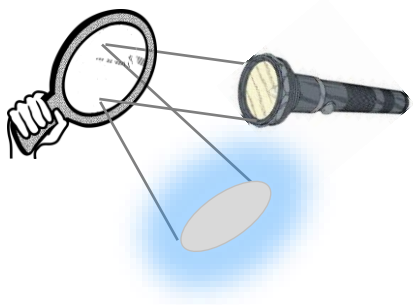
REFLECTING ON LIGHT (REFLECTION)

Ages 10-14, grades 5-8



Description

In this activity, students will discover what kinds of objects reflect light and how reflection works.

Materials

- Flashlight
- A rough textured ball, like a tennis ball
- Assortment of objects such as finished and unfinished wood, plastic or metal spoons, paper, cardboard, etc.
- A low power laser pointer
- Printed protractor from the internet
- Empty CD case to use as a mirror

Small mirrors that can stand vertically can be difficult to find but a clear CD jewel case makes a good substitute. Cut a piece of black paper to fit the inside cover, where the front label goes. Protractors suitable for printing can be found on the internet. The assorted objects can be anything found around the house or classroom, but they need to be wide enough to show a strong reflection. That is, spaghetti doesn't work well but corks, spoons, pieces of paper– even student hands and elbows– are fine.

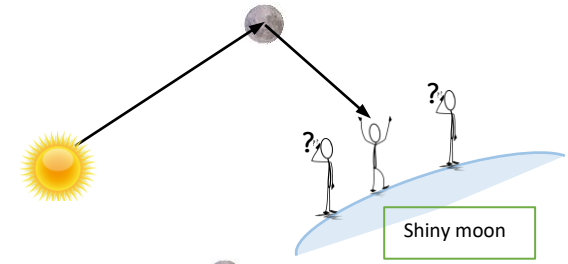
Background and Misconceptions

What reflects light? Most student will say "a mirror". But in order to see any non-luminous object, light must reflect from the object and enter your eye. That is, every non-luminous object you see is reflecting ambient light into your eyes. The first activities are designed to show that even rough surfaces reflect light. The "Reflection Rule" (the reflection angle is equal to the incident angle) is easy to deduce from a few careful measurements. The final activity locates where a mirror image forms. For additional information and more mirror activities see www.lasertechonline.org/Bending_Light-Reflection.html .

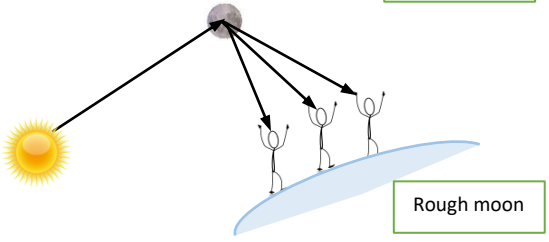
Teacher Guided Questions to Inquiry

Use these questions to get students started on their own inquiry.

1. **Choose one object in the room. Where does the light come from that illuminates that object?** (There can be many sources- sunlight through a window, room overhead lights, light leaking in from a corridor, an illuminated computer monitor, etc. The actual path taken from a light source to an object may be complex and involve multiple reflections. Some students will suggest that a reflective object (for example the face of a clock) is providing light and the concept of reflection can be discussed at that point. Students sometimes will say that the electrical outlets or rooftop solar panels are providing light. This is an opportunity to discuss the difference between the power sources for lights and the light sources themselves.)
2. **What is the difference between a shiny object and one that is dull or rough?**
   (Many students – and adults – believe that only mirrors reflect light, but rough objects such as skin, cloth, trees and wood also reflect light. Reflection from a rough surface is called is *diffuse*, that is, incident light reflects in all directions. Diffuse reflection allows an object to be seen from many vantage points at once. If the moon were a mirror-like (*specular*) reflector, for example, its light would only be visible over a small area. Because the moon reflects diffusely it can be seen in many regions at the same time.)



3. **Can you devise a test to determine if an object reflects light?**
   (In the activities, students use a flashlight to reflect light from a rough object onto the surface below. Seeing the reflected light shows that the object, though rough, is reflecting.)

