COLLEGE OF SAINT MARY

Light and Sound – Grades 3-5

Nebraska Science Standards
5.2.3.a Recognize that sound is produced from vibrating objects; the sound can be changed by changing the vibration
5.2.3.b Recognize that light travels in a straight line and can be reflected by an object (mirror)
5.2.3.c Recognize that light can travel through certain materials and not others (transparent, translucent, opaque)

Objective: The objective of this activity is to provide hands-on demonstrations that help students to understand the properties of light and sound.

Materials (provided by CSM):

- Handouts for the instructors to show students as a visual guide (3 of each)

Light Activities:
- Prism (3)?
- Flashlight (3)?
- Laser pointer (3)?
- Handheld mirrors (3)?
- Empty paper towel roll
- Craft knife (for volunteers to use)
- Scissors
- Blank/old CD
- Pencil
- Small piece of cardboard or cardstock
- Tape

Sound Activities:
- Slinky
- Tuning Forks
- Baking pans
- Paper towels

Materials (provided by the classroom):
- Water

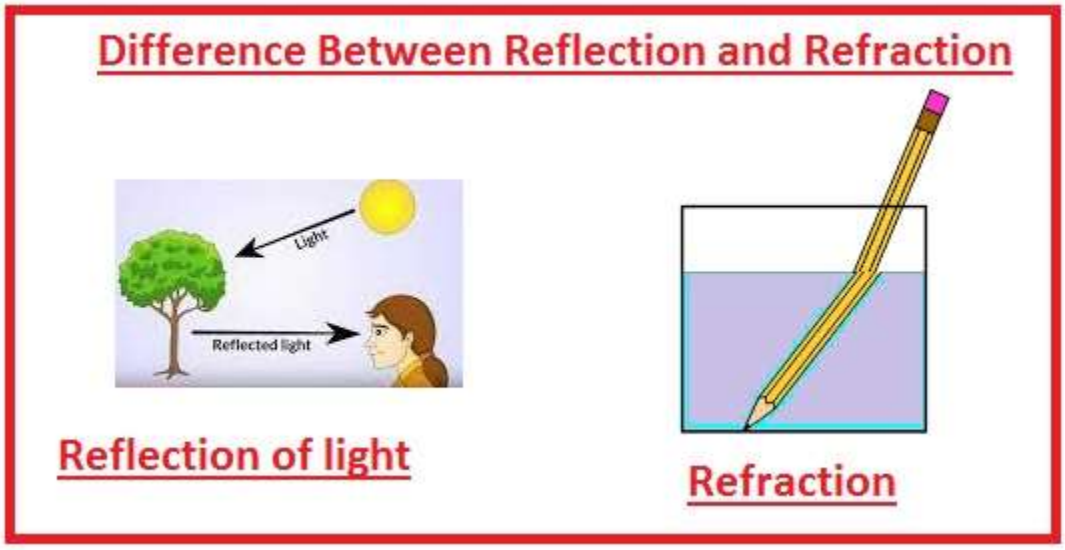
Setup:

- Break students into two big groups and have half the students start the light activity and the other group will start the sound activity

Light Activity Discussion (Questions to ask the students)

- Why is it important for scientists to study light and sound?
    - Light allows us to see our world and perceive visual information. Sound allows us to hear and communicate.
- How do sound waves travel? How do light waves travel? What's the difference?
    - Sound travels in the form of vibrations. For example, when someone picks a guitar string, the string vibrates and produces a sound. The sound produced travels in a longitudinal or compression wave. The volume and pitch of a sound depends on its amplitude and frequency.
    - Light travels in "energy packets" called photons. Photons look like waves. Light travels in transverse waves. These waves are like ocean waves, they go up and down. The reason why we are able to see is because light bounces off the surface of an object to our eyes.
- What is the difference between reflection and refraction of light?
    - Reflection occurs when light bounces off objects.
        - If light bounces off a smooth surface, the light will bounce off at equal angles, such as a mirror or when looking at a water
    - Refraction occurs because light bends.
        - Light bends as it passes from one substance into another. Imagine a glass of water with a straw. The straw appears to be bent because the light passes from the air to the water.

