Name _____ Class _____ Date _____

Exploration Lab Environmental Engineering

How Effective Are Sunscreens?

Teacher Notes

TIME REQUIRED One 45-minute period per experiment

SKILLS ACQUIRED

Collecting data
Designing experiments
Experimenting
Interpreting

RATING

Teacher Prep–2
Student Set-Up–2
Concept Level–1
Clean Up–2

THE SCIENTIFIC METHOD

Make Observations Students make observations in step 4 of the Procedure.

Analyze the Results Students analyze their observations and their experimental methods in questions 1 through 4 of the Analysis and in Conclusions questions 6 and 7.

Draw Conclusions Students draw conclusions about their results in Conclusions question 5.

MATERIALS

Sunscreens with SPF ratings of 4, 8, 15, and 30 are recommended. Sun-sensitive paper is available through science supply houses; some toy stores also stock it.

The acrylic sheet allows solar radiation to pass through. Sunlight passing through the sunscreen will therefore reach the sun-sensitive paper.

SAFETY CAUTIONS

Before beginning the experiment, ask any students who have known allergies to sunscreens to avoid contact with them.

Remind students that although the use of sunscreen is advised when they work or play outdoors, the best way to avoid skin damage is to cover up with hats, sunglasses and clothing, and limit exposure as much as possible.

TIPS AND TRICKS

Groups of 2 to 3 students work well for this activity. Ultraviolet beads can be substituted for sun-sensitive paper. UV beads will not show fading but they will test the effectiveness of the sunscreen.

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TEACHER RESOURCE PAGE

How Effective Are Sunscreens?

It's a gorgeous summer day, and you plan to spend the day swimming and soaking up some rays at a nearby park. Not wanting to suffer a painful burn, you grab a hat, spread a layer of sunscreen over your exposed skin, and put on some sunglasses before you leave. You may know that the sun's ultraviolet (UV) rays can burn you. Sunglasses and a hat provide shade for your eyes and face, but how does sunscreen help protect you?

Sunscreens contain chemicals that are designed to absorb or scatter UV radiation. Examples of such active ingredients, which can be found on the labels of sunscreen products, include avobenzone, benzophenones, cinnamates, and salicylates. These chemicals absorb or scatter UV rays before your skin absorbs them.

Sunscreens use a numbered rating system. According to this system, the higher the number, the higher the protection factor—that is, the greater the UV absorption or scattering. A sunscreen with an SPF (sun protection factor) of 8 is designed to allow you to stay in the sun eight times longer than you could with no protection. For example, if your skin normally burns after 10 minutes of exposure, applying an SPF 8 lotion should hypothetically allow you to stay outside for 80 minutes.

Do sunscreens really protect against UV radiation? Does the rating system give a reliable way to judge the relative strength of different sunscreens? In this experiment, you will compare the effects of sunscreens of varying SPF ratings to find out.

OBJECTIVES

Compare the effects of sunscreens with various SPF ratings.

Evaluate an experimental design.

Design an experiment to test the effects of another variable on the performance of sunscreens.

MATERIALS

- acrylic sheets, about 3 cm × 5 cm (5)
- baking sheet
- construction paper, dark, or dark cloth (several sheets)
- cotton swabs (5)
- lotion containing no sunscreen (such as baby oil)
- sunscreen lotions with different SPF ratings (4)
- sun-sensitive paper (1 sheet)
- water
- wax pencil

