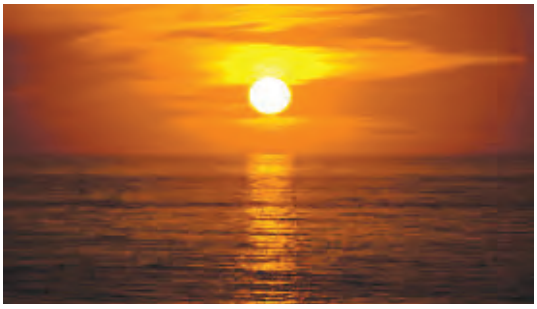
17. Effects of Light

Let's recall. When sunrays pass through a glass prism, what are the colours in the band of light seen on the other side of the prism?

You have learnt that light is composed of several colours. You must have also seen the dust particles in a beam of sunlight entering the house through a small window. We switch on the head lamps of a car when we drive through a thick fog. You might have seen the beams of those lamps. What do we really see, when we see a beam of light? We see tiny dust particles floating in the beam. That is why we are able to see the beam of light. We see a variety of shades of colour in the early morning and evening sky. In the photographs taken from space by satellites the earth appears to be bluish. What is the cause of all these effects?



Scattering of light

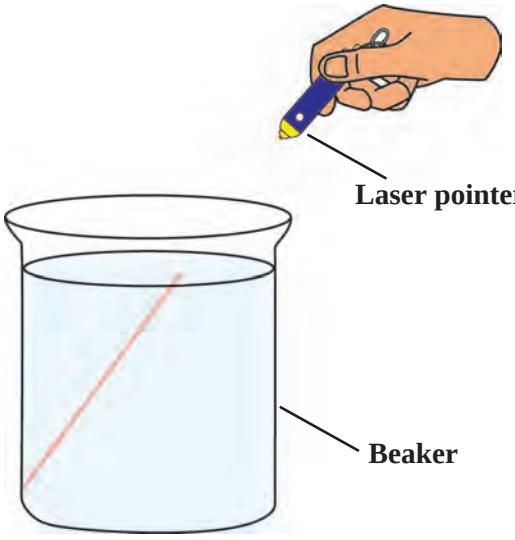
Try this. (All the experiments using laser rays should be done under the supervision of the teacher)

Apparatus : Glass beaker, diode laser (laser pointer), water, milk or milk powder, spoon, dropper, etc.

Procedure : Take clear water in a glass beaker. Pass a beam of laser rays through it. Check whether the beam is seen in the water.

Now use the dropper to add a few drops of milk to the water and stir. The water will be seen to have become slightly turbid. Now, pass the laser beam into it again. A light beam will show the existence of light rays.

A light beam is not seen in plain water, but is clearly seen in slightly turbid water. The light rays hit the tiny particles of milk and get scattered. If these scattered rays enter our eyes, we perceive the light.



17.1 A beam of laser light

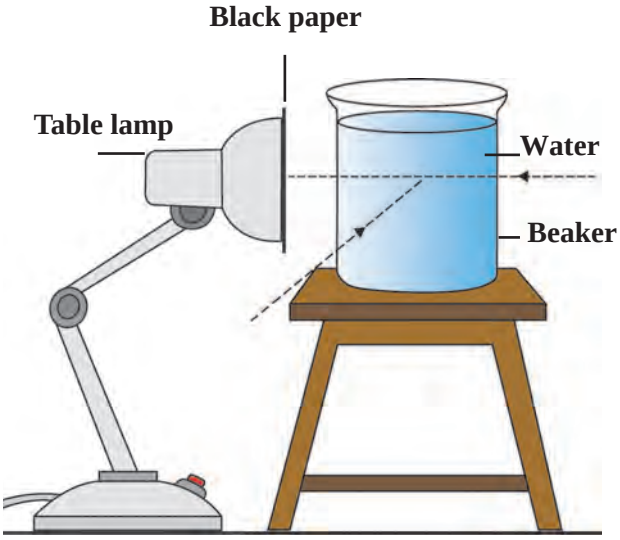
Try this.

1. Instead of using milk, mix salt, sugar and detergent powder in separate beakers of water and observe whether a laser beam is seen in them.

When the sun rises our surroundings appear illuminated. The entire sky appears bright. This happens because of the dust and other tiny particles in the air. This is the scattering of sunlight by the tiny particles of the various constituents of air. Had there been no atmosphere on earth, the sky would have appeared dark during the day and of course, the sun would be directly seen. This has been verified by observations from the rockets and satellites which go out of the earth's atmosphere.

Apparatus : A table lamp with a 60 or 100 W milky bulb (LED will not do), thick black paper, sticking tape, a packing needle, 100/200 ml glass beaker, milk or milk powder, dropper, spoon, etc.

Procedure : Cover the mouth of the lampshade properly with black paper, using sticking tape. Prick a hole of 1 to 2 mm diameter in the center of the paper with the help of the packing needle. Take clear water in the beaker. Light the bulb and place the beaker in contact with the hole. Observe from the front and at an angle of 90°. Now add 2-3 drops of milk to the water and stir. Observe again.



