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Light and Shadow

We'll cover the following key points:

- Light and its sources
- Light Travels in a Straight Line
- How Do We See Things?
- Shadow
- Eclipse



Hi, I'm EeeBee

Do you Remember:

Fundamental concept in previous class.

In class 4th we learnt

- Properties of light
- Shadow

Still curious?

Talk to me by scanning the QR code.



Learning Outcomes

By the end of this chapter, students will be able to:

- Understand the concept of light and shadow in our surroundings and their unique characteristics.
- Identify and differentiate between transparent, translucent, and opaque objects based on their interaction with light.
- Explore examples of shadows formed by different objects and learn about the factors affecting the size and shape of shadows.
- Learn how light travels in a straight line and how it interacts with objects to create shadows.

Guidelines for Teachers

The teacher can start the chapter by introducing the concept of light and shadow, encouraging students to observe how light behaves in their surroundings. Discussions can focus on the types of materials (transparent, translucent, opaque) and how they affect the formation of shadows. The teacher can also emphasize the role of light in creating shadows and guide students through simple experiments to understand how the size and shape of shadows change based on the position of the light source.



Categorise the transparent, translucent and opaque materials in the table from the list given below:

Glass window Wooden door Talcum powder Oil
Greased paper Ground glass Mirror Mouse pad

Transparent	Translucent	Opaque

Fun Fact

Light travels at a whopping 300,000 km per second, making it the fastest thing in the universe! Shadows form when objects block light, and their size depends on the light's angle. The Moon's shadow during a solar eclipse can race across Earth at speeds over 1,500 miles per hour. Also, some animals, like cats, have reflective eyes that help them see better in low light.

Light and its Sources

What is Light?

Have you ever imagined what it would be like if there were no light in this world. You can get this feeling if you enter a completely dark room and be there for some time. Suddenly if you switch on the lights, you are able to make out everything that is present in the room.

Thus light is a form of energy that helps us to see the world. Light comes from various objects that help us to see. These are called the sources of light.



Did you know ?

About two hundred years ago, though, people were very aware of light and dark, they worked during the day when the Sun was shining. As the Sun went down, they used candles or oil lamps to see. However, these lights were dim. Outside, there were no street lights like present day. The only light available came from the moon and stars. Night was very, very dark. People usually went to bed when the Sun went down and woke up early.

Sources of Light

Light can be obtained from different sources. Some of them are **natural sources** whereas others are **artificial sources**.

Natural sources of light are natural objects that emit light. Examples of natural sources of light are the Sun, stars, fire and electricity produced during storms.



Sun



Stars



Moon



Lightning

On the other hand , artificial sources of light are the ones that are created by humans and they emit light. For example LED bulbs, candles, torch light, televisions, neon lights, table lights at homes etc.



Bulb



Torch



Candle



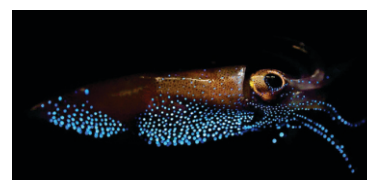
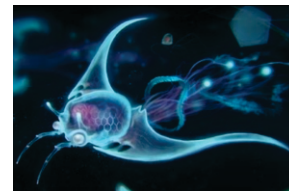
Neon Lights

Did you know ?

Many living creatures such as plants and animals have the magical ability to emit their own light, a phenomenon known as bioluminescence. Although bioluminescence is seen mostly among marine animals, a few land creatures also produce light, mostly insects and fungi.

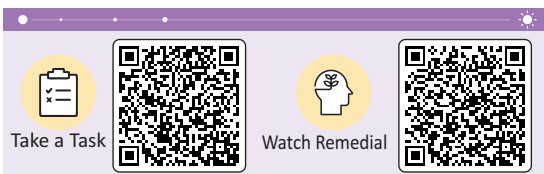
Bioluminescence requires three ingredients: a molecule called luciferin, oxygen and the enzyme luciferase to speed up the reaction. When oxygen combines with luciferin, the reaction produces light.

Some examples of organisms that produce light are Glowing mushrooms, Alarm jellyfish, Crystal jelly, Glow worm, Fireflies, Radiant railroad worms etc.



Light Travels in a Straight Line

Sometimes we all must have noticed that in our house whenever a beam of light enters a dark room through a tiny hole in the window, the light waves always travel in a straight line. This can be clearly observed in an atmosphere that dusty. Also the beam emerging from a torch always appears in a straight line. The tendency of light to travel in a straight line is called **rectilinear propagation of light**.



