

## 14.

# Light and the Formation of Shadows



### Can you tell?

1. Can we see anything in total darkness?
2. What helps us to see the objects around us?
3. What does the light in each one of the pictures originate from?

The objects or materials which emit light, meaning those which themselves are a source of light, are called **luminous objects or materials**. The intensity of light is determined by the extent to which the objects emit light. For example, the light emitted by an electric torch is more intense than that obtained from a candle.

The objects or materials that are not sources of light themselves, are called **non-luminous objects or materials**.

Some man-made objects or materials also emit light. These are called **artificial sources of light**.

The Sun is the main natural source of light. Other stars seen in the night sky, fireflies, some anglerfish as well as honey mushroom are natural sources of light.

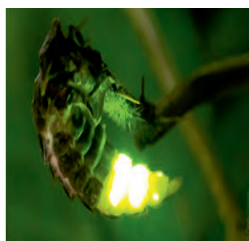
### The propagation of light

You may have seen in the afternoon, rays of light entering through a slit in a door or a small hole in the roof. As these rays of light from the slit or the hole move towards the floor, the dust particles in their way are seen clearly. Due to these particles, the path of the light becomes visible and we can see that their path is along straight lines.



### Let's try this.

Take three cardboards. Make a small hole in the centre of each cardboard using a thick needle. Arrange the cardboards in such a way that the three holes are in the same line, as shown in figure 14.3 on page 98. Stand a burning candle on one side of the cardboards and look at the flame of the candle from the other side.



14.1 : Sources of light



### Use your brain power!

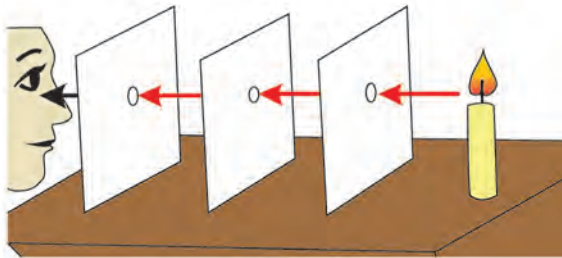
Make a list of some luminous objects and substances and classify them into natural and artificial sources of light.



14.2 Light entering through a window

### Step 1

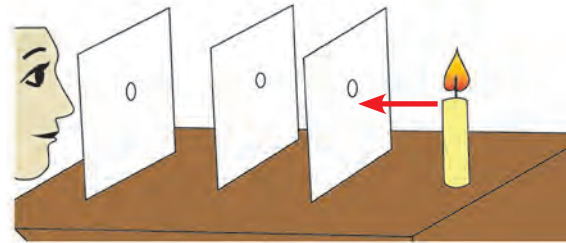
Look at the flame of the candle



Do you see the flame ?

### Step 2

Now move any one of the cardboards.



Why do you not see the flame ?

## 14.3 How light travels



Let's try this.

Take a straight tube that can be bent easily. As shown in the figure, place a burning candle on a stand, and look at it through the tube. Then bend the tube and look at the candle again. What do you see ?



Step 1



Step 2

14.4 : Looking at the candle



Use your brain power!

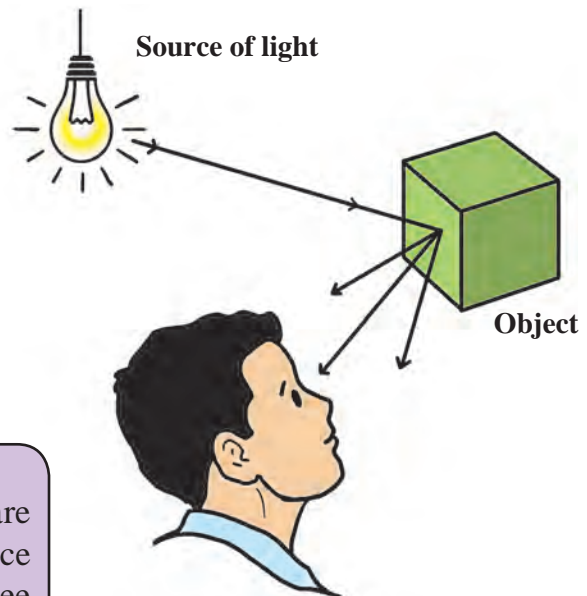
In which step is the flame of the candle seen clearly? Why?