How Effective Are Sunscreens? *continued*

Procedure

1. Use a wax pencil to label one acrylic sheet with the SPF ratings for each of the lotions you will be testing. Also label the acrylic sheet for the lotion with no sunscreen.
2. Place three drops of each different lotion on the corresponding acrylic sheet. Using a clean cotton swab for each sample, spread the lotion evenly over the surface of each sheet. Make sure that the thickness of lotion is as identical as possible on each acrylic sheet.
3. Indoors, working quickly but carefully, place a piece of sun-sensitive paper with the blue side up on a baking sheet. Work in a dimly lit area, if possible. Arrange the acrylic sheets, lotion side up, on the paper from lowest to highest SPF. Label the paper to show the SPF of each acrylic sheet. Quickly cover the tray and sheets with dark paper or cloth to avoid exposure to light.
4. Place the tray outside in a sunny location and uncover it. The blue paper will fade to very light blue when exposed to the sun. This process may take up to 15 minutes, depending on solar intensity. Watch carefully as the paper fades. As soon as the paper around the acrylic sheets fades completely, cover the tray and take it back to your classroom.
5. Remove the cover and acrylic sheets from the paper. Rinse the sun-sensitive paper in cold water for one minute, and spread it flat to dry.
6. Allow the sun-sensitive paper to dry, and then examine the spots where the acrylic sheets were placed.

Analysis

1. **Describing Events** Describe your results.

   The sun-sensitive paper faded less beneath high-SPF lotions than beneath low-SPF lotions.
2. **Examining Data** Which lotion was positioned over the least-faded paper? the most-faded paper?

   highest SPF, 0 SPF
3. **Analyzing Results** Which lotion was the control in this experiment? Explain.

   The non-SPF lotion (with no sunscreen) was the control.
4. **Analyzing Results** Is there a noticeable difference in the degree of paper fading among lotions with varying SPF ratings? If so, describe the difference.

   There may be little noticeable difference among similar SPF grades. There should be a pronounced difference among low-SPF and high-SPF lotions.

How Effective Are Sunscreens? *continued*

Conclusions

5. **Drawing Conclusions** Which lotion would you recommend to someone who anticipates being in the sun for a long period? Why?

   For extended exposure to the sun, the higher the SPF rating, the better. The longer the exposure to the sun, the more damage done to the skin by UV rays. High-SPF lotions absorb or scatter more of the harmful rays, reducing total UV exposure. With a high-SPF lotion, total UV exposure is reduced. However, the best way to avoid skin damage is to limit exposure to the sun as much as possible.

6. **Evaluating Methods** Describe any variables that may have affected your results.

   Variables include the age of the lotion, the brand of lotion, the intensity of sunlight (which depends on latitude, time of day, season, altitude, and cloud cover); the thickness of the layer of lotion applied, the relative transparency of the acrylic sheets to UV rays, the sensitivity of the paper, and the length of exposure to sunlight.

7. **Evaluating methods** How could you change this experiment to better control your variables?

   Use the same brand of lotion for every SPF grade; use only recently manufactured lotion; find a way to apply a uniform layer of each grade of lotion to the paper.

Extension

1. **Designing Experiments** Have students design another experiment to test the effectiveness of sunscreens. Encourage them to be creative but to remain diligent at isolating variables so that they can more easily interpret results.

   Student ideas may vary but could include one of the following: Testing different brands of sunscreen with the same SPF rating, testing a particular SPF lotion at different times of the day; testing a particular sunscreen on different days with varying cloud cover. Be aware that testing a particular lotion at different times of the day will vary due to the altitude of the sun and other factors, such as cloud cover.

How Effective Are Sunscreens? *continued*

2. **Designing Experiments** How could you determine the effectiveness of sunglasses in shielding your eyes from UV radiation?

   Students could collect sunglasses and compare their abilities to block UV radiation. A similar experiment to that described in the Procedure could be performed. Lenses from various sunglasses with different manufacturers could be placed directly on a sheet of sun-sensitive paper.

3. **Designing Experiments** Design an experiment to test the effectiveness of different brands of sunscreens with the same SPF. To collect as many different brands as possible, have all students bring in whatever brand of sunscreen that they have at home. For each brand, list the active ingredients printed on the label. Research each chemical to determine the types of UV radiation that it absorbs, or note if it is a chemical used to block, or scatter, UV radiation. Record your results in the table.

Sunscreen Data

Sunscreen Brand SPF 15	Sun-Sensitive Paper Observation	Active Ingredient(s)	Purpose of Ingredient(s)
1 **Answers may vary. Sample Answer:**	**Small degree of fading**	**Octyl methoxycinnamate octyl salicylate**	
2			
3			
4			

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