Polarized Light Art - Project 2

For ages 12+

1. Description/Learning Objective

Make an artificial stained-glass mosaic using transparent tape and polarizing materials.

2. Materials

- Two sheets of polarizing filters or film
- One clear plastic sheet (plastic page protectors work great)
- Clear, packaging tape
- Scissors
- Ruler
- Marker
- Xacto knife
- Paper fastener
- Bright light source

3. Background

Visible light from the sun or from an artificial source such as a light bulb, is made up of different wavelengths which travel outward in all directions. This light is said to be **unpolarized**. When light rays are restricted to only one direction, light becomes **polarized.** We can polarize light by using polarizing film or filter, or polarizing sunglasses. When polarized light passes through materials such as clear cellophane or 'packaging' tape, it produces bright colors. These colors appear as a result from the differences in the speed of polarized light as it goes through the tape.

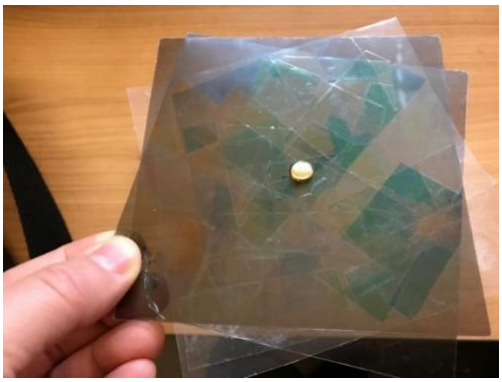
4. Instructions

1. The two polarizing filters and clear plastic sheet should all be the same size, or close to it. Cut material to identical size if they are not already.

2. Cut strips of packaging tape and stick each piece to the clear plastic sheet. For a more creative approach, cut tape to different shapes and sizes. Apply tape in different directions, overlapping to create different patterns.

3. Take your ruler and measure to the center of each filter and the plastic sheet. Mark the center of each piece. Using your Xacto knife, cut a tiny slit through the center of each filter and plastic sheet. The slit should only be wide enough to insert the paper fastener.

4. Take all three pieces and make a sandwich: filter, plastic, filter. Insert the paper fastener through the holes in all three pieces to create one piece. On the backside, bend the legs of the paper fastener outward to secure it.



5. Hold your piece up to light source and rotate the top polarizer to see the patterns and color change. If using a lamp, be careful not to get too close to the bulb. The heat from the bulb could melt the polarizers and plastic.

6. Be creative! Make multiple designs and switch them out from in between the filters.

5. Guided Inquiry and Questions

When light waves pass through a substance, they slow down. The measure of how light transmits through material is called **refractive index**. The higher the refractive index the slower the light travels, which causes an increased change in the direction of light within the material. Some materials such as cellophane tape are **birefringent** or **double refractive**. This means that the optical property of a material is dependent on polarization and propagation direction of light. As polarized light travels though through cellophane tape, the colors we see are a result of the differences in the speed in which light travels through the tape. Different colors will appear as you rotate the top filter to different angles.

1. Why do you see different colors when rotating the top filter?
2. What happens if you add thicker layers of tape? Do the colors change? What is happening?

6. More Information and Resources

See the Polarized Light worksheet by Dumpster Optics for more fun ways to learn about polarized light.