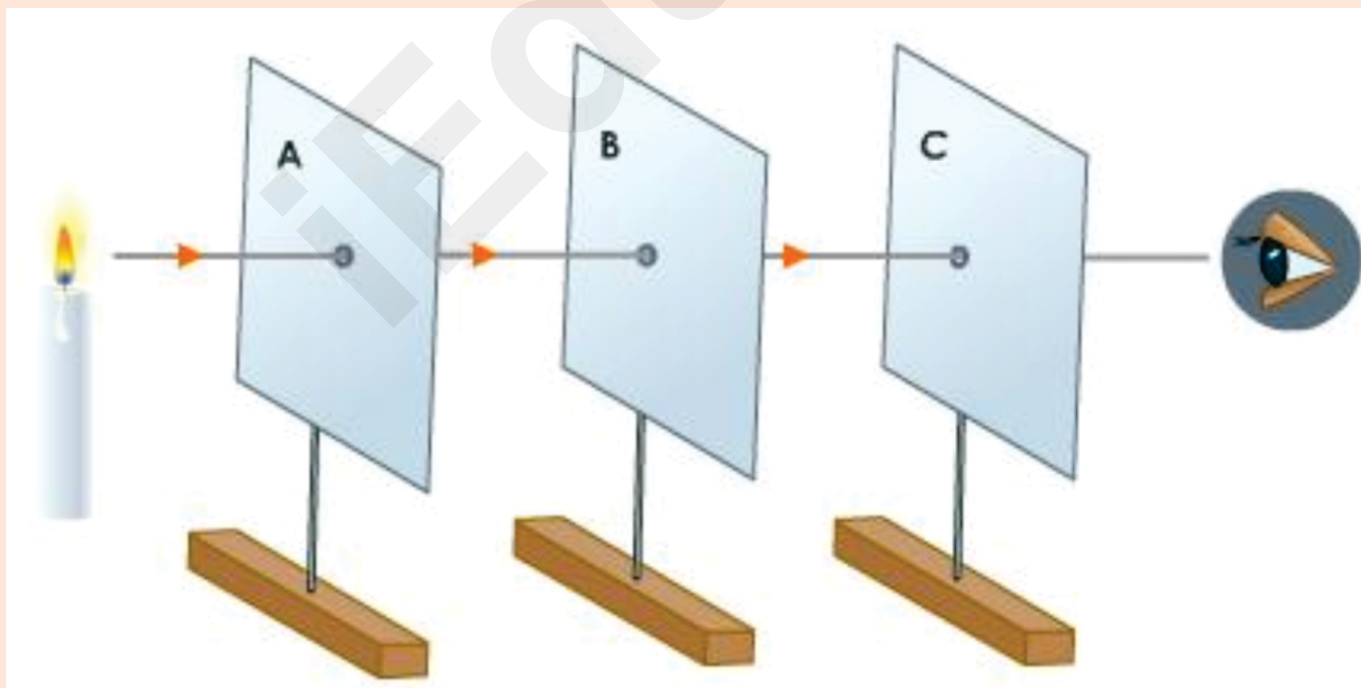
Activity

Creative Learning

To show rectilinear propagation of light

Let us carry out a small activity to show that lightwave travels along a straight line. Take three CD's and align them together. Align them in such a way that all the CD's lie in a straight line. Now take a candle and place it at the other end. Do make sure that the tip of the candle and the holes of the CD's all lie in a straight line. Ensure that the height of the CD's and the tip of the candle are the same. Observe the flame of the candle. We are able to see the flame of the candle because the light wave travels through the holes and reaches our eye.

Now if we displace the center of the CD's we observe that we are not able to see the flame of the candle. Why does that happen? This is because the light gets blocked. If the light could have the ability to take a curve and travel, we could have seen the light wave. But since light travels in a straight line, we were unable to see the flame of the candle when the CD is displaced. This proves that light travels along a straight line.



How Do We See Things?

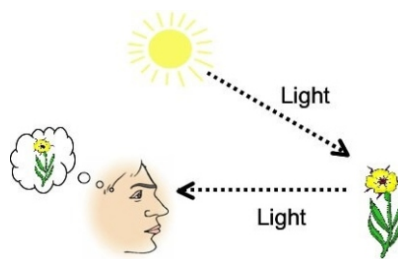
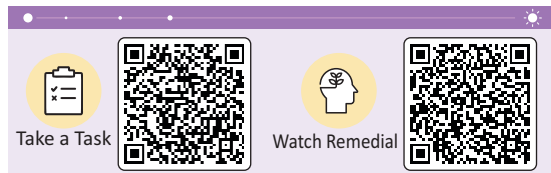
We know that light rays propagate in a straight line. When any object comes in the path of propagation, it bends or reflects back after striking the object. This reflected ray comes to our eye and we see the objects around us.

