

The Laws of Reflection

As you observed in Activity 11.5, when you shine an incident light ray at a plane mirror, the light is reflected off the mirror and forms a reflected ray. Both the incident ray and the reflected ray behave in a predictable way. This predictable behaviour of light leads to the two laws of reflection (Figure 1):

1. The angle of incidence equals the angle of reflection.
2. The incident ray, the reflected ray, and the normal all lie in the same plane.

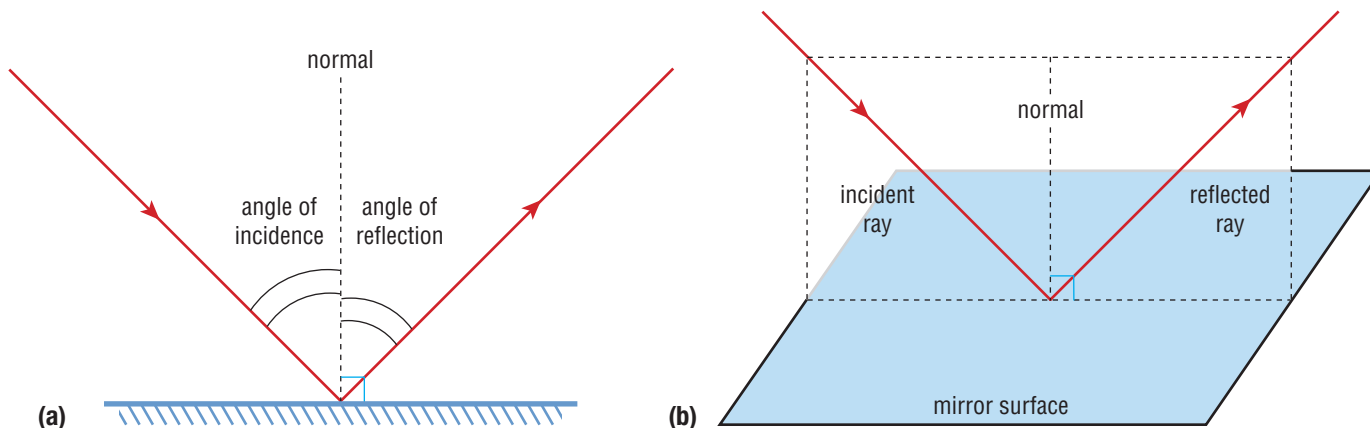


Figure 1 Diagrams illustrating the two laws of reflection

When more than one incident light ray is reflected off a surface, the laws of reflection still hold but the surface affects the way you see the reflected rays. For example, the reflections off a smooth piece of foil are not the same as those off a crumpled piece of foil. Find out by doing the activity “Reflecting Light.”

TRY THIS REFLECTING LIGHT

SKILLS MENU: Observing, Evaluating

SKILLS HANDBOOK
3.B.6., 3.B.8.

Equipment and Materials: flashlight (or an unshielded ray box); sheet of aluminum foil (about 30 cm × 30 cm)

1. Place a smooth piece of aluminum foil flat on a table. Turn off the lights in the room and reflect the beam from the flashlight or ray box off the aluminum foil. Aim the light beam so that it is reflected up onto the ceiling. Examine the reflected beam.
2. Now crumple up the aluminum foil. Open up the crumpled piece of foil but do not smooth it out. Again, reflect the light beam off the foil onto the ceiling and examine the reflected beam.
 - A. Describe the shape of the reflected beam on the ceiling when the aluminum foil was flat and when it was crumpled. **T/I**
 - B. Account for the difference in the reflected beam between your two trials. **T/I**

READING TIP

Using Text Layout

Subheadings are capitalized. This means that there are new concepts or ideas in this section. Write down the main ideas communicated in each subsection.

Reflecting Light Off Surfaces

Assume that a series of parallel incident rays strike a flat reflective surface. The angles of incidence for these rays are all identical. This means that their angles of reflection will also all be identical, and the reflected rays will all be parallel to each other. This is an example of regular or specular reflection.

Specular reflection is the reflection of light off a smooth, shiny surface (Figure 2). Reflection off a plane mirror is specular reflection, as is reflection off the surface of very still water (Figure 3), or a flat piece of aluminum foil.

specular reflection reflection of light off a smooth surface

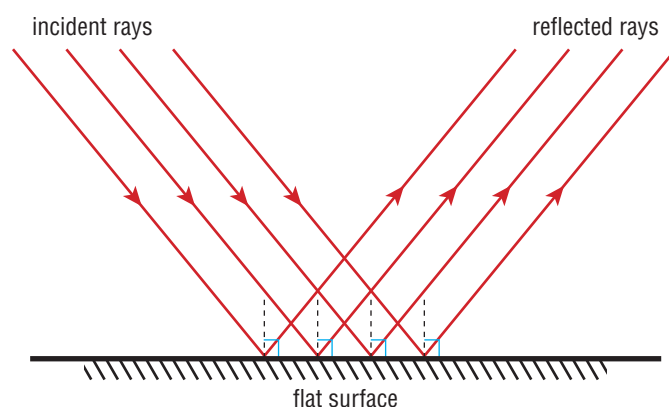


Figure 2 How specular reflection works



Figure 3 A spectacular example of specular reflection. The water acts like a plane mirror.

The mirrored surfaces on a disco mirror ball found in clubs and parties, for example, exhibit specular reflection. The ball consists of a number of plane mirrors on a spherical surface that produce an eye-catching display by reflecting light in all directions (Figure 4).

