TAPE ART

LEARNING OBJECTIVES:
Create an art design using cellophane tape.
Describe how light can change as it travels through a medium.
Describe how light interacts with polarizers.

MATERIALS:
Index cards
Clear (not transparent) tape
Clear packing tape
Polarizers
Clear transparency or acetate sheets

NGSS CONNECTIONS

4-PS4-2 Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.

ENGAGE or PHENOMENA
Take one polarizing filter and view your computer screen, phone screen, or the sunlight. Slowly turn the filter as in a clockwise direction as you continue viewing. Describe how turning the filter changes the object you are viewing.
ANS: As the filter rotates the brightness of the light will change depending on how light is reflecting off the surface being viewed. Computer screens and phone screens will vary in the colors seen through polarizers.

Take another filter and look through two polarizers at the same time. Slowly rotate ONE of the polarizers as you continue viewing. Describe what you see or what changes.
ANS: As the polarizers are rotated there will be two positions where there is no light passing through. This is when the “gratings” or lines on the filters are perpendicular to each other. Each polarizer only allows one direction of light (vertical or horizontal) to pass through. When the polarizers are perpendicular to each other, the light that gets through one is then stopped by the second filter.

EXPLORE
Teacher Notes: Below are other options for making the designs depending on the age of the student and materials available. For Option 1, if packing tape is not available students can tape a piece of clear food covering (Saran wrap) to the back of the card.
Be sure the filters and card are placed near a bright light source—excluding the Sun. If the room is dark, students can use a flashlight or their cell phone light to illuminate.
Option 1
Allow students to use an index card or cardstock to draw a design. Use scissors to cut out the design, leaving an opening in the card. Students can also use a hole punch to make openings.
Place a strip of clear packing tape across one side (i.e. covering the opening) to provide a base for the smaller strips of tape.
Turn the card over so the sticky side is face up.

Cut varying lengths of tape and place them over the packing tape creating a pattern with varying uniformity and thickness.

Place the card between two polarizing filters. Have a partner rotate one of the filters as it is being viewed through the first filter.
If desired add more tape to change the design colors.

Option 2
Give each student a piece of clear transparency sheet (acetate) that has been precut into small squares or shapes (about 2”x2”).
Allow students to use varying lengths of cellophane tape and place them over the acetate creating a pattern with varying uniformity and thickness.
Place the acetate between two polarizing filters. Have a partner rotate one of the filters as it is being viewed through the first filter.
If desired add more tape to change the design.

Why do the colors change as you rotate one or more of the polarizing filters?
ANS: As light passes through different materials, it can be bent or refracted because the speed of light changes as it goes through the material. As the thickness of a material changes, the speed changes within that material (different materials will also change the speed). Therefore, light bends differently as it travels through a medium (such as glass, plastic or in this case tape) resulting in the kaleidoscope of colors.

EXPLAIN
BACKGROUND
Light from the sun travels, or radiates, in all directions. Light can be made to change directions just as the direction of a tennis ball can be changed by tossing it to the left, right, or off a wall. Polarizing glasses have lenses, which are able to change the direction of the incoming light.

Light is composed of packets of energy called photons and behaves both as a particle and a wave. This dual nature of light is a quantum property, basic to quantum mechanics.
Familiar representations use wave patterns to
represent light. The wave pattern below (left) is a vertical wave representing light travelling in a vertical path. The wave pattern on the right is a horizontal wave representing light travelling in a horizontal path. The arrows in the picture represent the way the light particles are vibrating—up and down for vertical and side to side for horizontal.

Sunglasses can be polarized by coating the lenses with special fibers that act like a slit by allowing incoming light to “line up” and not be randomized as shown above. The aligning of the light results in the glare being reduced because it is not reflecting into your eye. This enhances vision in many sports such as golf and fishing. The polarization of light is similar to air traveling through a filter preventing certain types of sizes of particles to pass through.

The cost to polarize materials such as sunglasses contributes to the cost of polarized sunglasses being higher than nonpolarized sunglasses (which let light pass through in all directions).

Below are some samples of Quantum Art created by students.

**EXTEND**
Based on the colors seen, could someone determine which areas were the thickest? Explain.

Historically, polarization was designed in early 1900’s to check for flaws in scientific glassware. Later engineers used polarization to detect flaws in models of bridges and buildings. Students can use flexible plastic (i.e. fork, spoon, plastics) between two polarizers to detect stress patterns or weaknesses. The greater the stress the greater the changes in color. Based on your Tape Art, explain why the colors may vary.