NSBRI TAP Classroom Activity

Title: **UV OR NOT TO BE (AD), THAT IS THE QUESTION**

Grade Level: 5-8 and 9-12

Content Area: Science/Health

National Science Content Standards:
Unifying Concepts and Processes (Grades 5-8 & 9-12)

- Models and explanation

Standard A. Science as Inquiry (Grades 5-8 & 9-12)

- Abilities necessary to do scientific inquiry

Standard B. Physical Science (Grades 9-12)

- Interactions of energy and matter

Standard D. Earth and Space Science (Grades 9-12)

- Energy in the earth system

Standard F. Science in Personal and Social Perspectives (Grades 5-8 & 9-12)

- Personal health
- Natural hazards
- Risks and benefits

Behavioral Objectives:

- The student will use scientific inquiry methods during laboratory investigations and collect data by observing and measuring variables.

Lesson Objective:

- In this lesson, the students will compare and contrast the effectiveness of various sunscreens on ultraviolet radiation detecting beads. The students will learn about how radiation in space can affect astronauts during long duration space flight.

Time:

- Two 45 minute class periods; One 90 minute block period

Materials:

1. Ultraviolet (UV) Detecting Beads (can be ordered from Educational Innovations Inc. at 1-888-912-7474 or at www.teachersource.com)
2. Plastic zip-lock sandwich bags
3. Sunscreens (various brands and SPF numbers)
4. Black construction paper

This lesson was developed by participants and staff of the Teacher Academy Project at Texas A&M University with support from the National Space Biomedical Research Institute through NASA NCC 9-58.

Procedure:

Pre-activity Preparation

Note: You can group the students in groups of four or less and have them do the same activity with each group having different brands of lotion.

Count out one bag for each brand and each SPF value of each sunscreen. Label the bags with a marker.
In each bag, place the same number of UV Detecting Beads (for example, 20 beads) and seal.

Activity

1. Measure out a quarter-sized drop (25 cent piece) of sunscreen in your hand.
2. Coat one side of a plastic bag with the sunscreen and lay the bag, sunscreen side up, on a piece of black construction paper. Do not put the sunscreen on the side of the bag with the label.
3. Repeat steps 1 to 3 using sunscreens of the same SPF.
4. Lay the bags, sunscreen covered side up, on a piece of black construction paper. Place a sheet of aluminum foil on top of the bags prior to moving them into sunlight to prevent early exposure to sunlight.
5. Remove the aluminum foil and expose bags to outdoor sunlight for one minute.
6. Observe and count how many beads change color. Create a table and record your observations.
7. Repeat procedure using the same brand of sunscreen lotion with varying SPF numbers. Does a higher SPF number offer higher protection?

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Extensions:
Repeat the experiment and change the variables.

- Place the bags containing UV Detecting Beads in outdoor sunlight during different times of the day.
  Will you get different results during different times of the day?

- Does it matter if there are clouds overhead?

- Test different brands of sunglasses to determine if they completely block out or partially filter some of the UV radiation when placed over the bag of beads in outdoor sunlight.
  Are different brands of sunglasses equally effective?
  Should astronauts wear sunglasses or other protective goggles during space flight?

- Experiment with different types of glass to block UV radiation. The front windshields of cars usually filter out UV radiation, while the side windows do not. Are the windows on the International Space Station made with UV-protective glass?

- Experiment with cloth and different types of materials.

Resources:
Background information obtained from: http://www.nsbri.org/Research/index.html

http://srhp.jsc.nasa.gov/
Website dealing with space radiation health issues.

http://spaceresearch.nasa.gov/research_projects/radiation.html
Website from the Office of Biological and Physical Research.

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Background Information:

*Note: This information should be used post activity as a focal point of discussion.

The wavelengths of light given off by the Sun vary from long, low energy radio waves to the very short, highly energetic waves of gamma rays. Fortunately, our atmosphere blocks all of the deadly gamma rays and x-rays and most of the harmful ultraviolet radiation. Still without adequate protection from sunscreens on Earth, overexposure to the Sun can cause sunburn and many types of cancer. In space, however, there is no protection. Astronauts are exposed to dangerous levels of radiation from the Sun and deep space. These types of radiation come in three forms: particles trapped in the Earth's magnetic field; particles shot into space during solar flares; and galactic cosmic rays, which are high-energy protons and heavy ions from outside our solar system.