Different materials allow different amounts of light to pass through them. When we see through clear water or glass, we can see through them but not through a wooden block or a brick wall. This is so because wood and brick walls not allow light to pass through them at all whereas water and glass allow light to pass through them.

Materials that allow light to pass through them completely are called **Transparent** materials. Example: Glass, water, cellophane paper etc.

Materials that allow light to pass through them partially are called **Translucent** materials. Example, butter paper, frosted glass etc.

Materials that do not allow light to pass through them at all are called **Opaque** materials. Example, a wooden block, a book etc.



Transparent object



Translucent object



Opaque object



Critical Thinking

Write 'T' for true and 'F' for false statements.

1. Light is a form of energy that help us to see the world.
2. Artificial source of light are natural objects that emit light.
3. Transparent materials allow light to pass through them completely.
4. A wooden block, a book, pencil box etc. are translucent materials.

☐
☐
☐
☐

Shadow

Light a torch and let the beam fall on a wall. Now bring an opaque object like your hand in between the torch and the wall. What do you see? The shadow of your hand falls on the wall. Your hand being opaque blocks the light from the torch from falling on the wall. Thus a shadow of your hand is obtained on the wall. Now, if you switch off the torch, you can see that there is no shadow.

We have learnt that light travels in a straight line. An opaque object blocks the light falling on it. Thus, an area of darkness is created on the side of the object away from the source of light. The area of darkness formed by an opaque object when light is obstructed by it is called a shadow. For a shadow to form, the following three things are required:

- ✦ A source of light.
- ✦ An opaque object.
- ✦ A screen or surface where shadow can be obtained.



Did you know ?

1. A long time ago, people observed the way shadows were formed by the Sun and utilized this principle in making the world's most primitive clocks, the sundials.
2. Sunlight reaches Earth's atmosphere and is scattered in all directions by all the gases and particles in the air. Blue light is scattered more than the other colors because it travels as shorter, smaller waves. This is why we see a blue sky most of the time.



Shadow Formation During the Day

Shadows change length throughout the day because the angle at which the Sun shines on stationary objects changes with the Earth's rotation. When we go out in the Sun, we notice that the length of our shadow changes at different times of the day. For example, early in the morning, when the Sun is near the horizon, it casts long shadows. Same is the case in the evenings. However, during the noon time, when the Sun is just overhead, the shadow cast is shorter.



Shadow in Morning



Shadow in Noon



Shadow in Evening

Did you know ?

If there are multiple light sources, there are multiple shadows, with overlapping parts darker. For a person or object touching the surface, like a player standing on the cricket ground, multiple images of the player are seen.

When light shines on a soap bubble, some of the rays reflect back from its outer surface. Others travel through the thin soap film and bounce back from its inner surface. The two sorts of reflected rays are slightly out of step because they travel different distances. They interfere with one another and produce colourful swirling patterns on the bubble's surface.

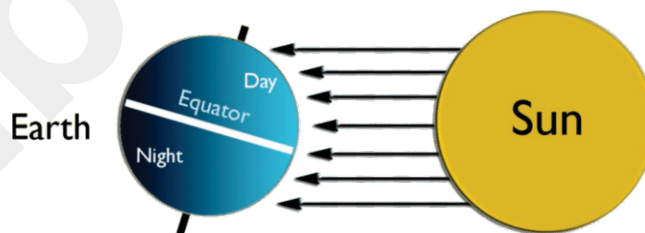
Properties of a Shadow

The following are the properties of a shadow:

- ✦ Irrespective of the colour of the object, a shadow is always black in colour.
- ✦ A shadow only shows the outline of the object and not the details.
- ✦ The size of the shadow depends on the distance between the object and the source of light and the distance between the object and the screen.

Formation of Day and Night

The earth revolves round the Sun and also rotates on its own axis. Though we don't feel it, the earth is constantly rotating taking us all along with it. It is this rotation of the earth that causes day and night. During rotation, the side of the earth that faces the Sun experiences day whereas the part away from it experiences night. Thus, when we are on the side of the earth that faces the Sun, we have daylight. As the earth continues its spin, we are moved to the side facing away from the Sun thus experiencing nighttime.



