

## UV Beads With Sunscreen

### Student Objective

The student:

- will be able to explain the importance of using sunscreen
- will be able to explain how the amount of UV radiation varies in differing conditions of sun and shade.

### Materials:

- UV beads (16 per group)
- plastic bags, snack size or sandwich size with zip top (4 per group)
- sunscreen - minimum SPF of 25 (sunscreen needs to be 'fresh')
- paper towels or scraps of material
- permanent marker
- Science Journal

### Key Words:

absorb  
condition  
electromagnetic spectrum  
hypothesis  
intensity  
prediction  
sunscreen  
ultraviolet radiation

### Time:

1½ to 2 hours

### Background Information

Sunburn is a condition resulting from an over exposure of the skin to Ultraviolet rays found in sunlight. Everyone, even dark skinned people, are at risk for sunburn. Fair skinned, blue eyed blonds and redheads are especially susceptible to being sunburned.

We all need exposure to the sun, as it is our primary source of vitamin D. But it does not take much time in the Sun for most people to get the needed amount of vitamin D. When we stay in the Sun for periods of time without skin protection the Sun's ultraviolet rays can cause minor to major damage. Damages from the Sun can be skin damage, sun poisoning, eye damage, immune systems suppression, and in some cases even cancer. It is not uncommon for people living in Florida who are less than 30 years of age, to have developed skin cancer. The Sun also weakens the skin's elasticity leading to premature aging, early wrinkles and a tough leathery look. Over exposure also leads to the development of flat, scaly, reddish patches called Solar Keratoses, which sometimes are precancerous. The most serious consequence of over exposure to the Sun is skin cancer. Over 700,000 new cases of this most common form of cancer occur each year. No tan is a safe tan.

Not all sunlight is "equal" in UV concentration. The intensity of the Sun's rays depends upon the time of year, as well as the altitude and latitude of your location. UV rays are strongest during summer. Remember that the timing of this season varies by location. Extra protection is

also required near the equator, where the Sun is strongest, and at high altitudes, where the air and cloud cover are thinner, allowing more damaging UV rays to get through the atmosphere. Even during the winter months, if your family goes skiing in the mountains, be sure to apply plenty of sunscreen; UV rays reflect off both snow and water, increasing the probability of sunburn. Even on cloudy, cool or overcast days, UV rays travel through the clouds and reflect off sand, water and even concrete. Clouds and pollution don't filter out UV rays, and they can give a false sense of protection. This "invisible sun" can cause unexpected sunburn and skin damage. Often people are unaware that they are developing sunburn on cooler or windy days because the temperature or breeze keeps their skin feeling cool on the surface.

### **Procedure (before class)**

1. With a permanent marker, prepare enough sets of plastic bags for each group in the class to have a set of four bags--one each marked 'Sun', 'Sun with sunscreen', 'Shade' and 'Shade with sunscreen'

### **Procedure (during class)**

1. Lead a classroom discussion on sun exposure, ultraviolet radiation and sunscreen.
2. Introduce the class to the key words **electromagnetic spectrum** and **ultraviolet radiation**.
3. Explain to the class that they are going to be investigating how well sunscreen blocks ultraviolet radiation, and therefore sunburn.
4. Show students the UV sensitive beads. Ask them what they think will happen when the beads are taken outside and exposed to the Sun.
5. Take the beads outside so that the students can see how they become colorful when exposed to UV radiation.
6. Return to the classroom and divide the students into lab groups of 4 students each.
7. Explain the lab procedure to the class.
  - Each lab group will test four conditions (write these on the board):
    1. full Sun with sunscreen
    2. full Sun without sunscreen
    3. shade with sunscreen
    4. shade without sunscreen
  - They will put four beads in each baggie.
  - Two of the baggies will be coated with sunscreen.
  - The baggies are then completely covered with paper towels or scraps of material so that they will not receive any UV radiation until they get to their designated test spot.
  - Each lab member is responsible for taking a baggie of beads to its test position.
  - Group members will then compare the beads in the four test conditions.
8. Have the students write their hypothesis in their Student Journal (questions 1 & 2).
9. Assist the students as needed during the lab activity.
10. Students should complete their Student Journal. Younger students may need a little help with the ranking question and with some of the terms (i.e. hypothesis, prediction, condition, absorb).

