Space Suit Visor Design

DESCRIPTION

Science Skills

Plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology; collect data and make measurements with precision; and communicate valid conclusions.

Math Connections

Gather and record data to determine functional relationships between quantities.

Grade Levels

Grades 5-10

Instructional Strategies

Guided Inquiry

Time Line

Laboratory Activity: 2-3 hours with pre-lab and post-lab assignments

Standards

National Science Education Content Standards
5-8 and 9-12 Science Content Standard A
Abilities necessary to do scientific inquiry
Understandings about scientific inquiry
5-8 Science Content Standard B
Transfer of energy
9-12 Science Content B
Interactions of energy and matter
5-8 Science Content Standard C
Diversity and adaptations of organisms
9-12 Science Content Standard C
Behavior of organisms
5-8 and 9-12 Science Content Standard E
Understanding about science and technology
5-8 and 9-12 Science content Standard F:
All students should develop understanding of

- Personal and community health
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

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Space Suit Visor Design

Information for Teachers

Introduction:

In this activity, the students are asked to design a visor that absorbs UV radiation. The problem is presented as the technology development problem of protecting astronauts' eyes from harmful short wave radiation. This task is designed as an introductory activity on the electromagnetic spectrum. Topics covered within the lesson are light, color, angle of reflection/refraction, radiation and problem solving skills. This activity maybe extended to include determination of wavelength, frequency, and energy.

Materials needed for preparation:

- UV beads (or UV sensitive fingernail polish on an index card)
- UV lamp (recommended)
- Spectroscope box

UV beads are inexpensive and they come in various colors. The beads used in this activity changed from clear to purple. Refer to the following websites for information on purchasing UV beads and lights:

http://www.arborsci.com or http://www.teachersource.com.

Preparation of a spectroscope box will need to be made prior to student evaluation. To make the spectroscope box, use a small cardboard box (such as a shoe box) and cut a rectangular hole in the top of the box where the students' visors will be attached. In addition, a door on one side will need to be made. Place the UV beads directly under the cut out window to determine the amount of UV rays absorbed. The box should be properly sealed in such a way that there will be no other way for UV light to get in and be absorbed by the beads. The UV beads will be measured qualitatively by the change in color intensity. The beads start out as completely clear and change color when exposed to a UV light source. The smaller the change in the color of the beads, the less exposure to UV rays. The students should use a UV lamp to expose the visor and the beads to radiation.

> **WARNING** There are safety concerns when using UV lamps and lights. Students should wear UV safety goggles and refrain from looking directly at the source of the light. Be sure to follow the safety precautions included in the manual specific to the UV light source used.

If a UV lamp is unavailable, direct sunlight will also work. Students should be reminded not to look directly at the sun. The color of the beads should be compared immediately to the calibrated color intensity of the beads (see the table below for a sample calibration.)

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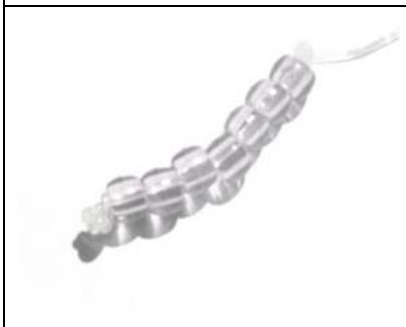
Qualitative Exposure Scale

Beads with no exposure to UV rays	Beads with slight exposure to UV rays	Beads with maximum exposure to UV rays
		

Conclusion:

- Visor Lens Color: Purple color should shield the most UV rays because the wavelength/frequency is closer to UV region on the electromagnetic spectrum.
- Visor Lens Angle of Reflection: The visor should be curved enough to use peripheral vision.
- Visor Lens Thickness: The more layers, the more shielding. However, students need to be able to see through the material.

Things to think about:

Give the students a few guidelines for visor materials appropriate for use in microgravity environments. Students may want to add sunblock between their layers, but don't allow this variation! Liquids are difficult to control and manipulate in space due to microgravity.

Sources:

Adapted from *Suited for Spacewalking: An Activity Guide for Technology Education, Mathematics, and Science* (available from NASA Spacelink web site).

