GELATIN REFRACTION

ELEMENTARY SCHOOL LEVEL 1

The use of gelatin in food dates back to the 1400s in medieval Britain, where cattle hooves were boiled down to make a gel. Gelatin is a great medium to use when learning about light reflection and refraction. Using clear gelatin and a laser pointer, we can visually observe the way that light is bent inside of a suspended solution. Use a protractor to measure the angles of refracted light inside of the gelatin.

EDUCATIONAL STANDARDS:

NGSS CONNECTION:
1-PS4-3. Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light.

COMMON CORE CONNECTION:
ELA/Literacy
W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

SL.1.1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.

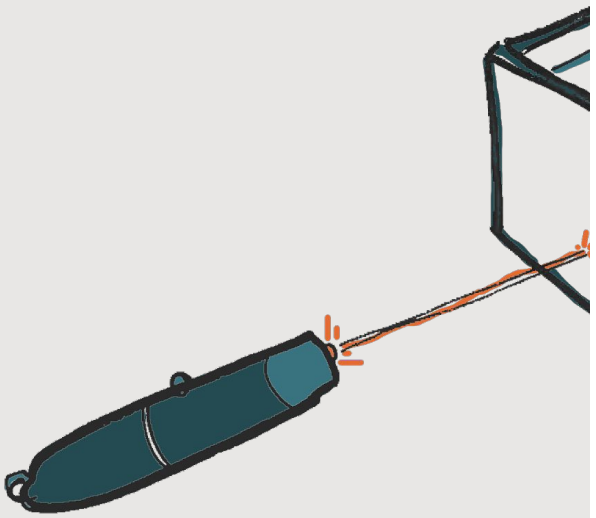
DOK:
Level 2: Concept
Level 3: Strategic Thinking

MATERIALS NEEDED:

- ❏ 1 box of gelatin
- ❏ Mirror
- ❏ Laser pointer
- ❏ Clear containers

DIRECTIONS:

1. Prepare the gelatin and let it harden. Use a rectangular dish that is deep enough to make a tall cube.
2. Remove the gelatin and place it on a flat surface.
3. Turn off the lights and shine a laser through the gelatin.
4. Use the mirror to reflect the light back into the gelatin. How far does it reach?
5. Measure the angles you can make.
6. See how far into the gelatin mold you can shine the laser before the light dies away..

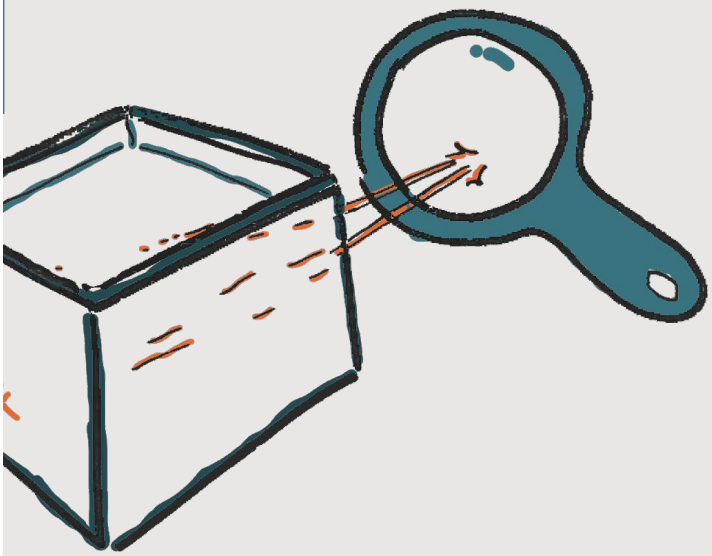


OBJECTIVE:

Students will be able to conduct scientific investigations to discover and describe properties of light and the effects objects have on light.

ESSENTIAL QUESTIONS:

- What effect do objects have on light?
- Why is the sky blue?
- What are rainbows?



