UV Beads With Sunscreen

Student Objectives
The student:
- will explain the importance of using sunscreen
- will explain how the amount of UV radiation varies in differing conditions of sun and shade.

Materials:
- UV detecting 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 develop 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.

UV Beads - The UV sensitive beads contain a pigment that changes color when exposed to ultra-violet light from the sun or certain other UV sources. The pony beads are not, however, affected by visible light so they will remain white indoors or when shielded from UV light. The electromagnetic radiation needed to affect change is between 360 and 300 nm in wavelength. This includes the high-energy part of UV Type A (400 - 320 nm) and the low energy part of UV Type B (320-280 nm). Long fluorescent type black lights will work well with these beads. Incandescent black lights (the type used to make fluorescent paints glow), will not change the color of the beads nor will UV Type C (280-1 nm). The beads will however respond to differing amounts of UV light, becoming a brighter color when more UV light is present. Students should also be able to see changes in the intensity of color when there is cloud cover versus a clear day, or in the morning versus noontime.

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 plastic bag.
    - Two of the plastic bags will be coated with sunscreen.
    - The plastic bags 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 plastic bag 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, absorbtion).

Key Words and Definitions

- **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

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 Ultraviolet 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

- ***The Ozone Layer (True Books: Environment)*** by Rhonda Lucas Donald (Children's Press, 2002)
  Ideal for the young investigative reader, the True Book series includes lively photos, sidebars and Internet sites. Topics covered include 'good' and 'bad' ozone, what would happen without the ozone layer, and suggestions (on a student level) of how to protect it.
- ***Vanishing Ozone: Protecting Earth from Ultraviolet Radiation*** by Lauence 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

https://www.epa.gov/sunsafety/sun-safety-fact-sheets-and-handouts
Environmental Protection Agency's list of Sun Safety Resources.

http://www.cpc.ncep.noaa.gov/products/stratosphere/uv_index/uv_current_map.shtml
Daily U.S. ultraviolet levels

Classroom Resources

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

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Florida NGSS Standards & Related Subject Common Core

			.1	.2	.3	.4	.5	.6	.7	.8
Grade 3										
The Practice of Science	**Big Idea 1**	**SC.3.N.1**	**X**	**X**	**X**		**X**			
Earth in Space and Time	**Big Idea 5**	**SC.3.E.5**		**X**						
Grade 4										
The Practice of Science	**Big Idea 1**	**SC.4.N.1**	**X**	**X**		**X**	**X**			
Forms of Energy	**Big Idea 10**	**SC.4.P.10**	**X**							
Grade 5										
The Practice of Science	**Big Idea 1**	**SC.5.N.1**	**X**							
Forms of Energy	**Big Idea 10**	**SC.5.P.10**	**X**							

Third Grade Benchmarks

Science--Big Idea 1: The Practice of Science

- SC.3.N.1.1 - Raise questions about the natural world, investigate them individually and in teams through free exploration and systematic investigations, and generate appropriate explanations based on those explorations.
- SC.3.N.1.2 - Compare the observations made by different groups using the same tools and seek reasons to explain the differences across groups.
- SC.3.N.1.3 - Keep records as appropriate, such as pictorial, written, or simple charts and graphs, of investigations conducted.
- SC.3.N.1.5 - Recognize that scientists question, discuss, and check each others' evidence and explanations.

Science--Big Idea 5: Earth in Space and Time

- SC.3.E.5.2 - Identify the Sun as a star that emits energy; some of it in the form of light.

Language Arts–Standard 6: Vocabulary Development

- LA.3.1.6.1 - The student will use new vocabulary that is introduced and taught directly.
- LA.3.1.6.5 - The student will relate new vocabulary to familiar words.

Fourth Grade Benchmarks

Science–Big Idea 1: The Practice of Science

- SC.4.N.1.1 - Raise questions about the natural world, use appropriate reference materials that support understanding to obtain information, conduct both individual and team investigations through free exploration and systematic investigations, and generate

appropriate explanations based on those explorations.

- SC.4.N.1.2 - Compare the observations made by different groups using multiple tools and seek reasons to explain the differences across groups.
- SC.4.N.1.4 - Attempt reasonable answers to scientific questions and cite evidence in support.
- SC.4.N.1.5 - Compare the methods and results of investigations done by other classmates.

Science–Big Idea 10: Forms of Energy

- SC.4.P.10.1 - Observe and describe some basic forms of energy, including light, heat, sound, electrical, and the energy of motion.

Language Arts–Standard 6: Vocabulary Development

- LA.4.1.6.1 - The student will use new vocabulary that is introduced and taught directly.
- LA.4.1.6.5 - The student will relate new vocabulary to familiar words.

Fifth Grade Benchmarks

Science–Big Idea 1: The Practice of Science

- SC.5.N.1.1 - Define a problem, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types such as: systematic observations, experiments requiring the identification of variables, collecting and organizing data, interpreting data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

Science–Big Idea 10: Forms of Energy

- SC.5.P.10.1 - Investigate and describe some basic forms of energy, including light, heat, sound, electrical, chemical, and mechanical.

Language Arts–Standard 6: Vocabulary Development

- LA.5.1.6.1 - The student will use new vocabulary that is introduced and taught directly.
- LA.5.1.6.5 - The student will relate new vocabulary to familiar words.

National Next Generation Science Standards

Third Grade Standards

Note: Related Common Core Language Arts Standards are listed in the Florida section above.

Fourth Grade Standards

Note: Related Common Core Language Arts Standards are listed in the Florida section above.

Fifth Grade Standards

Note: Related Common Core Language Arts Standards are listed in the Florida section above.

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. **Results:** 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 in 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? _____

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