

Sci Tech: UV Beads

Time: 4 Hours (Broken down in to 4-1 hour classes)

Standards:

4th grade science content standards:

LS2. All organisms need energy and matter to live and grow.

I&E6. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations.

I&E6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

I&E6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

5th grade science content standards:

I&E6. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations.

I&E6b. Develop a testable question.

I&E6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.

I&E6d. Identify the dependent and controlled variables in an investigation.

I&E6e. Identify a single independent variable in a scientific investigation and explain how this variable can be used to collect information to answer a question about the results of the experiment.

6th grade content standards:

ES3a. Students know energy can be carried from one place to another by heat flow or by waves, including water, light and sound waves, or by moving objects.

ES3d. Students know heat energy is also transferred between objects by radiation (radiation can travel through space).

ES4. Many phenomena on Earth's surface are affected by the transfer of energy through radiation and convection currents.

ES4a. Students know the sun is the major source of energy for phenomena on Earth's surface; it powers winds, ocean currents, and the water cycle.

ES4b. Students know solar energy reaches Earth through radiation, mostly in the form of visible light.

I&E7. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations.

Topical Objectives:

- Students will be introduced to the visible light spectrum and the electro magnetic spectrum.
- Students will explore many uses for color changing UV beads to test scientific theories.
- Students will create experiments using the UV beads to see why they would be a useful scientific tool.
- Students will examine, predict, hypothesize, and draw conclusions on the usage of UV beads in each experiment.
- Students will use observational skills to record data and information to form a conclusion.

Safety Precautions:

When in direct sunlight, remember to never look directly into the sun. Be cautious of sun exposure to skin and eyes. Remind students that dry ice and the water from the hot pots can cause burns. Only adults should handle the dry ice and hot pots.

Materials: (per groups of 4)

UV Beads (15 per student & needed amt. for each experiment)
Petri Dishes (5 per group)
UV light
Flashlight
Medicine Bottles (orange UV proof bottles)
Film Canisters
3-4 Types of Sunscreen (different SPF's and preferably waterproof)
Fabric Swatches (multiple colors and materials)
White paper
Pencils
Stopwatch/Timers
Fresh Water
Salt Water
Glasses (plastic or glass)
Dixie cups
Popsicle sticks/stirring sticks
Thermometers
Ice (or dry ice)
Hot Pots
Sharpies
Journals
Yarnstring for bracelets

Day 1:

Introduction to UV beads

Preparation:

1. Students will need their journals and pencils.
2. Each group will need 5 petri dishes, one filled with at least 25 beads.
3. Prepare for testing stations: UV light, Flashlight, Warm and Cold tap water.

Procedure:

1. Show students the UV beads. Write down any observations they notice about the beads. What color are they? What do they look like? What do you think they do?

2. Discuss observations and predictions with the whole group.
3. Write a brainstorm of how you think the beads will change? What causes the change? (Students should come up with glow in the dark, water changing, temperature, pressure, light)
4. Have students test their theories in groups. (Hold off on the UV light and going out of the classroom into the sunlight until later.)
5. What were their conclusions? Any new predictions? What about a black light or sunlight?
6. Explain to the students that these two lights do trigger the beads to change color. Have students predict what color they will be? Separate them by possible colors in each of the petri dishes and write down their predictions and how many there are of each.
7. Take the petri dishes outside and notice the change. Reorganize the beads by separating all of the colors. Write in notebooks what colors the beads did turn and how many they had of each.

Science Notebook Ideas:

Students should write ideas about why sunlight made the beads turn colors. Why did the other methods not cause the beads to change color? What are the differences between lights inside a classroom versus sunlight?

Day 2:

Light and Temperature Effects on UV Beads

Preparation:

1. Set up 3 Petri Dishes with 10 beads each (any colors) per group.
2. Place 1/3 of the petri dishes over dry ice (or regular ice) to begin to freeze.
3. Place 1/3 into a hot water bath to increase the temperature.
4. Set up group trays or buckets with infrared thermometers, stopwatches, and remaining 1/3 petri dishes, one per group.

Procedure:

1. Review with students what made the beads change colors. (Sunlight) Ask students what about sunlight is different from any other light we use?
2. Challenge the students to go outside without the beads changing color. Discuss their techniques. (Shade, covering with clothing, put it in your shoe)
3. Introduce the electromagnetic spectrum using the diagram. Show students the different types of rays and wavelengths.

Show students where the visible light spectrum falls. What causes the beads to change color? Remind them they were called **UV** Beads...what does the UV stand for? (ultraviolet!) Does the visible light from the sun actually matter in changing the beads? (no, the ultraviolet rays change the beads so placing them in the shade still causes change in color.)

4. Ask the students how fast the beads change. Students should place the petri dish of beads in direct sunlight and, using a stopwatch, time how long it takes the beads to become their darkest color.
5. Ask student discuss what could make them change faster or slower? (Temperature!) Predict if low or high temperature will cause the bead to change at a faster or slower rate.
6. Students should make a chart to record their data including temperature of the beads and rate of change.
7. Each group will have three different temperature petri dishes of beads, cold, warm, and the room temperature beads they had been using all day.
8. Students should record the temperature of each dish using the infrared thermometers before placing them in the sunlight.
9. Take the beads outside and place them in direct sunlight and start the stopwatch. One group member should time the experiment. Record when each group of beads stops changing. (If you are running out of time, do not have students record times, simply assess differences in rates of change visually. Have them record whether they were faster or slower than the room temperature beads.
10. Discuss class results. Does an increase in temperature increase or decrease the rate of change? Do colder or warmer beads change faster?