FUN FACTS

A. **Gelatin's spring-like molecular structure swells in cold water and dissolves in hot water.**

B. **Gelatin is a simple and effective way to keep hair, skin, nails, and teeth healthy.**

C. **LASER is actually an acronym: Light Amplification by Stimulated Emission of Radiation.**

ENGAGE / EXPLORE:

1. Two Bit Circus Foundation Magic Show using light refraction techniques
    a. Teacher does a class demonstration to make a piece of glass "disappear"
        i. Materials
            1. Large glass beaker
            2. Canola oil
            3. Small glass beaker—broken (be careful, edges are sharp!)
            4. Small glass beaker
            5. Tongs
        ii. Place the canola oil in the large beaker (enough to cover the small beaker)
        iii. Add the small glass beaker into the canola oil—you should notice that the beaker "disappears" (this should be done prior to the students arriving)
        iv. Put on your best magician character—you will turn a broken beaker into a new beaker!
            1. Tell students you will repair the beaker but not before they shout the magic word…..
            2. 1…. 2…. 3… place the broken beaker with tongs into the oil
            3. Quickly pull out the small beaker you put in before class and accept your applause!
    b. Students will be wondering how it works and wants you to teach them the trick.
        i. Do not tell them how it works but you may show them the other beaker if you so choose.
        ii. Tell them the next activity will help them understand how it works. And segue into your next activity.

*The magic show works due to the index of refraction of canola oil and the glass. Both have approximately the same refractive index which means they refract (bend) light at similar angles. You cannot, therefore, perceive the differences in the two objects as light passes through them.

1. Students plan and conduct an experiment on the properties of light and objects
    a. Students are given a variety of materials and a flashlight or other direct light source
        i. Materials should include reflective, opaque, translucent, and transparent objects
            1. Two Bit Circus Foundation has a variety of materials that may fit your needs
            2. Household items, cardboard, foil, wax paper, clear plastic also work.
    b. Ask students
        i. "How might we design an experiment to determine the effects of different materials on light?"
        ii. Allow students to generate and conduct their own test to determine the effects of light.
            1. Facilitate their designs by asking questions that foster critical thinking and reflection.
            2. Students should make predictions for each object (using a data table format)
            3. Students should track their data in a chart (teacher or student created)
            4. Students should conclude that different objects have different effects on light.
                a. Opaque: light is blocked/cannot pass through an object
                b. Translucent: some light passes through the object
                c. Transparent: all light passes through the object
                d. Reflective: light bounces off the object
            5. They may not know these terms, however, they may reach the same conclusion (i.e. "light is blocked" "it goes through" "comes back")

c. Evaluate learning
    i. Experimental design
    ii. Drawing conclusions from evidence (observations)

EXPLAIN:

1. Read a few children's books on light
    a. Light: Shadows, Mirrors, and Rainbows
    b. Light Is All Around Us
2. Discuss the book as a class
    a. Reflect back on the stories
        i. Compare examples from the books with the students' experiment above.
        ii. Introduce language
            1. Opaque, translucent, transparent, reflective
            2. Have students identify real-world examples of each one.
    b. Use 3D color wheel activity as supporting material for light reflection
3. The *Bill Nye The Science Guy* episode, "Light" is helpful for students to review concepts about light.

ELABORATE:

1. Students perform two experiments
    a. Perform Crystal Jars experiment
        i. Students make predictions and evidence-based conclusions on how the crystal Jar works
        ii. Students should be using academic language and discussing light through and bouncing off of the materials.
    b. Perform the Gelatin Refraction activity
        i. Students conduct an experiment to determine what will happen as a beam of light moves through the gelatin
        ii. Colored gelatin and a laser pointer can be used for further discussion.
            1. Light will only refract and pass through colors near the laser color
            2. Other colors will not pass through as the material becomes opaque and absorbs the laser beam
2. Why is the sky blue? And what are rainbows?
    a. Students should attempt to make arguments to answer these questions based on experiments and prior learning.
3. Evaluate
    a. Experimental design
    b. Conclusions based on observations and evidence
    c. Arguments for why the sky is blue and why we have rainbows.
    d. Explanation of the Two Bit Circus Foundation magic show