SCSU CRISP CCSA Kit Pages 2016

Title of Module: Exploring Materials: Polarizers

Subject or Unit of Study: Light and Waves, Optics

GRADE LEVEL_____5+_____ **LENGTH OF DEMO/LESSON**: _____

STUDENT OBJECTIVES
Students will...

Students will understand how polarized light moves differently because of the structure of the tape. The polarizing filter filters white light and produces the colors we see.

NEXT GENERATION SCIENCE STANDARDS

NGSS Performance Tasks	**4-PS4-2.** • Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. **MS-PS4-2.** • Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. **HS-PS4-5.** • Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*
NGSS Disciplinary Core Ideas (DSI)	**PS4.B: Electromagnetic Radiation** • An object can be seen when light reflected from its surface enters the eyes. **PS4.A: Wave Properties** • A sound wave needs a medium through which it is transmitted. **PS4.B: Electromagnetic Radiation** • When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. • The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. • A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. • However, because light can travel through space, it cannot be a matter wave, like sound or water waves. **HS - PS3.D: Energy in Chemical Processes** • Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. (secondary) PS4.A: Wave Properties • Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses.

	PS4.B: Electromagnetic Radiation • Photoelectric materials emit electrons when they absorb light of a high-enough frequency. **PS4.C: Information Technologies and Instrumentation** • Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, and scanners) and in scientific research. They are essential tools for Producing, transmitting, and capturing signals and for storing and interpreting the information contained in them.
NGSS Cross Cutting Concepts (CCC)	**CCC-2 Cause and Effect** • Cause and effect relationships are routinely identified. **CCC-6 Structure and Function** • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. **HS CCC-2 Cause and Effect** • Systems can be designed to cause a desired effect. **Interdependence of Science, Engineering, and Technology** • Science and engineering complement each other in the cycle known as research and development (R&D). • Influence of Engineering, Technology, and Science on Society and the Natural World • Modern civilization depends on major technological systems.
NGSS Science and Engineering Practices (SEP)	**SEP 2- Developing and Using Models** • Use models to describe phenomena. **SEP 7- Obtaining, Evaluating and Communicating Data** • Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

COMMON CORE STANDARDS

CC-ELA/Literacy Standards	**SL.4.5** • Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4- PS4-2) **SL.8.5** • Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS4-2) **WHST.9-12.2** • Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS4-5)
CC-Math	**MP.4** • Model with mathematics. (4- PS4-2) **4.G.A.1** • Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4- PS4-2)

MATERIALS

- Polarizing filters (2) in cardboard holders
- Overhead transparency sheets
- Transparent tape
- Diffuse light source (a window during daylight hours or an overhead light)
- "How polarizers block light" image sheet

SAFETY

Students should not be looking at direct sunlight. If you are doing this activity outside or near a window, be careful not to ask students to look directly into the sun.

LEARNER BACKGROUND

Describe the students' prior knowledge or skill related to the learning objective(s) and the content of this lesson, using data from pre-assessment as appropriate.

Students should understand that light is an electromagnetic wave. Light is considered **unpolarized** if the direction of this electric field fluctuates randomly in time. Many common light sources such as sunlight, halogen lighting, LED spotlights, and incandescent bulbs produce unpolarized light. If the direction of the electric field of light is well defined, it is called **polarized** light. The most common source of polarized light is a laser.

LEARNING ACTIVITY OR PROCEDURE:

Explicitly layout the lesson or demonstration

1. Each student should have a clear sheet of plastic and clear scotch tape
2. Cut pieces of tape and place onto clear sheet (be sure to add layers of tape in multiple directions
3. Place your design between two polarizing filters and hold light source such as a window during daylight or an overhead light.
4. Have student try rotating one of the filters.

ASSESSMENT:

Provide an assessment to measure student progress of objectives.

ADDITIONAL RESOURCES:

Apply any links or additional information for students or teacher including videos, websites, etc.

TEACHER NOTES:

- Ask students to hold the polarizers by the holders to avoid fingerprints on the polarizers.
- Students can take home the clear plastic sheets with tape on them, but not the polarizing filters. Since students will not be allowed to take home the polarizing filters with them, you can suggest one way they can continue their experimenting at home using a computer screen and some polarized sunglasses. Filters inside the screen polarize the light coming out of the computer and the sunglasses act as the second filter.
- They can also look at materials such as plastic silverware, plastic wrap, or other molded clear plastics by placing them in front of the computer screen and looking through the sunglasses.

STEM CAREERS:

Materials Scientist
Optical Engineer
Engineer
Environmental Engineer
Optician
Solar Energy Systems Engineers
Materials Engineers
Mechatronics Engineers
Nanosystems Engineers
Nanotechnology Engineering Technologists
Nanotechnology Engineering Technicians