### Further Research

1. Research the connection between the hole in the ozone layer and UV radiation. Why are children in Australia and Peru required to wear hats to school and when they are outside for recess?
2. Have your class make an Ultra Violet Detector:
  - Fill one beaker with tonic water and one with tap water.
  - Place both beakers outside in full sun (the hours around noon work the best).
  - Place a piece of white paper or cloth behind the beakers so that the surface of each can be seen clearly.
  - Observe the top of both beakers and ask the class to describe what they see. (*A slight fluorescence will be seen on the surface of the tonic water*)
  - Discuss with the class what is occurring. (*When a photon of UV energy—which is not visible to us—is absorbed by the tonic water, the quinine in the tonic re-emits the energy as a photon of visible light.*)
  - Experiment with your UV Detector on a cloudy day.

### Related Reading

- ***Conserving the Atmosphere (Conserving Our World)*** by John Baines (Steck-Vaughn, 1990)  
An introduction to the problems confronting the Earth's atmosphere, fossil fuels and their effects, the effect of chemicals on the ozone layer, radioactivity, and other forms of pollution and what can be done to stop the destruction of the atmosphere.
- ***Vanishing Ozone: Protecting Earth from Ultraviolet Radiation*** by Laurence Pringle (HarperCollins Publishers, 1995)  
This book involves readers in the exciting story of how dedicated scientists throughout the world struggled to gain understanding and evidence of the thinning ozone layer; the tug-of-war between industry, environmentalists, and governments; and the drama of media coverage of the crisis. Beginning with an explanation of the ozone molecule and continuing with a Jekyll-Hyde analogy of the positive/negative nature of it, the author clearly sets the stage for students in pursuit of answers. The organization is excellent, with the clear message that in order to address the scientific, as well as the philosophical, questions, one must first understand the facts. Concluding chapters offer suggestions for taking action and include addresses for government agencies and environmental groups.

### Internet Sites

**<http://epa.gov/sunwise/kids.html>**

Environmental Protection Agency's SunWise student site that includes games and puzzles as well as information on the ozone layer, UV index and action steps that can be taken to be sun wise.

**<http://www.noaa.gov/wx.html>**

Interactive Weather Information. Today's weather with satellite, radar and 3-D images, as

well as solar images and space weather forecast.

**<http://www.sel.noaa.gov/today2.html>**

Today's Space Weather including today's solar geophysical data and satellite images, as well as archived data.

**<http://www.srrb.noaa.gov/UV>**

Global Ultraviolet (UV) Radiation page. This web site was designed to inform both the scientific community and the interested public on Ultraviolet (UV) Radiation. Included is information on UV monitoring, instruments, publications, news meetings, and over 190 UV links.

### **EnergyWhiz**

Create a picture or mosaic out of UV sensitive beads. Submit photos of your creation showing it inside and outside in the Sun. Send them to the EnergyWhiz website at

**<http://energywhiz.com/>**

### **Classroom Resources**

Ultraviolet Detecting Beads are available from Educational Innovations,  
<http://www.teachersource.com/>

UV Beads With Sunscreen

			.1	.2	.3	.4	.5	.6
Energy	Standard 1	SC.B.1.2-					X	
	Standard 2	SC.B.2.2-						
Nature of Science	Standard 1	SC.H.1.2-		X	X	X		
	Standard 2	SC.H.2.2-						
	Standard 3	SC.H.3.2-						

**Benchmark SC.B.1.2.5:** The student knows that various forms of energy (e.g. mechanical, chemical, electrical, magnetic, nuclear and radiant) can be measured in ways that make it possible to determine the amount of energy that is transformed.

**Grade Level Expectations**

The student:

*Third*

- uses a variety of tools to measure the gain or loss of energy

*Fourth*

- extends and refines use of a variety of tools to measure the gain or loss of energy

*Fifth*

- extends and refines use of a variety of tools to measure the gain or loss of energy.

**Benchmark SC.H.1.2.2:** The student knows that a successful method to explore the natural world is to observe and record, and then analyze and communicate the results.

