PROTECTING YOURSELF AGAINST THE HARMFUL AFFECTS OF UV RAYS

GRADES 5-8

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TIME ALLOTMENT: Introductory Activity: 30 minutes
Learning Activity: 60 minutes
Culminating Activity: 60 minutes

OVERVIEW:

The energy from the sun is composed of wavelengths that include both visible and invisible light. We are most familiar with visible light because we often see its colors in the form of a rainbow or when viewed through a prism. The colors of visible light range from violet to red as the waves increase in length. Wavelengths shorter than violet are known as ultraviolet (UV). These wavelengths are invisible to the naked eye and include UVA, UVB, and UVC rays. UVA are the longest rays and travel through the ozone layer to reach earth. UVB rays are mostly absorbed by the ozone layer, but some do reach the Earth's surface. UVC rays are the most dangerous to plants and animals, but are completely absorbed by the ozone layer, never reaching the Earth's surface. UVA and UVB rays can cause the following health problems: skin cancer, cataracts, premature aging of the skin, and suppression of the immune system.

According to the EPA, the level of UV radiation that reaches the Earth's surface can vary, depending on the following factors: time of day, latitude, altitude, weather conditions, reflection, and the thickness of the ozone layer through which UV rays must travel. These factors are used in determining the UV Index. The UV Index was developed by the National Weather Service and the EPA. It provides a daily forecast of the expected intensity of ultraviolet radiation from the sun, in order to help people understand and protect themselves from the harmful effects of UV rays.

In this lesson, students will learn about the different types of UV rays and how they can protect themselves against their harmful effects.

SUBJECT MATTER: Environmental Science

LEARNING OBJECTIVES:

Students will be able to:

- Understand that UV radiation is part of the sun's electromagnetic spectrum, and that it has shorter wavelengths than visible light.
- Be able to explain the concept of fluorescence and demonstrate that UV rays will cause fluorescence in tonic water.
- Develop an understanding of how to protect their bodies from the harmful effects of ultraviolet radiation.
- Understand how to interpret the UV index in order to plan the best time to participate in outdoor activities and to protect themselves from UVs harmful effects.

STANDARDS:

National Science Education Standards
http://bob.nap.edu/html/nses/
Content Standard B:
Physical Science, Transfer of Energy
Content Standard F:
Science in Personal and Social Perspectives

Louisiana Science Frameworks:
State Standards for Curriculum Development
http:www.doe.state.la.us/doe/assessment/standards/SCIENCE.pdf
PS-M-C3: Understanding that the sun is a major source of energy and that energy arrives at the Earth's surface as light with a range of wavelengths.

MEDIA COMPONENT:

Video:

Enviro-Tacklebox™, *You, Me, and UV*

Host Greg Grandy explores some of the harmful and helpful effects of UV radiation, including UV damage to the skin, the use of UV by insects to guide them to food, and the effect of UV on the ozone layer.

Web site:

The Weather Channnel: Stay Safe in the Sun

http://www.weather.com/learn/raysawareness/?from=skinfl An interactive Web site that will give you personalized SPF recommendations and tips for enjoying the sun safely.

MATERIALS:

Per Teacher Demonstration:

- Pan of water
- Small mirror
- Small lump of clay
- White paper and tape
- Poster of the Electromagnetic Spectrum
- 3-4 realistic pictures of rainbows

Per Small Group:

- 2 clear, plastic cups
- Permanent marker
- Tonic water
- Tap water
- Black paper, felt, or cloth
- Sunlight, quartz 300 watt halogen light, **OR** UV black light

PREP FOR TEACHERS:

1. Prior to teaching the lesson, **CUE** the video to the beginning of the tape.
2. Bookmark the Website used in the lesson on each computer in your classroom or the Computer lab.
3. Set up a small pan of water by an open window to create a spectrum.
   - Place a dish of water on the windowsill and slant a mirror at one end of the dish. Stick the mirror in position with a small piece of modeling clay.
   - Face the mirror toward the sunshine.
   - Tape a white sheet of paper on the window.
   - Move the dish and the mirror until you can create a spectrum.
   - Cover the pan with a cloth until you are ready to display the spectrum.
4. Obtain several pictures of a real rainbow. There are many sites on the Internet that have pictures you may use.
5. **When using media, provide students with a FOCUS FOR MEDIA INTERACTION, a specific task to complete and/or information to identify during or after viewing of video segments, web sites, or other multimedia elements.**

INTRODUCTORY ACTIVITY:

1. Show students pictures of a real rainbow. Ask students, “What things are present in each picture that has a rainbow?” (water and sunlight) Have students identify the sunlight and water in each picture. Ask students, “What are some things that can make a rainbow?” (a prism, bubbles, sunlight shining through raindrops).