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Student Activity

Designing a Visor for a Space Suit

Introduction:

Space suits are one of the most important enabling technologies that have permitted humans to explore outer space. To survive the hostile environment, humans need to be protected when they exit their spacecraft. Scientists have a difficult task ahead of them! Trying to design a space suit using appropriate materials that will protect an astronaut from the hazards of space is very difficult. In particular, the space helmet needs to be sturdy and provide protection from ultraviolet (UV) rays. This task has been achieved with such great success that astronauts and cosmonauts have safely conducted thousands of hours of extravehicular activity.

Scientists now want to send astronauts on longer duration missions in space. These longer missions will expose astronauts to higher doses of radiation than those received on previous ventures. Scientists at NASA are now researching the effects of prolonged radiation exposure and are trying to find ways to minimize radiation exposure to astronauts.

Challenge:

Your mission will be to design and build a protective visor (the window that the astronaut looks through) for a space helmet that will permit future space travelers to explore the surface of Mars. The helmet must protect the astronaut from the hazards of the radioactive environment. Specifically, the visor needs to be designed to minimize the amount of UV radiation by choosing the best materials in terms of color, thickness, and angle of reflection.

Materials available:

These materials are available for your product design: various colors of plastic wrap and transparency films, wax paper, wire hangers, cardboard, paper, scissors, pencil, thread, glue, tape, duct tape, rulers, UV sensitive beads, stop watches.

Information Resources:

- www.whyfi1es.org/O20radiationlinde.html
- www.enn.comlnews/enn-stories/2001/12/12032001/ solar45762.aspwww.pheonixJiu.edu/~divenere/LI.Env/uvr.htm
- www.katipo.niwa.cri.nz/Laude/uvinfo.htm
- www.imagine.gsfc.nasa.gov/docs/science/knowl1/emspectrum.html

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DESIGN DOCUMENT

Design documents are a communication tool that helps the various Martian Surface Exploration Suit design teams coordinate with each other. This document will describe your design for a visor shield for the space suit helmet. The team working on the space helmet will learn from this document how to connect the visor to the helmet.

System Name: Space Visor

Page _____ of _____

Date _____

Revision Number _____

Team Members

Diagram of Visor

Scale:	Color:	Thickness:	Angle:

Briefly explain how this UV protection system functions and your reasoning for each of the following visor design variables: materials, color, thickness, and angle of reflection.

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Assessment

Space Suit Visor Grading Rubric

2 Cannot see through the visor	4 Close range sight only.	6 Limited sight ability.	8 Ability to see through the visor, but sight is obscured.	10 Clear ability to see through the visor.	**Points Earned** _____
2 Can only see straight ahead.	4 Can see side to side and straight ahead.	6 Can see up and down, side to side and straight ahead.	8 Can see immediate surroundings.	10 Has the use of peripheral vision.	_____
2 UV bead changed to a dark color.	4 UV bead changed to a medium color.	6 UV bead changed to a light color.	8 UV bead slight changed color.	10 UV bead did not change color	_____
4 No explanation of color used	8 No justification for color.	12 Explanation and justification for color are vague.	16 Flawed reasoning for use of color.	20 Logical justification for color.	_____
2 No explanation of materials used	4 No reasoning for materials used.	6 Explanation and justification for materials are vague.	8 Flawed reasoning for use of materials.	10 Logical justification for materials.	_____
2 No explanation of layering used	4 No reasoning for layering used.	6 Explanation and justification for layering are vague.	8 Flawed reasoning for use of layering.	10 Logical justification for layering.	_____
2 No explanation of angle used	4 No reasoning for angle of reflection used.	6 Explanation and justification for angle of reflection are vague.	8 Flawed reasoning for use of angle of reflection.	10 Logical justification for angle of refection.	_____
2 No sketch of product.	4 Sketch does no resemble finished product.	6 Sketch not drawn to scale.	8 Quality sketch without color	10 Quality sketch drawn to scale with use of color.	_____
2 Finished product is messy.	4 Finished product is poorly constructed.	6 Finished product is constructed well.	8 Finished product looks nice and is constructed well.	10 Finished product is outstanding.	_____
				Total Points Earned	_____

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