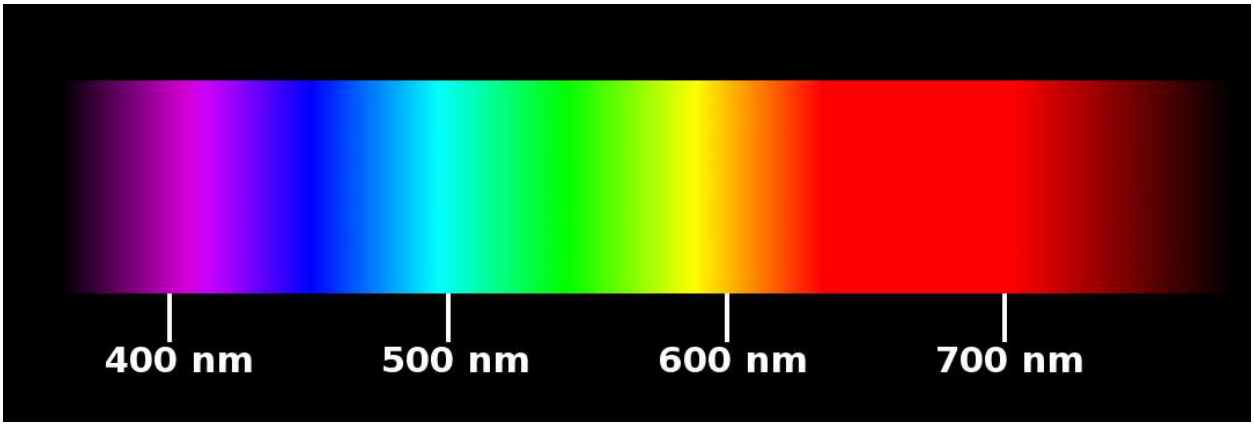
❖ Show the class:



- How do we see color?
    - Absorbed light is taken in and not reflected.
    - A red apple appears red because it absorbs all the other colors and reflects red.

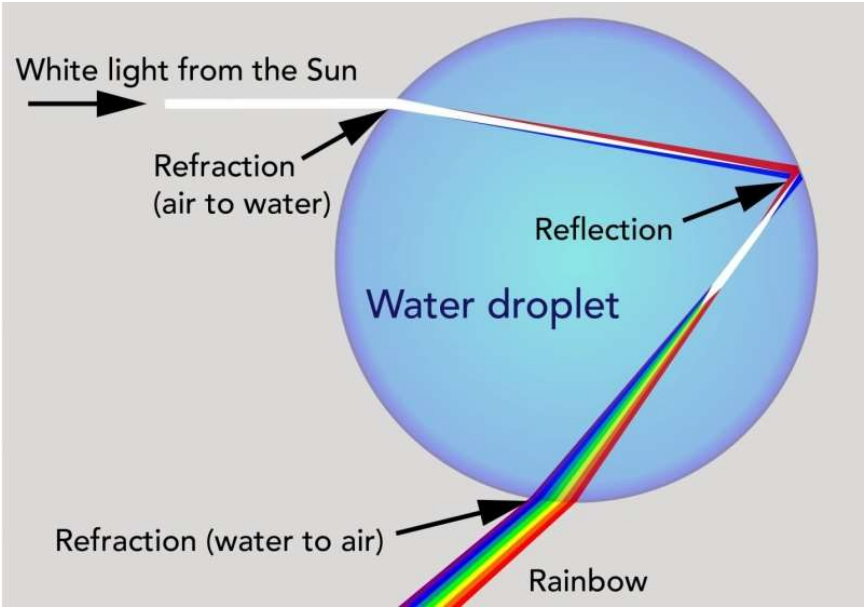
- Color is seen in a rainbow, ROYGBIV – red, orange, yellow, green, blue, indigo, and violet

❖ Show the class:



- How is a rainbow formed?
  - As light passes through a prism, it bends light (refraction) and is reflected back to your eyes as a rainbow. Raindrops act like tiny prisms.