2. Tell students that you are going to make a rainbow in the classroom. Uncover the pan of water and show students the rainbow that forms on the white paper. Tell students to observe the rainbow and ask, “What colors make up a rainbow?” (red, orange, yellow, green , blue, indigo and violet) “How is this rainbow being formed?” (As the light from the sun passes through the water in the dish the wavelengths that make up visible light are being separated into different colors. The mirror is reflecting the separated light back to the piece of white paper and you can see each individual color.)

3. Show students a poster of the electromagnetic spectrum. Tell students that light travels in waves and the colors they see are the visible part of the **electromagnetic spectrum.** The electromagnetic spectrum is a range of light waves made of gamma ray, X-ray, ultraviolet, visible, infrared, microwave, and radio light waves. We can only see the light waves in the visible range. The visible range is called the visible spectrum, which consists of white light. Each olor of white light can be separated into different wavelengths, allowing us to see the colors red, orange, yellow, green, blue, indigo, and violet.

4. Tell students that not all light waves can be seen. Some light waves are invisible to the naked eye because their wavelengths are too short or too long. Show students the part of the poster that illustrates gamma rays, x-rays, and ultraviolet waves. Tell students that these light waves are shorter than the waves in the visible spectrum and are therefore invisible. Tell students that we know that these waves exist because of the effect they have on people.

5. **Provide students with a Focus for Media Interaction,** asking them to view the video to learn about some of the effects of too much exposure to UV rays. **Start** the video at the beginning. **Pause** after you hear Greg, the host, say, “Got your attention? Let’s talk… you and me, and UV,” and you see him close the tacklebox. **Ask,** “What are some of the effects of too much exposure to UV rays?” (skin cancer, premature aging, and wrinkles)

6. **Provide students with a Focus for Media Interaction,** asking students to view the next segment of the video to complete a short quiz about the Electromagnetic Spectrum and UV rays (Worksheet 1: Test Your Savvy on Ultra Violet Light and the Electromagnetic Spectrum) Provide students with the quiz and **Resume** the video. Play until you see a student in a lab coats saying, “So, what could be here in the middle of the spectrum? Ultraviolet!” **Stop** the video.

7. Discuss answers from the short quiz. **Fast forward** the video till you see Greg Grandy holding a model of the earth and hear him saying, “So how does UV make it to the Earth?”

8. Tell students that today they will be learning about ultraviolet light waves and their effects on people.

LEARNING ACTIVITIES:

(Adapted from: http://www.ucar.edu/learn/1_5_2_23t.htm *Cycles of the Earth and Atmosphere: Detecting Ultraviolet Light Using Tonic Water)*

1. Ask students, "How can we prove that ultraviolet light exists if we can't see it?" Accept all reasonable responses. Then tell students, "We are going to do an experiment to demonstrate the presence of UV light."
2. Divide students into small groups. Give each group the materials needed.
3. Have students label the plastic cups "tonic water" and "tap water."
4. Fill the tonic water almost to the brim of one plastic cup and tap water almost to the brim of the second cup.
5. If sunshine is available, set the cups outdoors so that direct sunlight strikes the surface of the liquid in both cups. If no sunlight is available, use one of the UV light sources mentioned above.
6. Hold the black piece of paper or cloth behind the cups. Look across the surface of the tonic water and tap water through the sides of the glasses.
7. **Ask,** "Looking at the top quarter-inch of the liquids, what do you see?" (The upper quarter-inch of the tonic water should glow blue. There should be no color change with the tap water.)
8. **Ask,** "What causes the tonic water to glow with a blue color?" (The tonic water's color under the UV black light is fluorescent-blue because it contains quinine, a substance that undergoes fluorescence when it absorbs UV light.)
9. **Ask,** "Where is the UV light coming from?" (It is in the sunlight or artificial light that is shining on the cup of tonic water.)
10. **Ask,** "Why isn't the tap water glowing with a blue color? (It doesn't contain any quinine or other material that will fluoresce under UV light.)
11. Tell students that there are three types of UV radiation: UVA, UVB, and UVC. **Provide students with a Focus for Media Interaction,** telling them to view the video to find out about the most dangerous form of UV radiation and its effects on people. **Resume** the video until right after you see the skeleton falling apart and you hear the words, "If UVC ever made it to you it could possibly damage some of your connective tissues, the tissues that literally hold your body and organs together." **Stop** the video and **Fast Forward** it until you see the third picture of the earth from space with the last words of the sentence, "Even with a ban on CFCs, residual molecules will continue to cause damage to the ozone layer well into the 21st century." **Pause** the video.
12. **Ask**, "What keeps UVC rays from reaching people? (the ozone layer) What can happen to you if UVC rays could reach you? (possibly damage some of your connective tissues)
13. **Provide students with a Focus for Media Interaction,** asking them to view the video to understand the difference between UVA and UVB radiation and the different ways they affect the body. **Resume** the video until you see the skeleton's body coming back together and you hear, "So, while UV radiation has potential to do damage to your body, it also helps you generate Vitamin D to build it up." **Stop** the video.
14. **Ask,** "Which UV rays are the most dangerous? (UVB rays, because they cause skin cancer) What damage does UVA radiation cause? (aging, wrinkling, and toughening of the skin) What benefits can you get from UV? (it stimulates your body's production of Vitamin D)
15. Ask students, "How can people protect themselves from the harmful effects of UV radiation? (by using sunscreen, covering their bodies, staying out of the sun, etc.) Tell students that in the culminating activity they will learn how to protect themselves from UV radiation

