



# Wave Behavior

S8P4a. Identify the characteristics of electromagnetic and mechanical waves.

S8P4b. Describe how the behavior of light waves is manipulated causing reflection, refraction, diffraction, and absorption.

# Reflection

- Reflection occurs when a wave strikes an object or surface and bounces off.
- An echo is reflected sound.
- Sound reflects from all surfaces.
- You see your face in a mirror or a still pond, because of reflection.
- Light waves produced by a light source such as the Sun or a light bulb bounce off your face, strike the mirror, and reflect back to your eyes.

# Reflection (continued)

- When a surface is smooth and even the reflected image is clear and sharp.
- When light reflects from an uneven or rough surface, you can't see a sharp image because the reflected light scatters in many different directions.

Reflections From the Surface of Water



Smooth Water Surface



Wavy Water Surface

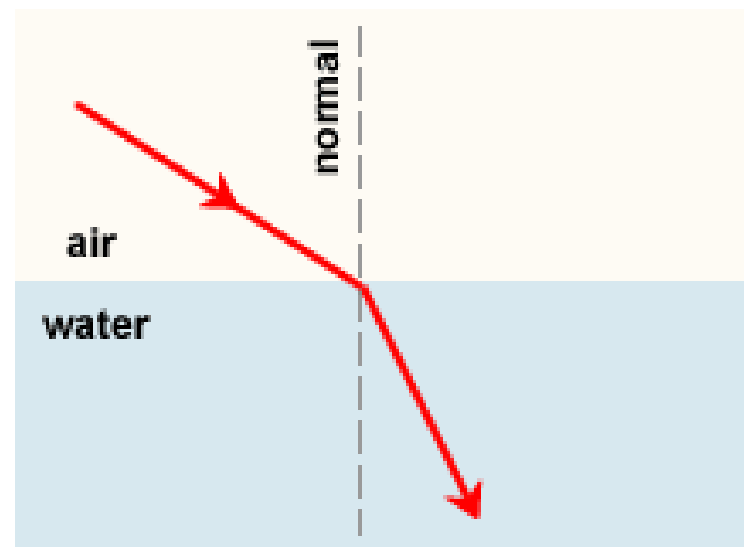
Figure 1

# Refraction

- Refraction is the bending of a wave as it moves from one medium into another.
- The speed of the wave can be different in different mediums.
- For example, light waves travel faster in air than in water.
- Refraction occurs when the speed of a wave changes as it passes from one substance to another.

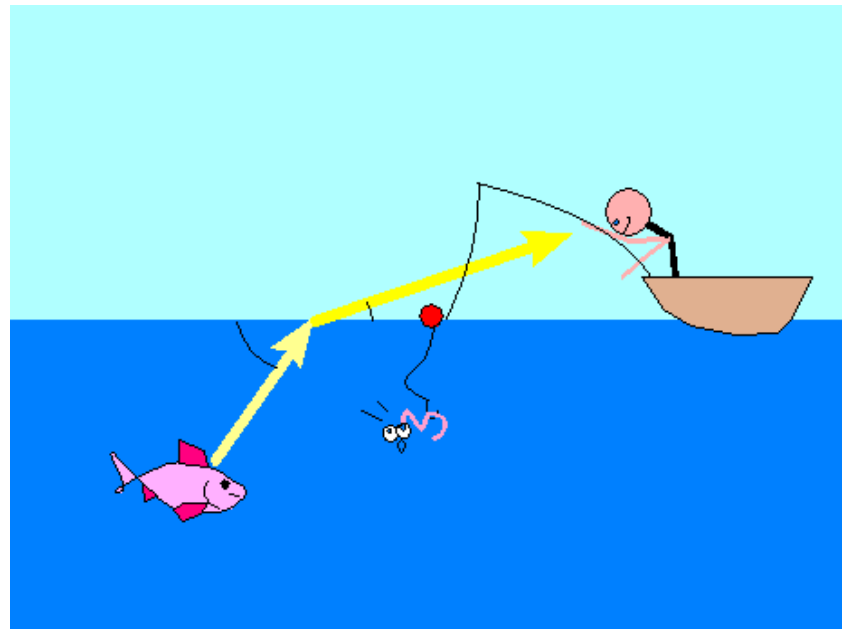
# Refraction (continued)

- A line that is perpendicular to the water's surface is called the normal.
- When a light ray passes from air into water, it slows down and bends toward the normal.



# Refraction (continued)

- When the ray passes from water into air, it speeds up and bends away from the normal.
- The larger the change in speed of the light wave is, the larger the change in direction.



# Color from Refraction

- Sunlight contains light of various wavelengths.
- When sunlight passes through a prism, refraction occurs twice: once when sunlight enters the prism and again when it leaves the prism and returns to the air.
- Violet light has the shortest wavelength and is bent the most.
- Red light has the longest wavelength and is bent the least.

# Color from Refraction (continued)

- Each color has a different wavelength and is refracted a different amount.
- As a result, the colors of sunlight are separated when they emerge from the prism.
- Rainbows are created when light waves from the Sun pass into and out of raindrops.



