

Light Explorations

Teacher Lesson Plan



Background Information

Light is energy that travels in waves. Light has both electric and magnetic fields, thus is referred to as electromagnetic radiation.

- Light waves move as transverse waves and travel at 186,000 miles per second. Since they can travel in space, without friction, it stays at a constant velocity.
- Light waves travel in straight paths called rays and do not need a medium in which to move. Sound waves travel in all directions from a source and need a medium in which the particles vibrate to transfer the energy.
- Light waves are characterized by their wavelength and the frequency of the waves.
 - The size of a wave is measured as its wavelength which is the distance between any two corresponding points on neighboring waves.
 - Frequency is the number of waves passing a given point every second.
 - The greater the frequency, the greater the amount of energy. High frequency gamma rays have more energy than low frequency radio waves.
- Light travels in straight paths until it hits an object.
 - If light hits the surface of a medium that is smooth and polished, the wave will bounce back or be reflected. The wave that strikes the surface is called the incoming/incident wave and the one that bounces back is the reflected wave. The reflected wave will be reflected back at the same angle as the incoming/incident wave.
 - Refraction means the bending of a wave due to the change in speed as it moves from one translucent medium to another. The frequency does not change. The amount of refraction (bending) depends on the density of the material it is entering, the wavelength and angle which the light enters the medium.
 - A rainbow is an example of both reflection and refraction. Sunlight is refracted when it enters the raindrop, it is reflected off the back of the spherical raindrop and again is refracted as it leaves the raindrops.
- Light passes through some materials easily. You can see through transparent objects. Examples are clear glass, air and clean water. Materials that partially transmit or scatter light are known as translucent. Examples are wax paper and frosted glass. Opaque materials block light. The energy is absorbed and can be transferred to heat energy. Examples are metal, wood and bricks.

Content Standards

- Physical Science
 - Light and sound are forms of energy that behave in predictable ways.
- Earth and Space Science
 - Most of the cycles and patterns of motion between the Earth and sun are predictable.

Student Activities – Light Explorations

LESSON 1: Lunar Eclipse

Lesson Materials:

- Strong flashlight
- Pictures of Earth and Moon
- Tape

Background Information:

Contrary to popular belief, Christopher Columbus was not the first to suggest that the Earth was round. One of the first recorded arguments for a spherical earth comes from Aristotle – nearly 2,000 years before Columbus. Historian James Evans says in his book, *On the Heavens*, “During an eclipse of the moon, you see the shadow of the Earth falling on the moon and it always looks circular in shape.” Light travels in straight lines. Because of this, a round shadow would be made by a round object.

Procedure:

- Tape picture of the moon on the wall.
- Have student hold flashlight and shine it onto the moon. The flashlight represents the sun.
- Hold the Earth picture in the beam of the sunlight. Move it so that the shadow crosses the picture of the moon.
- Observe the shadow from the Earth on the moon.

Student Discussion Questions:

- What is the shape of the shadow of the Earth of the moon? *It is circular or round.*
- How does this prove that the Earth is round? *Only round objects produce round shadows.*
- What does this demonstrate about the properties of light? *Light travels in straight waves or rays from the source.*

LESSON 2: Light and Matter

Lesson Materials:

- Flashlight (not included)
- Cut outs of groundhogs in transparent, translucent and opaque materials
 - Transparent-overhead transparency
 - Translucent-milk carton
 - Opaque-dark paper or cardboard

Procedure:

- Groundhog Day on February 2 is a day dedicated to shadows. A shadow occurs when light hits and opaque object and the light is blocked. The shape of the object is revealed by the shadow.
- Use the flashlight as a light source.
- Place the opaque groundhog in the path of the light ray. What is the shape of the shadow on the wall? You may have to adjust the distances of the light, groundhog or wall to get a sharply defined shadow.
- Repeat using transparent groundhog. Describe the shadow on the wall? Adjust the distances of the light, groundhog or wall. The light should shine through the transparent ground hog.
- Repeat using translucent groundhog. Describe the shadow on the wall? Adjust the distances of the light, groundhog or wall. The shadow should be fuzzy (the light scatters) through the translucent groundhog

Student Discussion Questions:

- What happened to the light when it hit the opaque groundhog? *A shadow was produced with sharply defined edges.*
- What happened to the light when it hit the transparent groundhog? *No shadow was formed. The outline edges of the groundhog may be visible.*
- What happened to the light when it hit the translucent groundhog? *The shadow appears fuzzy due to the light scattering when it hits a translucent object.*

LESSON 3: Transparent, Translucent, Opaque

Lesson Materials:

- Student Worksheet
- Samples of transparent, translucent and opaque materials: paper towel, aluminum foil, wax paper, wooden block, colored cellophane, magnifying glass, book and a clear glass window. *Not included in classroom kit.*

Procedure:

- Students will experiment, then decide whether the objects on the list are transparent, translucent or opaque and check the appropriate box.
- Answers:
Opaque – *white shirt, aluminum foil, wood, book (possibly paper towel depending on brand)*
Translucent – *paper towel (depending on brand), wax paper, colored cellophane*
Transparent – *glass window, magnifying glass*

LESSON 4: Transparent, Translucent and Opaque Scavenger Hunt

Lesson Materials:

- Scavenger Hunt Worksheet

Procedure:

- Have students explore their school, home or other surroundings to locate five or more items that are transparent, translucent and opaque.
- Record on Scavenger Hunt Worksheet.