CULMINATING ACTIVITIES:

1. **Provide students with a Focus for Media Interaction**, asking them to view the video to learn some of the ways that people can protect themselves against the harmful effects of UV radiation. **Resume** the video. **Stop** when you see Greg Grandy and the kids sitting under an umbrella on the beach and after you hear the words, "Your skin coloring can slow UV damage from overexposure, but you can still suffer damage if you're not careful. **Fast Forward** the video until after you the lights of a tanning bed and hear Dr. Parry saying, "There is no safe way to get a tan." **Pause** the video.
2. **Ask,** "So how do you protect yourselves from UV? (don't sunbathe, know your skin type when choosing a sunscreen)
3. Ask students to list additional ways they can protect against UV radiation. Record these suggestions on the board. **Provide students with a Focus for Media Interaction** by saying, "Let's see some more ways we can protect our bodies from UV." **Resume** the video and play it until the end.
4. Ask students to name some more ways to protect themselves against UV. (Stay out of the sun between 10 a.m. and 2 p.m., wear hats, long sleeve shirts, and long pants, wear sunglasses, especially during periods of long exposure to reflected light, and wear a sunscreen of at least 15 SPF.)
5. **Provide students with a Focus for Media Interaction** by telling students that they will learn how to plan for a day in the sun by using an interactive website called "Stay Safe in the Sun."
6. Ask students to think about one outside activity that they plan to participate in this week. Send students one at a time to the computer to access the following website: http://www.weather.com/learn/raysawareness/?from=skinfl . Students should enter their zip code into the "Stay Safe in the Sun" box and click on **Go.** Then have them answer the five questions to receive a personalized SPF recommendation and tips for their day in the sun. Students should record the recommendations on *Worksheet # 2: Personal Recommendations for Safety in the Sun.*
7. Students should also check out different times during the day when the activity could more safely be done and record these times on their worksheet.
8. After completing the worksheet, have students compare their recommendations with another student doing the same activity that has a different skin type.
9. Ask students to evaluate the differences in recommendations between themselves and other classmates and explain why there is a difference.

CROSS-CURRICULAR EXTENSIONS:

LANGUAGE / ARTS:

- Prepare a UV Safety Poster educating others about UV radiation and the recommendations they should follow to be "Safe in the Sun."

MATHEMATICS:

- Use the formula from the video to have students determine the number of minutes of protection they get from sunscreens having different SPF values.

SCIENCE:

- Have students determine the effectiveness of sunscreens with different SPFs by coating squares of overhead transparencies made from cellulose acetate with each sunscreen. Place the acetate sheets on top of glasses of tonic water and observe the difference in the blue color created by UV radiation.
- Compare how much UV is blocked by glass as compared to plexi-glass by using small squares of each on top of the tonic water glasses and then comparing the difference.
- Have students research some of the benefits of UV light:
  a) plant growth
  b) heating foods at restaurants
  c) correcting jaundice in babies
  d) disinfecting foods and food areas
  e) killing bacteria in wastewater before release into receiving water
- Research the types of UV rays emitted by tanning beds and their harmful effects to the skin. Create posters to warn others about their dangers.

SOCIAL STUDIES:

- Have students select a city on a map that is at a different latitude. Use the internet to find out one of the zip codes in the city. Go to Google Search and type in "Zip codes for *City"* Choose one of the zip codes to use in the Safety in the Sun website. Compare the difference in recommendations at different latitudes. Discuss why these recommendations would be different.
- Determine the difference in the UV index at different latitudes and days of the year by accessing the website: http://www.cpc.ncep.noaa.gov/products/stratosphere/uv_index/uv_meanmax.html Then compare the maximum UV indices for different seasons and at different latitudes to see how they affect the UV index.

