ray can be thought of as the incident ray and the other become the reflected.
- When the Activity is performed with thick objects like pencils, their thickness presents the problem of drawing the incident and the reflected rays. Incident ray may be drawn on any side of the object and the corresponding reflected ray is drawn using the same side (Fig.53.5).

Notes

ACTIVITY 54

What we have to do?

To observe that the appearance of the moon changes every night.

What do we need?

A big ball, black and white paints, brush for painting, 5 m long thick thread, two large size nails.

How do we proceed?

1. Take the big ball and paint half of it white and half black (Fig. 54.1).
2. Go out in the playground with some of your friends.
3. Fix a nail on the ground and with the help of the thread, draw a circle of radius about 4 m on the ground (Fig. 54.2).
4. Divide the circle into eight equal parts.
5. Stand at the centre of the circle to represent the earth.
6. Ask another friend to hold the ball at different points of the circle to represent the different positions of the moon in its orbit around the

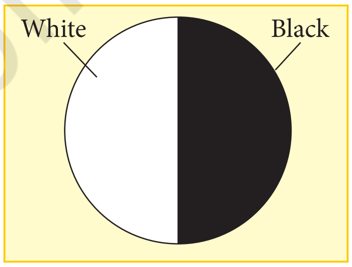


Figure 54.1


Figure 54.2

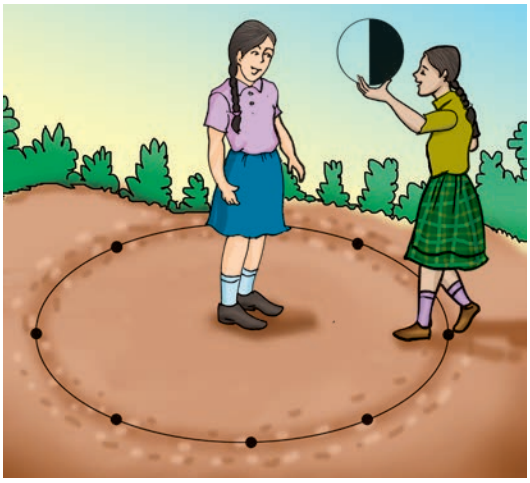


Figure 54.3

earth. Ask her to keep the white portion of the ball always facing the Sun (Fig. 54.3). If you are performing this activity in the morning then the white portion of the ball should be kept towards the east. If the activity is being performed in the afternoon then the white portion of the ball should be kept towards the west. However, in each case the line dividing the white and black portion should be kept vertical.

What do we observe?

- When you stand at the centre of the circle, observe the visible white portion of the ball while your friend stands at different points marked on the circle with the ball.
- Draw the shape of the white portion as you see it.
- Compare your drawings with the different phases of the moon as shown in Fig. 54.4.

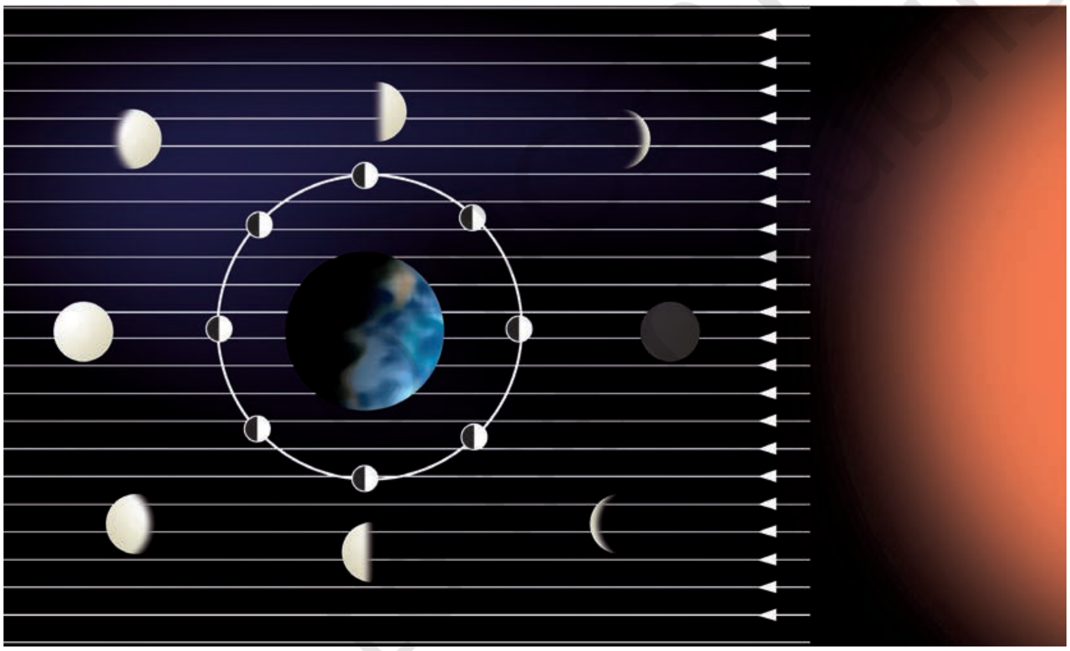


Figure 54.4. Positions of the moon in its orbit and its corresponding phases

What do we conclude?

- From this activity we conclude that due to the revolution of the moon round the earth, the shape of its visible portion changes everyday.
- We see only that part of the moon, from which the light of the Sun is reflected towards us. This determines the visible portion of the moon.

- This is the cause of the moon's changing phase regularly.

Let us answer

1. Why do the phases of the moon occur?
2. In which part of the sky, eastern or western, will the new moon rise?
3. In which part of the sky, eastern or western, will the full moon rise?

(**Note:** For hints to answers to these questions, look at Fig. 54.4.)

What more can we do?

- Starting from the full moon day, observe the moon for several nights. Make the sketch of the moon every might in your notebook (Fig. 54.5). Compare your drawings with the phases of the moon as drawn in Fig. 54.4.
- Make a sketch of the relative positions of the Sun, moon and the earth on the day of the full moon and on the day of the new moon.

Figure 54.5

Note for the teacher

- If a big ball is not available then you can ask the students to take a spherical pitcher and paint half of it white and half black.
- Encourage students to observe and compare the shape of moon on 7th and 22nd day, starting from new moon day.
- Ask them to make a sketch of the relative positions of the Sun, moon and the earth on these days.