Eclipse

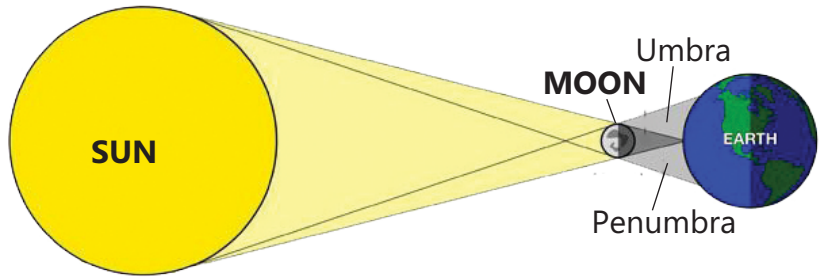
An eclipse is a phenomenon when three celestial bodies, the Sun, the moon and the earth lie in a straight line. During such a phenomenon, one of the celestial bodies is partially or fully hidden by another. The movement of the earth along its axis together with the revolution of the earth around the Sun causes eclipse.

Solar Eclipse: A solar eclipse occurs when the moon comes in between the earth and the Sun thus casting a shadow of the moon on the earth. Therefore, during a solar eclipse, the view of the Sun is hidden either partially or totally from the earth.

Total Solar Eclipse: A total solar eclipse occurs when the entire central portion of the Sun is blocked out by the moon.



Partial Solar Eclipse: A partial solar eclipse occurs when only a part of the Sun's surface is blocked out by the moon.

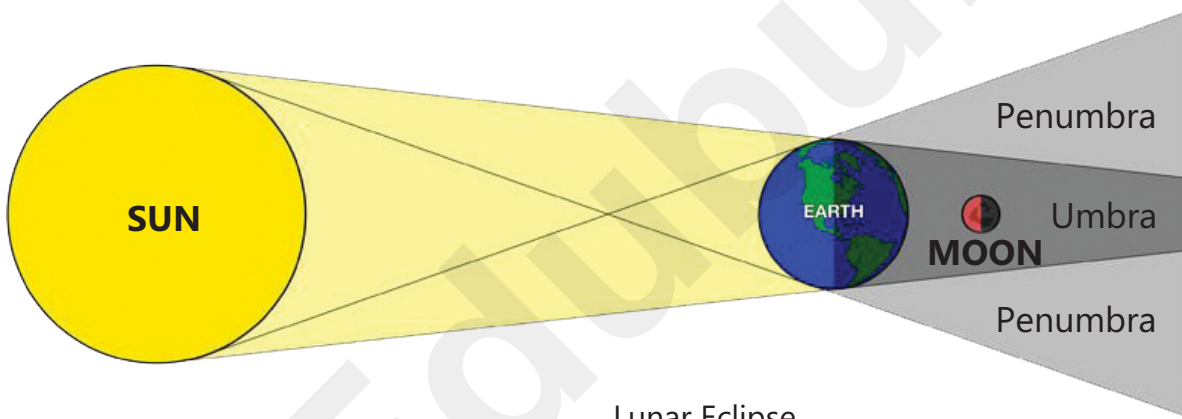


Solar Eclipse

Lunar eclipse: A lunar eclipse occurs when the earth comes in between the Sun and the moon so that the shadow of the earth is cast on the moon. A lunar eclipse occurs only on a full moon night. During a lunar eclipse, the moon is hidden by the earth either partially or fully.

Total Lunar Eclipse: When the moon is hidden by the earth fully or the earth completely blocks the sunlight from reaching the moon, it is called a total lunar eclipse.

Partial Lunar Eclipse: When the moon is hidden by the earth partially it is called a partial lunar eclipse.



Lunar Eclipse

Check 'N' Mate

Critical Thinking

Fill in the blanks with correct words.

1. _____ (Opaque/Transparent) objects form shadows.
2. The length of shadow changes at _____ (same/different) times of the day.
3. A shadow only show the _____ (outline/whole details) of the objects.
4. A _____ (solar/lunar) eclipse occurs when the moon comes in between the earth and the Sun.
5. When the moon is hidden by the earth partially it is called a _____ (total lunar/partial lunar) eclipse.



In a Nutshell

- ✦ Light is a source of energy that helps us see the world. It is obtained from different sources.
- ✦ Light can be obtained from either natural or artificial sources.
- ✦ Light always travels in a straight line. This is called the rectilinear propagation of light.
- ✦ We see things when light striking any object reflects back and comes to our eyes.
- ✦ Depending on the amount of light that materials allow to pass through them, they may be classified as transparent, translucent or opaque.
- ✦ When an opaque object blocks the path of light, a shadow is created.
- ✦ Rotation of the earth along its axis causes day and night.
- ✦ An eclipse is a phenomenon caused when three celestial bodies, the Sun, the moon and the earth lie in a straight line.