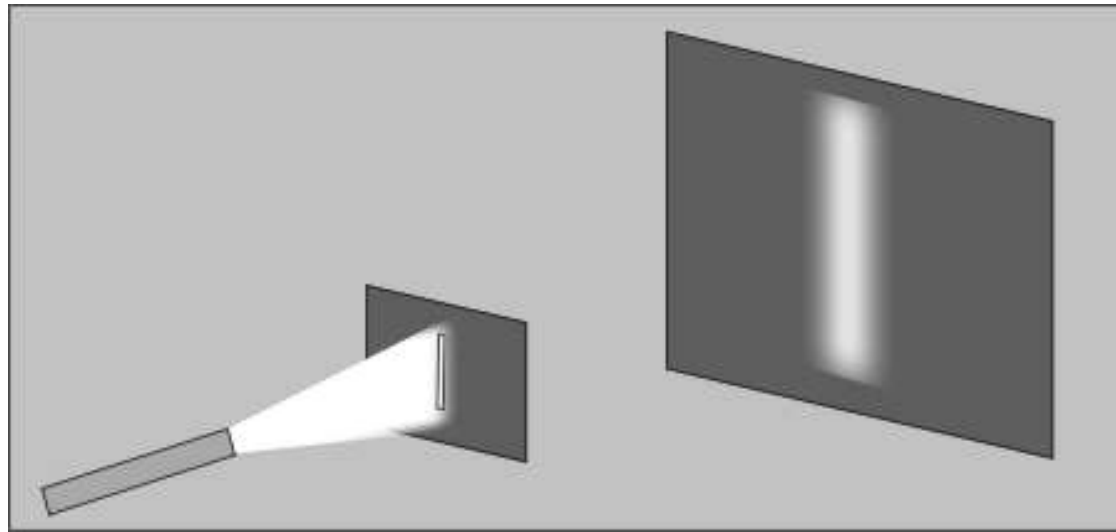
# Color from Refraction (continued)



- The colors you see in a rainbow are in order of decreasing wavelength: red, orange, yellow, green, blue, indigo, and violet.

# Diffraction

- Diffraction is the bending of waves around a barrier.
- Sound waves diffract more than light waves.
- You can hear sound around a corner, but you can't see around corner.

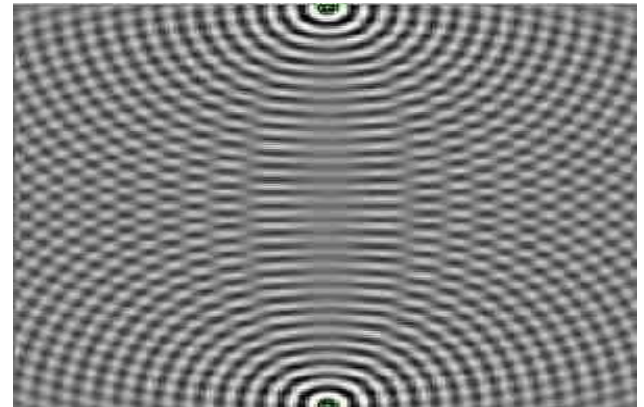


# Diffraction and Wavelength

- Light doesn't diffract much when passing through an open door because the wavelengths of visible light (400 to 700 billionths of a meter) are much smaller than the width of the door (1 meter).
- Sound waves that you can hear have wavelengths between a few millimeters and 10 m.
- A wave is diffracted more when its wavelength is similar in size to the opening.

# When Waves Meet

- Waves pass right through each other and continue moving.
- While two waves overlap a new wave is formed by adding the two waves together.
- The ability of two waves to combine and form a new wave when they overlap is called interference.



# Types of Interference

- When the crest of one wave overlaps the crest of another wave it is called constructive interference.
- The amplitudes of these combining waves add together to make a larger wave while they overlap.
- Destructive interference occurs when the crest of one wave overlaps the trough of another wave.
- The amplitudes of the two waves combine to make a wave with a smaller amplitude.

# Waves and Particles

- When waves travel through a small opening, such as a narrow slit, the light spreads out in all directions.
- If particles are sent through the same slit they would continue in a straight line.
- Spreading, or diffraction, is only a property of waves.

# Waves and Particles (continued)

- If waves meet, they reinforce or cancel each other, then travel on.
- If particles approach each other, they either collide and scatter or miss each other completely.
- Interference is a property of waves.

# Summary

- Reflection

- Reflected sound waves can produce echoes.
- Reflected light rays produce images in a mirror.

- Refraction

- The bending of waves as they pass from one medium to another is refraction.
- Refraction occurs when the wave's speed changes.



# Summary (continued)

- A prism separates sunlight into the colors of the visible spectrum.
- **Diffraction and Interference**
  - The bending of waves around barriers is diffraction.
  - Interference occurs when waves combine to form a new wave while they overlap.
  - Destructive interference can reduce noise.