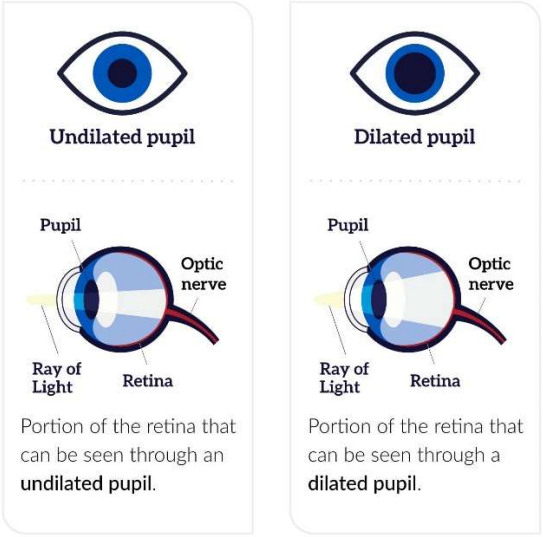
❖ Show the class:



- How fast does light from the sun get to the earth?
  - 499 seconds for light from the sun to travel to earth, which is about 8 minutes and 20 seconds.
- How do we see light?

- Light passes through the cornea, pupil, and lens before hitting the retina. The iris controls the size of the pupil. In a dark room, the iris gets smaller, allowing the pupil to dilate. In a bright room or outside, the iris gets bigger, which does not let as much light pass through.

❖ Show the class:



- What speed does light travel?
  - 186,282 miles per second! That's like running around the entire Earth in 7.5 seconds! In theory, nothing travels faster than light.

Light Activity 1 Description: Refraction and Reflection

Students will experiment with refraction, the bending of light through different mediums, and reflection, allowing light to bounce off objects.

❖ Break up the light group into three total groups.
❖ Make sure the students know to not shine the laser in anyone's eyes.

You will need:

- Prism (3)?
- Flashlight (3)?
- Laser pointer (3)?
- Handheld mirrors (3)?

Procedure:

1. Allow the students to play around with the items at the station: prism, flashlight, laser pointer, and mirror.

2. The prism and flashlight can be used to “bend” white light (refraction) and make rainbows. Point the flashlight at the prism near a wall or solid object. Observe the rainbows that are produced on the solid object after the light passes through the prism.

3. The laser pointer and mirror can be used to “bounce” the light (reflection) onto another object. Direct the laser pointer at the mirror and move the mirror to reflect the light onto a solid object like a wall or desk.

Light Activity 2 Description: See the Rainbow

Students will create a spectroscope to be able to refract light to create rainbows.

Setup:

- Instructors should cut a thin slit at a 45° angle toward the bottom of the cardboard tube.
- Directly across from the slit, also cut a small peephole or viewing hole

You will need:

- Empty paper towel roll
- Craft knife (for volunteers to use)
- Scissors
- Blank/old CD
- Pencil
- Small piece of cardboard or cardstock
- Tape

Procedure:

1. Give each student a cut paper towel roll to use to make their spectroscope.

2. Have the student, trace one end of their paper towel roll onto a small scrap of cardboard and cut it out.

3. Then have the student cut a straight slit right across the center of their cardboard circle.

4. Students should then tape the circle to the top of their spectroscope.

5. Hand out one CD to each student and have them place the CD into their 45° angled slit with the shiny side facing up towards the cardboard circle end.

6. To use the Homemade Spectroscope, point the top slit at the sky (NOT directly at the sun). Look through the peephole. You will see a rainbow inside!

Sound Activity Description:

Students will participate in a demonstration and activity highlighting the concepts of sound.

