SCSU CRISP CCSA Kit Pages 2016

Title of Module: Thin Films

Subject or Unit of Study: Structure-Property Relationships, Properties of Materials, Reflection

GRADE LEVEL: 4 – 12 **LENGTH OF DEMO/LESSON**:

STUDENT OBJECTIVES
Students will understand that:

- The way a material behaves on the macroscale is affected by its structure on the nanoscale.
- The thin film reflects light differently depending on how thick it is, so you 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)	**CC-2 Cause and Effect** • Cause and effect relationships are routinely identified. **CC-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 CC-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:

Shallow pan
Strips of black paper
Clear nail polish
Permanent markers in metallic color
Peacock feather (optional)
Thin film solar cell sample (optional)

SAFETY:

Students should not ingest the chemicals.
Students should wear gloves if handling chemicals.
Do this activity in a well-ventilated area.

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 the definition of wavelengths and reflection as well as have a basic understanding of wavelength concepts, i.e. interference and crests etc.

LEARNING ACTIVITY OR PROCEDURE:
Explicitly layout the lesson or demonstration

Activity 1:

1. Write your name on a strip of black paper.
2. Slide the paper into the pan. Make sure it is completely under water.
3. Use the brush to drip one drop of nail polish onto the surface of the water. The polish will spread out into a thin film.
4. Hold one end of the paper and life it up out of the water. The film of nail polish will stick to the paper.

Activity 2:

1. Wavelength activity sheet

ASSESSMENT:

Wavelength activity sheet

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

TEACHER NOTES:

- Before you begin: fill the pans halfway with water and set up an area to let the strips of paper dry.
- Black paper is used for this activity because it absorbs all visible light. The colors that appear are created by the interaction of light with the thin film.
- Writing their name with the permanent marker helps visitors find their thin film later. The marker doesn't make the colors appear on the black paper--that's the thin film created by the nail polish.

STEM CAREERS:

Researcher
Optician
Materials Scientist
Optical Researcher
Materials Engineer