Long-duration missions will expose astronauts to greater doses and more varied types of radiation than those received on previous ventures. Galactic cosmic rays (heavy, high energy ions of elements that have had all their electrons stripped away as they journey through the galaxy at near the speed of light) are the dominant source of radiation that must be dealt with aboard the International Space Station and future mission's within the solar system. This type of radiation is affected by the Sun's magnetic field and may be at its greatest when there is a period of minimum sunspots indicating a time of weakness in the Sun's magnetic field. This weakened field is not able to deflect the ions as efficiently, therefore, allowing for an increased chance of being exposed to galactic cosmic rays. When these particles travel through a material or tissue it can lose energy in the form of ionizing radiation. This radiation can have a direct effect on biologics, for instance DNA molecules near the path of the particle can sustain breaks in its structure. These breaks are not easily repaired by the cells and could lead to mutations. A secondary effect may occur due to the space radiations that include extra particles being formed, including neutrons, during collisions with the spacecraft or the astronaut.

There are many different ways that we can protect astronauts from the detrimental effects of space radiation. Astronauts typically do spacewalks at times when they are not traveling through radiation belts that surround the Earth. These belts can trap ionizing radiation and if an astronaut was to do a spacewalk while in this belt they might be exposed to an increased dose of ionizing radiation. The space station is also shielded primarily in the areas of the sleeping quarters and the galley (kitchen). Materials that have high hydrogen contents, such as polyethylene, are used for shielding. These materials reduce primary and secondary radiation to a greater extent than metals, such as aluminum.

Another way that astronauts may be protected is through chemoprevention. Chemoprevention is a pharmaceutical approach to arresting or reversing the process of carcinogenesis during cancer's typically prolonged latent period (often 20 years or more) before invasion or metastasis occurs. Surging scientific and public interest in applying chemoprevention strategies to people in the general population that have been identified to carry even slight increases in the risk of developing cancer (e.g. genetic risk) is fueling the identification of exciting new chemopreventive agents. Some now argue that future development of

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chemopreventive agents offers greater potential for the long-term control of cancer than the much more widely studied and aggressively pursued chemotherapy agents. Another way prevention or intervention might occur is in eating a diet high in antioxidants after radiation exposure.

The major long-term risk associated with radiation exposure received during space travel is predicted to be radiation-induced cancer. The cancer-causing effects of low-LET radiations such as x-rays, gamma rays, or electrons, typical of environmental earth exposures, have been relatively well established. However, radiation likely encountered in space includes mainly heavy ions and protons along with their secondaries. Much less is understood about the biology and risks associated with these types of radiation. The doses of radiation likely to be received even for long missions are probably low, but cover a broad range and are very unpredictable due to solar events. Like other types of radiation, the increased cancer risk associated with proton and heavy ion exposure is troubling because many radiation-induced cancers do not appear until later in life. Therefore, a large amount of uncertainty exists in how best to assess and manage the radiation risks associated with space travel.

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Student Assessment (Student Copy)

Title: **UV OR NOT TO BE (AD), THAT IS THE QUESTION**

Discussion:

1. Which brand(s) of sunscreen offered the most protection?

2. Were there beads of a specific color that changed to another color first? Last? Not at all?

3. What do you predict might happen if you exposed the bags to outdoor sunlight for 5 min., 10 min., 15 min., 30 min., 60 min., etc.? What is the limiting factor at which protection stops?

4. Astronauts can be exposed to what types of radiation in space?

5. Why is it important to learn about how this radiation affects astronauts?

Presentation:

6. Students will discuss and present their findings to the class. Student groups may use charts and graphs to help convey information learned to their peers.

7. Have students design their own data table.

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   Ans. Over time the effectiveness of the sunscreen should decrease. The limiting factor could be due to environment (i.e. evaporation or decreased ability to absorb UV rays).

4. Astronauts can be exposed to what types of radiation in space?

   Ans.
   - They can be exposed to gamma ray, X-ray, UV radiation, heavy ion and proton.
   - Heavy ion and proton are the two that are least known about.

5. Why is it important to learn about how this radiation affects astronauts?

   Ans. The studies that involve the radiation research can go far in promoting preventative cancer therapies here on earth. Many cancers that are manifested by radiation are not seen until the individual is much older.

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