Key Words

Improving Vocabulary

Bioluminescence	: The production and emission of light by a living organism.
Beam	: A group of light rays together.
Rectilinear propagation of light	: The property by which light travels in a straight line.
Transparent	: Materials that allow light to pass through them completely.
Translucent	: Materials that allow light to pass through them partially.
Opaque	: Materials that do not allow light to pass through them.
Celestial body	: A natural body outside the earth's atmosphere.



Time to Discuss

Pondering and Communicating

1. The moon is a non-luminous body but it appears bright. Why?
2. The earth shines as a bright, blue ball when viewed from space. Why?



EXERCISE

That turn curiosity into confidence—let's begin!



Gap Analyzer™
Take a Test

A. Objective Type Questions.

1. The things required for a shadow to form are:
 - a. A source of light ☐
 - b. An opaque object ☐
 - c. A screen to obtain the shadow ☐
 - d. All of these ☐
2. Materials that allows light to pass through them partially are called:
 - a. Transparent ☐
 - b. Translucent ☐
 - c. Opaque ☐
 - d. None of these ☐
3. During a partial lunar eclipse, the moon is hidden partially by the:
 - a. Sun ☐
 - b. Earth ☐
 - c. Mars ☐
 - d. None of these ☐
4. The size of a shadow depends on the:
 - a. Distance between the object and the source of light ☐
 - b. Distance between the object and the screen ☐
 - c. Both (a) and (b) ☐
 - d. None of the above ☐
5. Butter paper, frosted glass and tracing paper are examples of:
 - a. Transparent objects ☐
 - b. Translucent objects ☐
 - c. Shadows ☐
 - d. Opaque objects ☐

B. Fill in the blanks :

1. Light is a form of _____ .
2. _____ is created when a source of light is obstructed by an opaque object.
3. Light energy travels in _____ .
4. Bricks and books are examples of _____ objects that do not allow light to pass through them.
5. When the entire central portion of the Sun is blocked out by the moon a _____ occurs.
6. A shadow only shows the _____ of an object and not the details.
7. Our shadow is the shortest during _____ time.

C. Very Short Answer Questions.

Name them.

1. Materials that allow light to pass through them completely _____.
2. A natural body outside the earth's atmosphere _____.
3. A phenomenon when the moon is hidden by the earth partially _____.
4. A light bulb, a candle and neon lights are examples of _____.
5. This is always the colour of a shadow _____.

D. Short Answer Questions.

1. What are natural and artificial sources of light? Explain with examples.
2. What is a shadow? List the conditions required for the formation of a shadow.
3. Explain with examples what are transparent, translucent and opaque materials.
4. What do you mean by artificial sources of light? Name a few.

E. Long Answer Questions.

1. What do you understand by rectilinear propagation of light? Explain with an example.
2. Explain the formation of day and night. Which movement of the earth is responsible for it?
3. With the help of a diagram, explain the phenomenon of a solar eclipse.
4. What do you understand by a lunar eclipse? Explain with the help of a diagram.
5. Enlist the properties of a shadow.



Custom Learning Path



Time to Recall

Recall and complete the concept map given below.

Light

Sources of Light

Can pass Through Materials

e.g.

e.g.

Time to Apply

Applying and Creating

Sahil was looking through a transparent sheet and a cardboard piece. He was amazed to see that both behaved differently. He asked about this to his elder brother Mayank. Mayank explained that this is because these substances allow different amounts of light to pass through them.

1. Give some example of transparent and opaque objects.
2. What values are shown by Mayank?



Time to Observe

Observing, Critical Thinking, Analysing

Take Pictures of Your Shadow Antics

Taking pictures of your shadow can be tough. It's hard to find a way to take the picture without the camera being obvious in the photo. In the photo below, I was holding the point and shoot camera at my chest.

It's also hard to take pictures of other people's shadows without finding some part of your own shadow in the frame, but it sure is fun to try!



Time to Create

Creating and Collaborating

Shadows can be very interesting to observe and especially if we choose to use light and shadows in storytelling. Therefore try to create the following animals using shadows and weave them into a story of your own. You may do this as a team activity.

Deer, Rabbit, Dog, Snail, Birds, Crab, Swan, Elephant etc.