**Light travels in a straight line. This is called the linear propagation of light.**

## Reflection of light

How do we see an object ?

The rays of light falling on an object from a source of light are thrown back from the surface of that object. This is called **reflection of light**. We see the object when the reflected rays reach our eyes.



14.5 : How an object is seen



Do you know ?

Stars are luminous. Planets, satellites are non-luminous. Sunlight reflected from the surface of the moon reaches us. That is how we can see the moon. We call this light moonlight.



### Can you tell?

1. In which objects do we see a reflection?
2. What is the difference between an object and its reflection? What causes the difference?

Let us see how light is reflected from the three surfaces shown alongside.

When you see your face in a mirror, the light reflected from your face falls on the mirror, and gets reflected back again. That is why you see the image in the mirror.

Do you see your image in a glass pane? You do, although it is somewhat faint. No image will be seen at all on a wooden surface.

You may have seen your image formed in surfaces such as a new steel dish, the glossy granite cladding of a wall and the still water in a lake. Make a list of other similar surfaces. Compare the images seen in them. Make a guess about the property of a surface due to which an image is formed. Discuss this with your teachers and parents.



14.6 : An image



### Let's try this.

### Images in a plane mirror

Stand in front of a plane mirror and look at your image in it.

1. Raise your right hand. Which hand of the mirror image is raised?
2. What change do you see in the image if you decrease or increase your distance from the mirror?
3. Is there any difference between your height and height of the mirror image?



14.7 : The image in a plane mirror

- The left and right sides of the original object appear to be exchanged in the mirror image.
- The image is as far behind the mirror as the object is in front of it.
- The size of the image is the same as that of the object.



### Use your brain power!

1. How will you light up a dark room using reflected light?
2. Try to start the TV by operating the remote control from behind it.





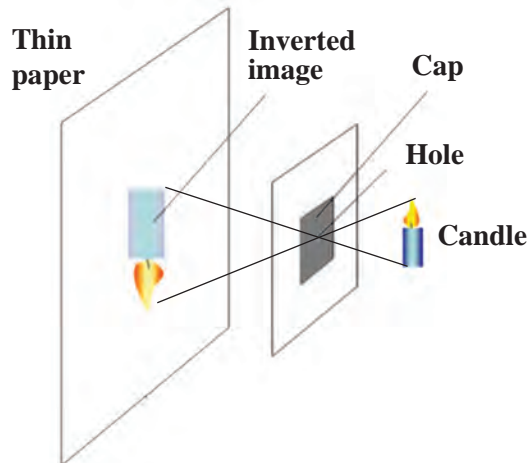
### Try this.

## A pinhole camera

Take an empty cylindrical box. Remove its cap on one side and paste a thin white paper in its place. Make a small hole at the centre of the other cap. Light a candle and hold the box in such a way that the flame of the candle is in front of the hole. Now you will see an upside down or inverted image of the flame on the thin paper at the other end.



14.8 : Pinhole camera



### Use your brain power!

Why is the image on the diaphragm of the pinhole camera inverted?



### Can you tell?

1. What difference do you notice on looking through the windows in the picture? What causes the difference?
2. The picture shows transparent, opaque, translucent window panes. Spot them.

Depending on the nature of the window pane, we may or may not see the objects on the other side through it.

Identify the transparent, opaque and translucent objects from among the following : piece of a glass, wax paper, tinted glass, oil paper, white plastic, a tea kettle, a notebook, cloth, water, a wooden cupboard, sheet of a notebook.