You will need:

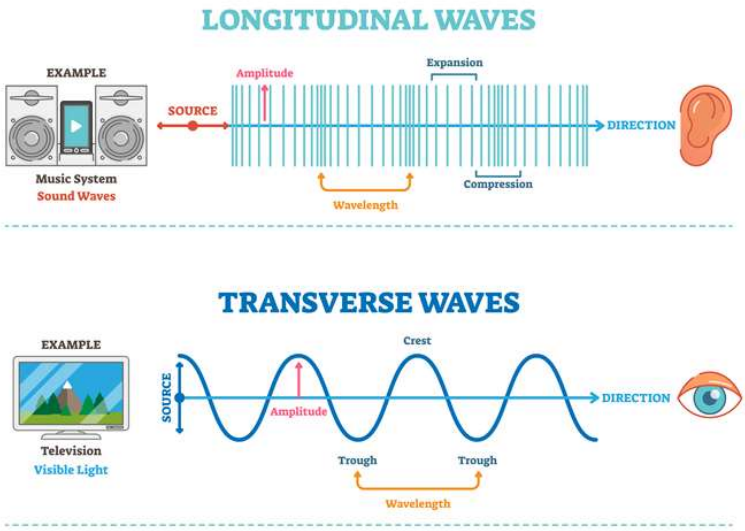
- Slinky
- Tuning Forks
- Baking pans
- Paper towels
- Water

Setup:

- ❖ While the other group is participating in the light activity, have the rest of the class perform the sound demonstration and activity.
- ❖ Ensure students take care with the slinky so it doesn't get tangled.

Sound Activity Discussion (Questions to ask the students)

- Why is it important for scientists to study sound?
  - Sound allows us to hear and communicate.
- Why do we hear sounds at different pitches?
  - Different pitches are caused by different frequencies in sound waves. The bass, drum and tuba have low frequencies. Chirping birds and playing the triangle have high frequencies.
  - Vibrations are detected in the ear.
- How do sound waves travel? How do light waves travel? What's the difference?
  - Sound travels in the form of vibrations. For example, when someone picks a guitar string, the string vibrates and produces a sound. The sound produced travels in a longitudinal or compression wave. The volume and pitch of a sound depends on its amplitude and frequency.
  - Light travels in "energy packets" called photons. Photons look like waves. Light travels in transverse waves. These waves are like ocean waves, they go up and down. The reason why we can see is because light bounces off the surface of an object to our eyes.



Wave Demonstration:

- Transverse waves demonstration
    - Chose two students to help you with the demonstration. Have each student hold one end of the slinky. One student will gently make an up-and-down motion with his/her hand. These waves are light waves.
- Compression waves demonstration
    - Chose two other students to help with the demonstration. Set up the slinky on a solid surface, either a long table or a tile floor. The students should be a little bit closer than the transverse waves demonstration as this wave does not move as easily. Have one student hold the slinky stationary and do not move. Have the other student push the slinky towards the other helper without letting go. The vibrations felt are sound waves.
- Tell the students they did a great job and have them return to their group to begin the next sound activity.

Sound Activity 2: Pitch and Frequency

- Students brainstorm and hypothesize about pitch and frequency. High pitches move faster, low pitches move slower.
    - High pitches: Flute, Violin, Birds chirping, Sirens/alarms
    - Low pitches: Tuba, Bass clef instruments, Bear/lion roar, A hungry stomach
- Discuss how we can "see" sound
    - Vibrations can be seen in water

Set up:

- Put water about 1 ½ inches deep in each pan, place paper towels under the pans to reduce water mess

Procedure:

1. Let the students hypothesize what size of tuning fork will have a high sound and low sound.

2. Then let them experiment by **gently** tapping the tuning fork on the edge of their desk or the palm of their hand.

3. Have them notice the fork shaking as it produces the sound.

4. Have them put it a few inches from their ear and notice the sound, is it high pitched or low pitched? What do you think these sound waves would look like?

5. Now, have them tap the fork again, but this time have them put the end of the tuning fork in the pan with water. What do they see? *The tuning fork should NOT be submerged or else the experiment won't work.

6. The intended result is to see the waves/ripples go out from the fork when placed in the water. These waves correspond to pitch and frequency.