17.2 Scattering of light

A few more drops of milk may have to be added to make the water turbid. A blue tinge is seen when observed along the 90° angle. This is the scattered blue light. Because the blue light is scattered, a red-yellow light is seen from the front, and the hole appears reddish.

(**Important :** This experiment should be done in a dark room and by small groups of students.)

Use your brain power!

If a few more drops of milk are added, the reddish colour seen from the front becomes an intense red. However, if many more drops are added, the reddish colour is not seen. Why is this so?

Sunlight is scattered by the molecules of gases like nitrogen, oxygen in the atmosphere. The blue colour in the sunlight is scattered the most, and, therefore, the sky appears blue.

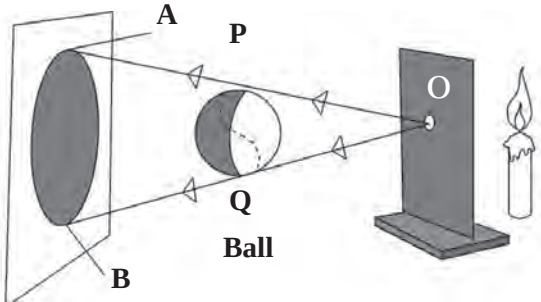
Sunlight reaches us through the layer of the atmosphere. At sunset, the light reaching us travels a greater distance through the atmosphere. Due to the greater distance, there is more scattering of the blue colour. As a result the red-yellow light reaches us directly and the sun appears red. Red light is scattered less than blue light.

Let's recall. What is a shadow? How is a shadow formed?

The shadow obtained from a point source and extended source.

Try this. **Apparatus :** Candle/torch, cardboard, screen, small ball, big ball, etc.

Take either a candle or torch as a light source. In front of it, set up a cardboard with a tiny hole (O) as shown in the figure. Now the light is seen to emerge from the hole on the cardboard. Such a light source is called **point source.** Place a screen vertically at a distance of one metre beyond the cardboard. Hang the big ball between the screen and the cardboard. Observe the shadow AB of the ball.

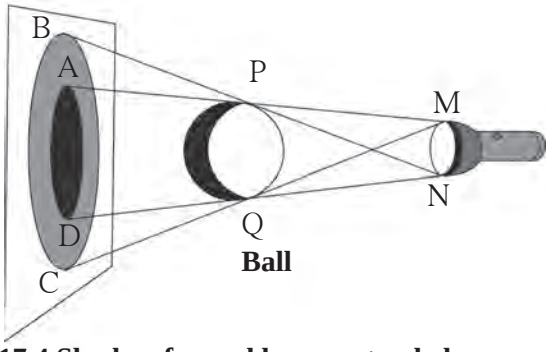


17.3 Shadow formed by a point source

The rays OP and OQ starting from the point source just pass by the ball and fall on the points A and B on the screen, respectively. However, since no rays reach the screen between the points A and B, that part remains unlit. This is the dark shadow or the umbra.

What happens if the cardboard with the pinhole is removed? Now, we do not have a point source. This source is called an **extended source**. What is the nature of the shadow formed by an extended source?

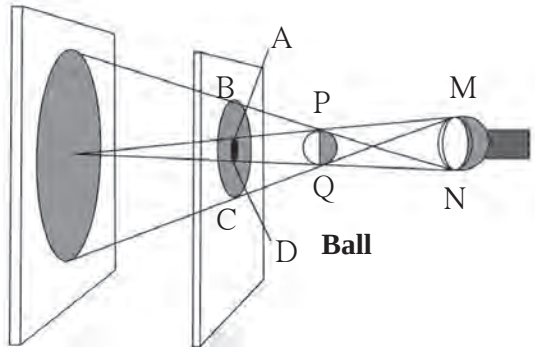
Due to the extended source, we see two parts in the shadow of the ball on the screen – one faint and one dark. The faint part BC is called the **penumbra** and the dark part AD, is called the **umbra**.



17.4 Shadow formed by an extended source

Let us see what happens in the following activity when the ball is bigger than the extended source. Keeping the distance between the extended source and the ball constant, move the screen further and further away and observe the shadow. As the screen moves further, the umbra and the penumbra in the shadow of the ball are seen to become bigger and bigger.

Now replace the big ball with one that is smaller in size than the light source. Observe its shadow on the screen. We see the umbra and penumbra of the ball on it. Now, without moving the light source and the ball, move the screen further away from the ball and observe its shadow. As the screen moves further, the umbra becomes smaller and smaller and at a certain point it disapperars.



17.5 Shadow of a small object formed by an extended source

Eclipses

What is an eclipse?

The moon revolves about the earth, and the earth along with the moon, revolves around the sun. Their orbits of revolution are all different. When the sun, the moon and the earth come in a straight line an eclipse is said to have taken place.