**Grade Level Expectations**

The student:

*Third*

- plans and investigates an experiment that defines a problem, proposes a solution, identifies variables, collects and organizes data, interprets data in tables, charts and graphs, analyzes information, makes predictions and presents and supports findings
- uses various kinds of instruments to collect and analyze information (for example, meter sticks, timing devices, graduated cylinders, force meters, pan balances, calipers, microscopes, cameras, sound recorders, hot plates, magnets, collecting nets)

*Fourth*

- plans and investigates experiments in which hypotheses are formulated based on cause and effect relationships; distinctions are made among observations, conclusions/inferences and predictions; a limited number of variables are controlled; and numerical data that are

- contradictory or unusual in experimental results are recognized.
- uses metric tools to measure, record and interpret data

*Fifth*

- understands that scientists use different kinds of investigations (for example, observations of events in nature, controlled experiments) depending on the questions they are trying to answer
- understands the importance of accuracy in conducting measurements and uses estimation when exact measurements are not possible.

**Benchmark SC.H.1.2.3:** The student knows that to work collaboratively, all team members should be free to reach, explain, and justify their own individual conclusions.

**Grade Level Expectations**

The student:

*Third*

- knows that to work collaboratively, all team members should be free to reach, explain and justify their own individual conclusions

*Fourth*

- works collaboratively to collect, share, and record information for a scientific investigation

*Fifth*

- understands the importance of communication among scientists.

**Benchmark SC.H.1.2.4:** The student knows that to compare and contrast observations and results is an essential skill in science.

**Grade Level Expectations**

The student:

*Third*

- knows that to compare and contrast observations and results is an essential skill in science

*Fourth*

- knows that comparisons between experiments can be made when conditions are the same

*Fifth*

- uses strategies to review, compare and contrast and critique scientific investigations
- knows that an experiment must be repeated many times and yield consistent results before the results are accepted.

## UV Beads With Sunscreen

**absorb** - to be able to take in, soak up, retain, use up, or consume

**condition** - a mode or state of being

**electromagnetic spectrum** - the entire range of wavelengths or frequencies of electromagnetic waves extending from gamma rays to the longest radio waves and including visible light

**hypothesis** - a proposal intended to explain certain facts or observations that can be tested by further investigation

**intensity** - the amount of strength or force of electricity, light, or heat per unit area or volume

**prediction** - the act of telling about something in advance of its occurrence by means of special knowledge

**sunscreen** - a cream or lotion used to protect the skin from the damaging ultraviolet rays of the Sun

**ultraviolet radiation** - located beyond the visible spectrum at its violet end and having a wavelength shorter than those of visible light but longer than those of X-rays

### UV Beads With Sunscreen

1. Hypothesis: I think the beads in \_\_\_\_\_  
(full sunshine or shade)  
with \_\_\_\_\_  
(sunscreen or no sunscreen)  
will turn the brightest color.
2. Number the four conditions in the order that you think they will change color. In other words, put a (1) by the set of beads that you think will be the brightest, a (2) by the set of beads that you think will be almost as bright, down to (4) which is the set of beads that you think remain the most white.  
  
\_\_\_\_\_ full sun with sunscreen  
  
\_\_\_\_\_ full sun - no sunscreen  
  
\_\_\_\_\_ in the shade with sunscreen  
  
\_\_\_\_\_ in the shade - no sunscreen

Answer the questions below after you have finished your experiment.

3. How did your results compare to your hypothesis? Did the beads that you predicted would be the brightest color actually turn the brightest color?  
  
\_\_\_\_\_
4. What was happening to the beads in this experiment? Why did they change color? \_\_\_\_\_

5. Which beads absorbed more UV radiation? Using the same numbering system as you did in your hypothesis in question 2. Match the brightness of color (on the left) with the experiment condition (on the right).

\_\_\_\_\_ full sun with sunscreen

\_\_\_\_\_ full sun - no sunscreen

\_\_\_\_\_ in the shade with sunscreen

\_\_\_\_\_ in the shade - no sunscreen

6. How were the results (from question #5) different than your prediction (question #2)? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

7. Why do you think it is important to wear sunscreen? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

8. Why do you think that doctors say to wear sunscreen at the beach even if you plan to stay under a beach umbrella? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_