Science Notebook Ideas:

Students should write in their notebooks what causes the UV beads to change color. Can you slow down the effects of UV light? How do UV rays affect us? How can you protect yourself from UV rays?

Day 3:

How to Block Ultraviolet Light

Preparation:

1. Set up different types of fabric (cotton, felt, foam, paper, foil, plastic wrap) with all different colors.
2. Have petri dishes filled with 10-15 beads.

3. Groups should get 3 petri dishes of beads and a medicine bottle filled with 10-15 beads.

Procedure:

1. Review what caused the UV beads to change color. How do they effect us? What happens if you go to the beach and stay out in the sun all day? (Sunburns!!!) Explain that sunburns are cause by Ultraviolet rays.
2. Ask students to brain storm ideas on how they protect themselves from UV rays? (Sunscreen, umbrellas/shade, t-shirts)
3. Ask students if they wear clothes at the beach to keep from burning, does it matter what kind of clothes or what color they were.
4. Students should predict what types of fabric would keep out the most UV rays ad what color fabrics.
5. Have groups choose 3 different fabrics. They should cover each of their 3 petri dishes and fill in a data chart.
6. Students will need a scale to gauge changes in color. (0=No change in color, 1=lightest, 5=darkest)
7. Once all of the beads have been wrapped, place in direct sunlight for 3 minutes then have them come inside and quickly unwrap the beads to record any changes.
8. If extra time, you can do trials after certain intervals of time, 1 minute, 3 minutes, and 5 minutes.
9. Have students record which material or color worked best.
10. As a class, decide if thick or thin materials worked better. How about dark and light colored materials?
11. Take the medicine bottles outside. Are the beads changing colors? Why do you think the medicine bottles are that color? Explain that most medicine is sensitive to certain lights or UV rays. Many need to be kept at specific temperature to make sure they work properly.

Student Notebook Ideas:

Students should explain one way UV light effects us and how to protect yourself. What types of fabrics or colors work best to keep our skin healthy? Write down why prescription bottles are specifically designed for medicine.

Day 4:

UV Beads: Sunscreen test

Preparation:

1. Have SPF 15, 30, and 45 sunscreens available for each group.
2. Each group will need 4 separate cups or petri dishes with 10-15 beads in each dish.
3. If time permits for the waterproof test, you will also need to prepare tap water and salt water in separate cups for each group.
4. Each groups supplies:
 - a. 4 Cups with beads, 4 popsicle sticks, sunscreen (One set for each SPF and a control)
 - b. Data table
 - c. Stopwatch

Procedures:

1. Have students recall what we tested in the last meeting in order to prevent UV light from harming our skin. (Different fabric and colors.) What else do we use in the sun to prevent a sunburn? (Sunscreen)
2. Pass out different bottles of sunscreen and have students find all of the information on the bottle. What are some difference between bottles? Is there any information you do not understand?
3. Introduce UV rays and how they are classified (UVA, UVB, and UVC rays, SPF= sun protection factor). Why are there different SPF numbers? Do they really work differently? Which would work the best?
4. Have students form a hypothesis about which SPF sunscreen would work best at protecting you skin from harmful UV rays.
5. Students will mix 10-15 beads in cup or petri dish with one of each SPF. Remember to leave one group as a control with no sunscreen to compare a change. Also, use a new popsicle stick with each sunscreen to avoid mixed results.
6. Students will take all 4 bead cups into direct sunlight and time each trial. At 1 minute, students will use the same 0-5 scale of change from the fabric test to judge how much the beads change. Students will record the change on their data table at 1, 3, and 5 minutes. When finished, the students should find the average change for each SPF.
7. As a class, discuss results. Did all sunscreens work the same? Which one worked best?
8. If extra time, have students test the waterproof factor of sunscreen. Students will place tap water or salt water in each of their cups. Using corresponding popsicle sticks, mix the

beads in the water for 1 minute. Drain the water out, leaving only the beads in the cup/dish. Take the cups outside in direct sunlight, time each trial, record results with the 0-5 scale. Discuss class results: Did the beads change? How did your results change from the first test without water? Is sunscreen completely waterproof? Do you think you would have to reapply sunscreen occasionally or will it stay on all day and protect your skin?

Student Notebook Ideas:

Students should write down what information can be found on a sunscreen bottle. What does SPF stand for? How do we classify UV rays and why are they important? How are UV rays damaging?

Extension and Background:

- <http://www.911skin.com/uvbubarays.html>
- <http://www.skincancer.org/Understanding-UVA-and-UVB.html>
- <http://jaxmed.com/articles/wellness/spf.htm>
- <http://uhs.berkeley.edu/home/healthtopics/sunsafety.shtml>

	Control: _____	Fabric: _____	Fabric: _____	Fabric: _____
Trial 1				
Trial 2				
Trial 3				
Average				

	Control: _____	Fabric: _____	Fabric: _____	Fabric: _____
Trial 1				

	Control	SPF 15	SPF 30	SPF 45	SPF ____
1 min					
3 min					
5 min					
AVG					
Trial 2					
Trial 3					
Average					

UV Protection

UV Protection

Waterproof UV protection Tap Water

		Control	SPF 15	SPF 30	SPF 45	SPF	
1 min							
3 min							
5 min							
AVG							

Waterproof UV Protection Salt Water

		Control	SPF 15	SPF 30	SPF 45	SPF	
1 min							
3 min							
5 min							
AVG							