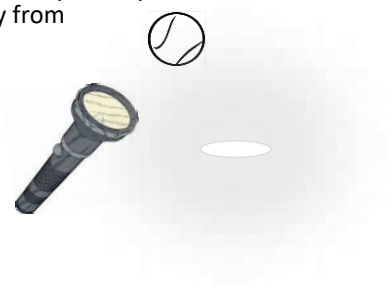


Guided Inquiry

Activity 1: Warm up- where does light come from?
Pick out an object in the classroom and write down all the sources of light that illuminate it. Choose one of these light sources and see if you can figure out the pat that light took from the source to the object to your eye.

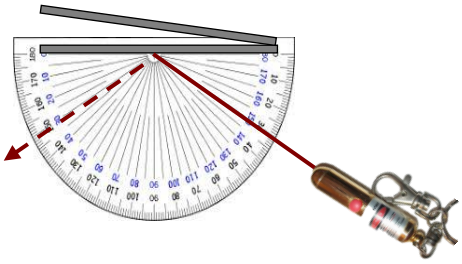
Activity 2: What reflects light?

1. Shine the flashlight on the rough surfaced ball. Do you think the ball is reflecting the light? Why or why not?
2. How does a mirror reflect light? Hold the mirror (or CD case) in the flashlight beam and turn it to reflect the light onto a wall. Is the spot of light on the wall proof that the mirror reflects light? Why or why not?
3. Now test the ball to see if it reflects light. Hold the flashlight so that it points away from the table at an angle. Do you see a spot of light on the table? (If you do, point the flashlight a bit higher.) Now move the ball into the flashlight beam. Do you see a spot of light on the table? Where did it come from? Does a rough ball reflect light?
4. You will be given a collection of objects. Sort them into three groups: SHINY, ROUGH and DULL. Which of these objects do you think reflect light? Test each one using the same test you used for the ball.
5. What objects reflected light? Make a general statement about how reflection allows you to see the objects around you.

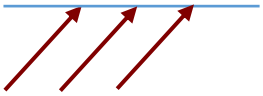


Activity 3: Find a rule for reflection
SAFETY RULES: Keep the laser pointer flat on the table. Only turn it on when you are making measurements.

1. Place the printed protractor on a table. Stand the mirror (or CD case) vertical so that it is lined up on the "zero" line of the protractor.
2. Predict what would happen if you were to shine a laser at the mirror along the 30° line. Try it! What is the reflected angle?
3. Now try a few more angles that you choose. Can you state a general rule for angles when light is reflected from a mirror?

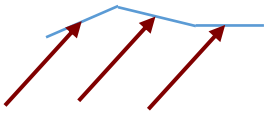


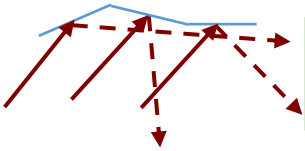
Activity 4: Diffuse reflection from a rough surface
Show how light is reflected from a flat mirror surface by drawing the reflected rays. The red arrows represent three laser beams striking the mirror.



Reflected rays go in the same

Suppose instead of a flat mirror you have a surface made up of many pieces of mirror. Use the reflection rule to show how each of the the four rays is reflected from the mirror pieces? Can you explain how diffuse reflection works?

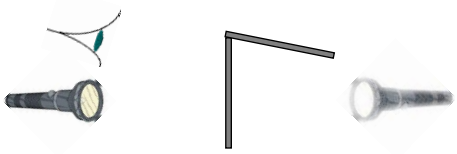




Reflected rays go in different directions.

Activity 5: Where is the image?

1. Remove the black paper you put inside the CD case so you have a clear plastic "window". Set up the CD vertically on a table. Turn off the room lights
2. Place the flashlight (or other small light source like an LED) on the table about 20-30 cm in front of the CD window. Look into the window for the light's reflection.
3. Carefully reach behind the window and put your finger at the position of the reflection. Without moving your finger, measure the distance from the window to your finger. Then measure the distance from the flashlight to the window. What do you notice about these distances?



Analysis Questions

1. What type of object (shiny, dull, rough) reflects light?
2. How do shiny objects reflect light? How do rough or dull objects reflect light?
3. What is the rule for angles in reflection?
4. How far behind a mirror does an image form?