What would happen if the parallel incident rays were directed at an irregular surface? Now the incident rays would all have different angles of incidence. This means that their angles of reflection would also be different. The reflected rays would not emerge parallel to each other but would be reflected or scattered, in many different directions. This is called diffuse reflection. **Diffuse reflection** results from the reflection of light off an irregular or dull surface (Figure 5). Examples of diffuse reflection are reflection off a sheet of paper, a water surface with waves (Figure 6), or a crumpled piece of aluminum foil.

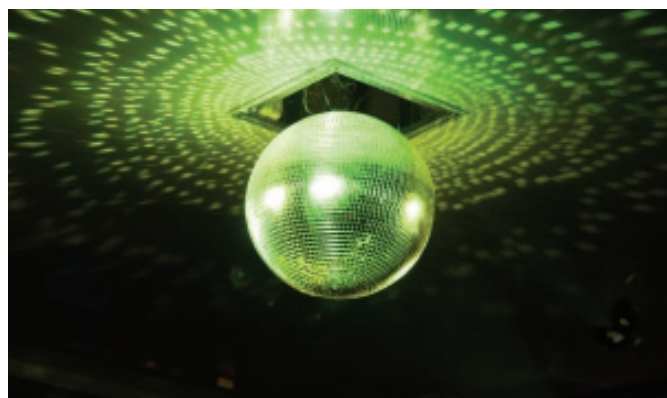


Figure 4 A disco mirror ball is an example of specular reflection from its many surfaces.

diffuse reflection reflection of light off an irregular or dull surface

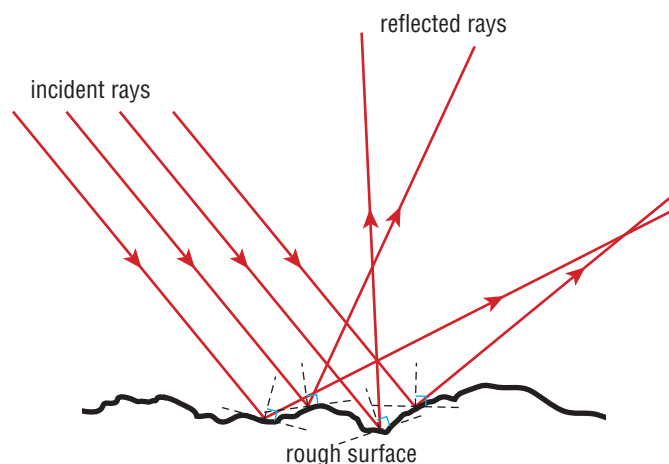


Figure 5 How diffuse reflection works



Figure 6 Diffuse reflection as a result of ripples in the water

TRY THIS RETRO-REFLECTORS

SKILLS MENU: Performing, Observing, Evaluating



In this activity, you will draw a diagram of a retro-reflector. You will learn more about retro-reflectors in the next chapter.

Equipment and Materials: ruler; protractor; piece of paper; pencil

1. Draw two mirrors meeting at a right angle (forming an L-shape) near the centre of the paper. Pick any orientation that you wish for the mirrors.
2. Use a ruler to draw a ray that strikes one of the mirrors.
3. Use the laws of reflection to determine the angle of incidence. Draw the reflected ray off this mirror. This ray will now act as the incident ray striking the second mirror surface.

4. Use the laws of reflection to draw the second reflected ray.
5. Repeat steps 2 to 4 using a second incident ray that strikes the mirror at a different angle from the first one. Use a different colour for each incident ray.

Optional: Do this experiment with two plane mirrors and a ray box.

- A. How did the incident ray compare with the ray that emerged after the two reflections in your first trial? **T/I**
- B. Did this result change for your second trial? **T/I**
- C. Based on your observations, what is the main characteristic of a retro-reflector? **T/I**

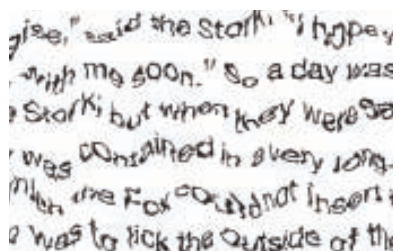


Figure 7 This is how text might appear to a person with dyslexia.

Reflection and Dyslexia

People with dyslexia have difficulty reading print (Figure 7). Many people who are dyslexic complain about the glare off white paper: there is too much reflected light from the paper. The contrast between the white paper and the black text makes reading difficult. For some people, this condition can be helped by the use of coloured filters or glasses that reduce the glare of reflected light from paper. This sometimes makes reading easier.

UNIT TASK Bookmark

You can apply what you learned about optics in this section to the Unit Task described on page 588.

IN SUMMARY

- When light is reflected off a plane mirror, the angle of incidence equals the angle of reflection.
- When a light ray strikes a plane mirror, the incident ray, the reflected ray, and the normal all lie on the same plane.

CHECK YOUR LEARNING

1. Using a diagram, distinguish between the incident ray, the reflected ray, and the normal. **K/U C**
2. Clearly state the two laws of reflection. **K/U**
3. (a) What is the difference between specular reflection and diffuse reflection?
(b) Provide some examples of both specular and diffuse reflection other than those given in this section. **K/U A**
4. (a) If you were painting the walls in your classroom, would you want the walls to exhibit specular or diffuse reflection? Explain.
(b) Given your choice, should you use gloss or matte paint? **K/U A**
5. (a) What would be the angle of reflection for an angle of incidence of 32° ?
(b) What would be the angle of incidence for an angle of reflection of 47° ?
(c) What would the angle of reflection be if the incident ray was 40° from the reflecting mirror surface? **K/U**
6. Specular reflection and diffuse reflection are concepts that can be applied to every room that you have ever been in. Describe how these concepts can be applied to your kitchen, bathroom, and bedroom. **A**