14.9 : Window

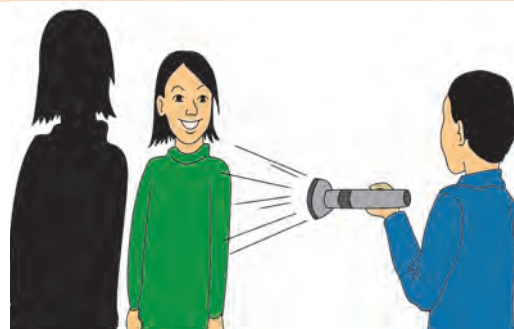
- The material through which light passes is said to be transparent.
- The material through which light does not pass is said to be opaque.
- The material through which light passes partially is said to be translucent.

## Formation of shadow



### Let's try this.

Take an electric torch. Flash its light on a wall. Now make your friend stand in between the torch and the wall. What happens?



14.10 : Formation of a shadow

If an opaque object comes in the way of a light source, light does not pass through it. As a result, the light does not reach a wall or any other surface on the other side of the object. That part remains dark. This dark part is called the 'shadow of the object'.



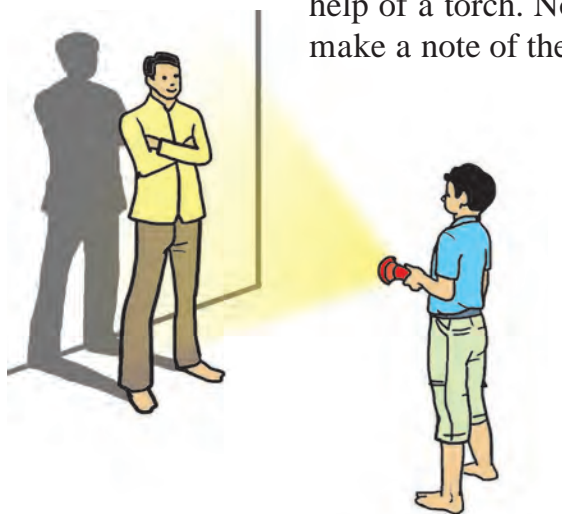
### Compare this.

Compare the objects in your environment with the shadows they form.

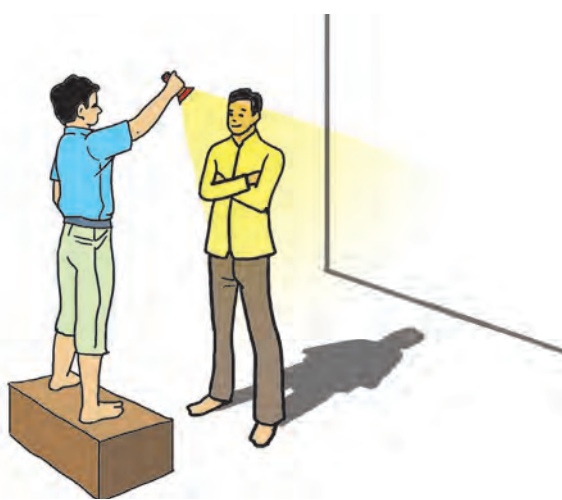


### Try this.

Ask your friend to stand at a certain distance from you in a big room and obtain the shadow of your friend on the wall with the help of a torch. Now carry out the following actions. Observe and make a note of the changes taking place in the shadow.



1. Send the friend closer to the wall.
2. Ask the friend to come towards you.
3. Next, you move further away from him and towards him again.
4. Hold the torch high and then low.
5. Go toward the left and then to the right of the friend.



The shadow of an object is formed only when light does not pass through the object. The kind of shadow it forms depends upon the relative distances between the source of light, the object and the surface or the screen on which the shadow is formed.

The shadow of an object formed due to sunlight is long in the mornings and evenings and short in the afternoon. We can easily note these changes if we observe the trees along the roadside. This change in the shadow depends on the source of light, the object and also on the surface on which the shadow is formed.



### Do you know ?

A **sundial** : A sundial is an instrument that indicates the time with the help of the extent and the direction of the shadow of an object formed in sunlight. Earlier, time was measured by placing a stick parallel to the axis of the earth and by noting the position of its shadow on the dial at different times of the day. The sundial given in the picture is at Jantar Mantar, New Delhi.



