Teacher Station Page

Station 1: Reflection Hologram Station

Overview

This station models how **specular reflection** (mirror-like reflection) creates the illusion of a hologram. Students use a semi-transparent surface (acetate sheet) placed at an angle to reflect an image from a phone screen, giving the impression of a "floating" 3D object.

Learning Goal

Students will observe how light can be **reflected and transmitted** through a material, and describe how these properties create visual illusions.

Materials (per station)

- 1 sheet of transparent acetate (sturdy, clear plastic works best)
- Black cardboard or poster board
- 1 smartphone or tablet with a prepared hologram video (black background, bright object in center)
- Tape or glue
- Scissors or box cutter (for prep only, not for student use unless supervised)

Teacher Preparation

1. Cut and fold cardboard into a small "stage" or platform.
    - The stage should allow a piece of acetate to rest securely at a **45° angle**.
2. Secure the acetate sheet in place using tape or glue.
3. Load a hologram-style video onto the phone (many free samples are available online; search "hologram pyramid video").
4. Test the setup in a dimly lit area for best results.

Key Science Explanation

- Light waves travel in straight lines until they interact with a surface.
- According to the **Law of Reflection**, the angle of incidence (incoming light) equals the angle of reflection (outgoing light).
- The acetate sheet reflects part of the light from the phone while transmitting the rest, creating a **semi-transparent reflection**.
- The human brain interprets this partial reflection as a 3D image suspended in space.

Troubleshooting Tips

- **Image is faint:** Dim the room lights and increase the phone brightness.
- **No floating illusion:** Check that the acetate is exactly at 45° and that the video has a black background.
- **Image is distorted:** Ensure the acetate is clean and flat without bends.

Extensions

- **Modeling activity:** Ask students to draw ray diagrams showing how the light from the phone is reflected on the acetate into their eyes.
- **Engineering challenge:** Have students design a sturdier or more portable "hologram viewer" structure.
- **Real-world connection:** Discuss how fighter pilots use transparent heads-up displays (HUDs) to project flight data onto cockpit glass.

Station 2: Refraction of Light (Disappearing Test Tube)

Overview

This station demonstrates **refraction**—the bending of light when it moves between materials with different refractive indexes. Students see how objects appear distorted, less visible, or nearly invisible depending on how light transmits through them.

Learning Goal

Students will model how light waves are **transmitted and bent** through different materials, and explain how matching refractive indexes can make objects appear invisible.

Materials

- 1 clear glass beaker (filled with water)
- 1 empty glass test tube
- 1 test tube filled with water
- 1 test tube filled with glycerin

Teacher Preparation

- Fill one test tube with water, one with glycerin.
- Place beaker of water at the station.

Science Explanation

- **Refraction** occurs when light slows down and bends as it enters a new material.
- Each material has a **refractive index**. The closer two indexes are, the less bending occurs.
- Glass and glycerin have nearly identical indexes, so little light bends at their boundary — making the test tube appear invisible.

Troubleshooting

- If the glycerin test tube is still visible, check that room lighting is dim enough to reduce reflections.
- Ensure test tubes are clean and free of air bubbles.

Extensions

- Research how refractive index is used in eyeglasses and contact lenses.
- Connect to nature: some animals (like squid) use near-invisible tissues underwater.

Station 3: Decomposition of Light (CD Diffraction)

Overview

This station uses a CD's microscopic grooves as a **diffraction grating** to split white light into its color spectrum.

Learning Goal

Students will observe how light waves are **transmitted and separated** into different wavelengths through diffraction and interference.

Materials

- Old CD or DVD
- Flashlight, candle, or phone flashlight
- Black cardboard with a cutout window
- Tape or glue

Teacher Preparation

- Secure CD at an angle inside the cardboard frame.
- Test with a flashlight in a dim area.

Science Explanation

- The CD surface contains microscopic grooves.
- When light hits these grooves, it **diffracts** (bends) and spreads.
- Different wavelengths (colors) bend at different angles, creating a spectrum.

Troubleshooting

- If no rainbow appears, dim the lights and adjust the angle of the CD.
- Bright, white light works best (avoid yellow-tinted bulbs).

Extensions

- Connect to real-world use: diffraction gratings in spectrometers.
- Compare this with how raindrops create rainbows (refraction + reflection).

Station 4: Total Internal Reflection (Optical Fiber Model)

Overview

This station models **total internal reflection**, the principle behind fiber optics, where light is trapped inside a medium and transmitted over long distances.

Learning Goal

Students will explain how light can be both **transmitted and reflected** within a medium, allowing efficient energy transfer.

Materials

- 1 clear glass test tube
- Cooking oil (enough to fill test tube)
- Red laser pointer

Teacher Preparation

- Fill test tube with cooking oil.
- Test laser pointer for safety (remind students never to point at eyes).

Science Explanation

- When light travels from a denser to a less dense material (oil to air) at a steep angle, it can't escape.
- Instead, it reflects back inside, a process called **total internal reflection**.

- This is how fiber optic cables guide light for internet and communication systems.

Troubleshooting

- If light escapes, check that the test tube is full and laser is angled correctly.
- Conduct in a dim room for better visibility.

Extensions

- Research medical applications of fiber optics (endoscopes).
- Build a water stream fiber optic demo (shine laser into flowing water).

Station 5: Polarization of Light

Overview

This station demonstrates **polarization**, where light waves are filtered depending on their orientation. Students will see how polarizers can block or transmit light.

Learning Goal

Students will describe how light can be **absorbed or transmitted** when passed through polarizing filters.

Materials

- 2 polarizing discs (or polarizing sunglasses)
- Sample digital images (high contrast colors)
- Light source (optional for brightness)

Teacher Preparation

- Provide polarizing filters and images at station.
- Ensure students know how to rotate one filter relative to the other.

Science Explanation

- Light waves normally vibrate in many directions.
- A polarizer only allows waves in one orientation to pass — the rest are **absorbed**.
- Rotating the second polarizer changes which light waves are transmitted, reducing brightness or blocking the image.

Troubleshooting

- If no change is visible, ensure discs are truly polarizers, not just tinted plastic.
- Dim the lights slightly to make filtering easier to see.

Extensions

- Explore how photographers use polarizing lenses to reduce glare.
- Research natural polarization (e.g., skylight polarization used by bees for navigation).