COMMUNITY CONNECTIONS:

- Invite a dermatologist that specializes in treating UV radiation-related diseases to speak to the class. Have students prepare a list of questions to ask about UV and its effects on the skin.
- Invite several people who work outdoors to visit the class and talk about the safety precautions they take in their daily work to prevent UV-related diseases.

STUDENT MATERIALS:

- Worksheet #1: Test Your Savvy on UV and the Electromagnetic Spectrum
- Worksheets #2A and 2B: Personal Recommendations for Safety in the Sun

Worksheet 1

TEST YOUR SAVVY ON UV AND THE ELECTROMAGNETIC SPECTRUM

Directions: View the video to learn about the Electromagnetic Spectrum and UV rays. Then answer the questions below:

1. What does UV stand for? _____
2. Name three places where you can see the sun's visible spectrum.
   _____ _____ _____
3. Near what color of the visible spectrum can you find UV waves?
   _____
4. How does light in the Electromagnetic Spectrum travel?
   _____
5. Why are some waves in the Electromagnetic Spectrum not able to be seen?
   _____
6. What kinds of rays generate the heat you feel from the sun?
   _____
7. Are radio waves longer or shorter than infrared waves?
   _____
8. What is the type of waves humans can see?
   _____
9. What is the most energetic type of waves? _____
10. What can these waves be used for?_____
11. What type of waves are used to cook food?_____
12. Where in the electromagnetic spectrum do UV rays fit?
    _____

Worksheet 2A
PERSONAL RECOMMENDATIONS FOR SAFETY IN THE SUN

Name_____
Activity Planned_____
Date of Activity_____
Time of Day: From _____ **to** _____
Length of Time_____

Directions:
Access the Web site: http://www.weather.com/learn/raysawareness/?from=skinfl
Find the Sun Safety Advisor Box. Type in the zip code for the place of the activity. Select GO. Answer the five questions about your activity and skin type, then select GO again.

Part I: Read the recommended sun safety tips and answer the questions below:

1. The recommended SPF for this activity, day, and time is _____.
2. Can this amount of radiation cause skin damage if you are unprotected? _____
3. What level of UV radiation will you be exposed to during this time?
   ____enough to cause skin damage
   ____1 time the radiation level that can cause skin damage
   ____2 times the radiation level that can cause skin damage
   ____3 times the radiation level that can cause skin damage
   ____Other: _____times the radiation level that can cause skin damage
4. The following clothing is recommended for this activity:
   ____wide-brimmed hat ____UV-protective sunglasses
   ____long-sleeved shirt ____long pants

5. List other recommendations made for sun safety during this activity:
   _____
   _____
   _____

Part II: Change the time for the activity and see if the recommendations change. Record your answers below. Why do you think these changes occurred?

1. New recommended SPF is _____
2. Level of UV radiation you will be exposed to:_____
3. Following clothing recommended for this level of radiation is:
   _____
   _____
4. New recommendations for sun safety during this activity include:
   _____
   _____
5. Why do you think these changes occurred? _____
   _____

Worksheet 2B

Part III: Change the season for the activity and see if the recommendations change. Record your answers below. Why do you think these changes occurred?

6. New recommended SPF is _____
7. Level of UV radiation you will be exposed to:_____
8. Following clothing recommended for this level of radiation is:
   _____
   _____
9. New recommendations for sun safety during this activity include:
   _____
   _____
10. Why do you think these changes occurred? _____
    _____

Are My Sun Safety Recommendations the Same as My Friend's?

Directions: Find a friend that is planning to do the same outdoor activity as you. This friend should have a different skin type. Compare and discuss the similarities and differences you find.

My skin type is: _____
_____

My friend's skin type is _____
_____

My recommended SPF is _____

My friend's recommended SPF is _____

I should wear: _____
_____
_____

My friend should wear:_____
_____
_____

One specific difference in the recommendations is: _____
_____
_____
_____

Answer key to Worksheet 1

1. UV stands for ultra-violet.
2. You can see visible light waves when you play with bubbles, in a rainbow, and when light is separated with a prism.
3. Ultra Violet waves are found right below violet in the visible spectrum.
4. Light in the Electromagnetic Spectrum travel in waves.
5. They have so little or so much energy that they can't be seen.
6. Infrared waves generate the heat we feel.
7. Radio waves are longer than infrared waves.
8. People can see waves in the visible part of the spectrum.
9. The most energetic type of waves is Gamma waves.
10. These waves can be used to kill cancer cells.
11. Microwaves can be used to cook food.
12. Ultra violet waves can be found between the visible waves and x-rays.