The research work presented by the Indian scientist Sir C. V. Raman regarding scattering of light is known as the 'Raman Effect'. He discovered this effect on 28th February 1928. To commemorate this event, 28th February is celebrated as 'National Science Day' since 1987 in India.



### A little fun !

Use your hands and feet to make different shadow shapes of birds, animals, etc.



### Let's try this.

1. Apparatus : A glass, water, a large white sheet of paper

Place a glass filled with water on a sheet of paper in the window so that it receives direct sunlight. What is seen on the paper ?

Can we do the same in a dark room with the help of a prism and a torch ? What do we learn from this ?

2. Apparatus – Soap water, a small loop of wire.

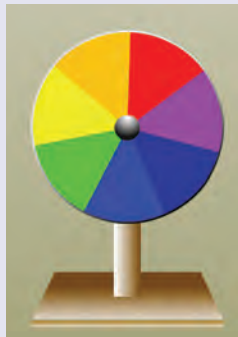
If you dip the wire loop in the soap water and then blow on it, soap bubbles are formed. The beautiful colours of the rainbow are seen in these bubbles.

3. What do you see on holding a CD in the sun ?



### In the past ...

The British scientist Sir Isaac Newton made a special disc. One side of the disc was divided equally into seven petals of the seven colors – red, orange, yellow, green, blue, indigo and violet. The disc was fitted on a stand and rotated fast. As the disc rotated, the seven colours disappeared and only white was seen. This proved that sunlight is made of seven colors. That is why, the disc is known as **Newton's disc**.



Newton wrote a book called 'Opticks' about light.



### Always remember...

The shape of a shadow depends upon the source of light, the object and the surface on which it is formed. We should not get frightened by the shadows we see at night because there is simple science behind that.



### What we have learnt-

- A substance that emits light is a source of light.
- The natural sources of light are the sun, the stars, fireflies, etc. The lantern, the flame of a candle, an electric bulb, etc. are artificial sources of light.
- Light is propagated in a straight line.
- Light must be reflected from the surface of an object for the object to be seen.
- If an opaque object obstructs the path of light, it casts a shadow.
- White sunlight contains seven colours.

### Science watch ...

Many questions arise in our mind while studying science; some easy, some difficult. Where can we find the answers to them?

Do not keep the questions to yourself. Keep asking those questions and look for the answers. The store of knowledge is enormous. Glean as many particles of it as you can.

#### Did you ever wonder :

- Why do we pucker our lips when blowing a candle out?

When we pucker our lips, we leave only a small space for the air to come out. That increases the pressure on the air and it helps to put out the candle.





**Exercise**

**1. Choose an appropriate word and fill in the blanks.**

- (a) A ..... is a natural source of light.
- (b) A ..... is an artificial source of light.
- (c) When light passes through a prism, it gets separated into ..... colours.
- (d) The image obtained in the pinhole camera is .....
- (e) A shadow is formed when an ..... object comes in the way of light.
- (f) When a ..... object comes in the way of light, light passes ..... it.  
(options : seven, star, through, transparent, opaque, colors, shape, erect, inverted, luminous, candle)

**2. Write whether of the following objects are luminous or non-luminous.**

Object	Luminous/ Non-luminous
A book	
A burning candle	
A wax cloth	
A pencil	
A pen	
A light bulb	
A tyre	
A torch	

**3. Match the following.**

**Group A**

- (a) Mirror
- (b) Firefly
- (c) Pinhole camera
- (d) Moon

**Group B**

- (1) Non-luminous
- (2) Inverted image
- (3) Reflection
- (4) Luminous

**4. Write the answers to the following.**

- (a) What things are necessary for the formation of a shadow ?
- (b) When can an object be seen ?
- (c) What is a shadow ?

**Project :**

- Prepare a Newton's disc.
- Find out how to save electricity with the help of the sunlight we receive during the day.
- Read a biography of Sir C. V. Raman and find out about the discoveries he made.