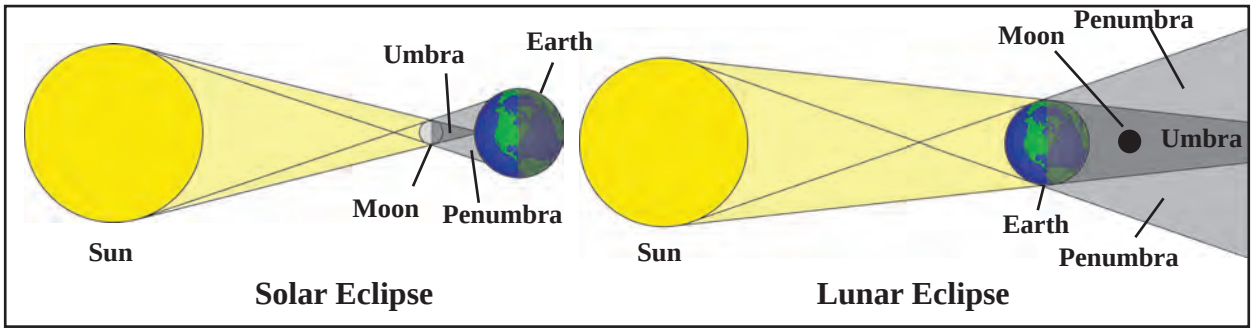
Solar eclipse

During its revolution, when the moon comes between the sun and the earth, a shadow of the moon is cast on the earth and the sun cannot be seen from the part in the shadow. This is called a solar eclipse. A solar eclipse is seen only on a new moon day. The solar eclipse may be either partial or total. Sometimes the solar disc is completely covered by the moon. This is the total solar eclipse. When the solar disc is not covered fully by the moon, we have a partial solar eclipse. During a solar eclipse, ultra-violet rays which are harmful to us reach the earth. A solar eclipse should never be watched with the naked eye. A special type of goggles should be used for this purpose.

Lunar eclipse

When the earth comes between the sun and the moon a shadow of the earth is cast on the moon and a part of the moon is covered. This is called the lunar eclipse. A lunar eclipse is seen only on a full moon night. If the whole moon comes in the shadow of the earth, it is a total lunar eclipse. When the shadow of the earth is cast only on a part of the moon, it is a partial lunar eclipse. You can watch a lunar eclipse with the naked eye. A lunar eclipse can be seen over a period of a few hours.

Note : For more information refer to the lesson 'The Sun, the Moon and the Earth' in the Geography textbook.



17.6 Eclipse

Do you know?

Eclipses often occur in the solar system. As seen from the earth, when a planet or a star passes behind the moon, that state is called a '**occultation**'. It is a common phenomenon that occurrs with the sun, the moon or other stars. For example, in 2016 the star called 'Rohini' was hidden behind the moon. After some time it came appeared on the other side of the moon. Did you see this occultation?

Find out.

1. Time periods of lunar and solar eclipse.
2. Various eclipses in the past and relevant interesting information about them.
3. Eclipses and transits which will occur in the near future.

Zero shadow day

The day on which the sun reaches exactly overhead is called the **zero shadow day**. On that day, at noon shadows completely disappear. This event can only be seen in the region between the Tropic of Cancer (23.5^0N) and the Tropic of Capricorn (23.5^0S). This event occurs in summer on different days in different places in this region.

Always remember –

An eclipse is a natural phenomenon. Many superstitions connected to eclipses are prevalent in the society. It is necessary that everyone makes efforts to rid the society of superstitious beliefs.

Think and discuss.

1. Discuss why it is not right to tie lemon-chilli to our car?
2. In our surroundings and in day-to-day life, we unknowingly believe in many such things. Is that right?

1. Fill in the blanks.

(a) When the beams from the headlights of a car fall on an object in the night, the shadows called ..... and ..... can be seen.

(b) During a lunar eclipse the shadow of the ..... falls on the ..... .

(c) During a solar eclipse the shadow of the ..... falls on the ..... .

(d) Various shades of colour are seen in the sky at sunrise and sunset due to ..... .

2. Give reasons.

(a) Space beyond the earth's atmosphere appears dark.

(b) We are able to read while sitting in the shade.

(c) We should not observe the solar eclipse with naked eyes.

3. Give some example of scattering of light that we come across in day-to-day life.

4. Why is the shadow of a bird flying high not seen on the earth?

5. Why is a penumbra not obtained from a point source?

6. Answer the following questions in your own words.

(a) What is meant by scattering of light?

(b) Does the shadow really vanish in the zero shadow condition?

(c) Will the laser beam be seen if it passes through a glass box which contains a lighted incense stick?

7. Discuss and write.

(a) Write a science based paragraph on 'What if the sun did not rise?'

(b) What efforts will you make to remove the misconceptions about eclipses?

(c) Various eclipses and the conditions during that period.

8. Explain the difference :

(a) Point sources and extended sources of light.

(b) Umbra and penumbra.

Project :

Obtain information about the special goggles used to watch a solar eclipse.

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