Investigating UV Protective Materials

TEACHER

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SUBJECT/GRADE LEVEL

Subject

Chemistry,
Environmental Science

Materials

- **UV light Source** - Sun, UV light, UV flashlight, UV wand.
- **Demonstration materials (things that glow in UV)** - petroleum jelly, Rock Salt, highlighter pens, cotton balls, ketchup.
- **Tools to measure UV** - UV beads (cheap on amazon color changes indicates UV exposure), UV Sensors or light sensor (vernier Technology).
- **Possible UV protective materials to test (depends up on variable selected for experiment)** - sun tan lotions, Fabric Types, Packaging materials.
- **Other materials for experimentation:** plastic slide covers (to coat with sunscreen), ring stand to hold samples / light sources

****Experimental Setup examples****



Figure 1



Figure 2

Figure 1 shows a sunscreen coated slide on top of the UV emission box with sensor above. Figure 2 shows illumination from above and sensor below. *A simpler set up can be done with sunlight above and UV beads below.*

STANDARDS

Next Generation Science Standards

HS-PS4-1 Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

Performance Expectation Grade: High School (9-12)

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem

HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

LESSON OBJECTIVE(S)

Students design and perform a research project to explore the effectiveness of UV-blocking material.

CAREER CONNECTION(S)

Mentor Background: Michael Don received a bachelor's in electrical engineering from Cornell University in 1997. He interned at Digital Equipment Corporation, performing integrated circuit design for their next generation Alpha processor, the fastest processor in the world at that time. After graduating, he worked for Bell Labs where he engaged in the mixed-signal design of read channels for their mass storage group. After a 10 year hiatus from engineering, he resumed his career at the U.S. Army Research Laboratory in 2007 specializing in high-performance embedded computing, signal processing, and wireless communication. He is also currently pursuing a Ph.D. in electrical engineering at the University of Delaware, researching compressive sensing applications for guided munitions.

STEM Careers: This lesson links with careers related to Chemistry, Environmental Science and research methodologies.

ENGAGEMENT

This portion of the lesson will involve getting the students focused and interested in the topic. By the end of this portion, the teacher should have gotten an assessment of student prior knowledge related to the topic.

Teacher Actions:
Have students **complete KWL chart** focused on UV radiation as they examine resources:
EPA ppt

- **Radiation & UV**

Videos

- **How UV Rays Damage Skin**
- **11 Things you thought you knew about sunscreens.**
- **What are the active ingredients in Sunscreen?**

Hands on or Teacher Demonstrations (Can be done as teacher demo or hands on by student groups)

Examples shown in video: **UV light demos**

Perform demonstrations using UV flashlights and common material that react to UV. (Petroleum Jelly, Rock Salt etc.) Also examine the effects of common materials to block UV - glass slides, sunglasses etc

Student Actions:
Complete KWL Chart

Observe and / or Experiment with UV flashlight / UV beads & UV blocking materials.

EXPLORATION

In this portion of the lesson, students design an experiment to test a variable related to sunscreens and light absorption.

Teacher Actions:

Present the issue of sunscreens and questions regarding effectiveness. Can use videos and have students add to KWL chart

- How does sunscreen work?
- **SPF numbers How Stuff Works**
- How does fabric protect from UV?

Have students identify a variable and design an experiment. Possible variables:
(1) The UV light-blocking ability as a function of a particular ingredient (PABA, coconut oil, etc.)
(2) The UV light-blocking ability as a function of a particular brand with the same SPF values (accuracy of product labeling)
(3) The UV light-blocking ability as a function of solar irradiation level (does the level of irradiation affect UV-blocking ability)
(4) The UV light-blocking ability as a function of time or exposure to elements - water, wind, sunlight etc.
(5) The UV light-blocking ability as a function of brand (anonymous labeling)
(6) The UV light-blocking ability of UV blockers at a specific relative humidity.

Have students complete a poster to represent their project. Variety of templates here and suggested template for students here

Student Actions:

1. Select a variable to investigate
2. Create a copy of experiment poster template
3. Create title
4. Use your KWL chart to fill in the introduction
5. Begin methodology and set up experiment (don't forget lots of pics)
6. Record Results
7. Graph Results Graphing can be done in programs like excel or online programs https://nces.ed.gov/nceskids/createagraph/
   Can also do statistical analysis using online calculators
8. Write Conclusion

(1) Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question.

(2) With guidance, plan and conduct an investigation in collaboration with peers.

(3) Record data generated by the investigation to produce evidence for supporting the investigative team's answer to a question.

EXPLANATION

This portion of the lessons has the students expand their knowledge of the topic as they begin to describe results, relate to previous knowledge, and perform any needed additional research.

Teacher Actions:
Review poster templates and have students complete the conclusion and abstract. Each section will require a summary of the experiment and results.

(1) Invite and encourage students to use their own words in explaining the ideas and concepts involved with the UV experiment they have performed.

(2) Ask students to provide evidence for their conclusions

(3) Follow with formal definitions and explanations, using students' previous knowledge as a guide.

Student Actions:
(1) Explain their results with colleagues on the basis of the observations recorded from experimentation.

(2) Listen critically to the explanations offered by other students and question those explanations. This can be accomplished in a video meeting or a combination of pre-recorded video presentations with a live question-and-answer session.

ELABORATION

This section will allow the students to organize their results formally and related to the initial information learned.

Teacher Actions:
Provide rubric for lab poster and review expectations

Student Actions:
Complete research poster to meet Rubric Criteria.
Should now be finishing the synthesis sections which include the conclusion and abstract. Students should relate results to prior knowledge and apply them to the real-world problem

EVALUATION

This section of the lesson will be in the form of a lab report. It could be done in a traditional format or using a poster template.

Teacher Actions: Review expectations for lab report / poster.

Student Actions: Perform a gallery walk to review the work of each group. Students fill in a rubric for another poster and provide comments.

REFERENCES

- https://www.nextgenscience.org/
- https://www.epa.gov/sites/production/files/2013-07/6-8_intro.ppt
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