Sun's Energy

Children tell a story about a trip to the beach on a sunny day and investigate ultraviolet (UV) light by using UV-sensitive beads as a tool to detect UV light outdoors.

30–40 minutes

Workshop
(can be adapted as drop-in)

Up to 20 children

Content Learning Goals

- Children explore the idea that the Sun gives off energy, and that some of this energy is helpful to us.
- Children explore the idea that we protect ourselves from the Sun's UV light with hats, sunscreen, and sunglasses.
- Children use tools, such as UV beads, to detect invisible energy from the Sun.

Science Practices

Children begin to investigate the phenomenon of UV light by:

- Using UV sensitive beads as a **tool** to help them **observe** the presence of UV light when they cannot see this form of light just with their own eyes.
- Co-constructing, with educators or parents, **explanations** for when UV light is present, based on their observation of the UV beads.

Materials

- Sun Flashlight

Activity 1: Trip to Park/Beach

- Sunglasses
- Hats
- Sunblock
- Umbrella / parasol

Activity 2: UV Beads

- UV-sensitive beads, available at www.teachersource.com
- Container for beads (e.g. muffin pan)
- Pipe cleaners / chenille stems (one per child, available at craft stores)
- Book about the Sun (optional), e.g. *The Sun is My Favorite Star* by Frank Asch

SET-UP

- Prepare the improv items (hats, sunscreen, sunglasses, parasol or other items of your choosing).
- Trim the pipe cleaners to a length appropriate for a child's wrist. Bend over and twist the ends, which can be sharp.
- If you'd like children to be able to choose the color of their UV beads, expose them to sunlight so that you can see their colors, and then sort them by color into containers. A muffin pan works nicely for this. Label the containers with a sticker indicating the color. Do this sorting well in advance of your program to give the beads time to fade back to white. This can take up to a half hour.
- Set up stations with beads and pipe cleaners as appropriate for the size of the group.

ACTIVITY DESCRIPTION

Introduction

1. Introduce the Sun (5 min.)
Show children a picture of the real Sun, or use an inflatable Sun ball. Ask: *What is the Sun? What do you know or wonder about the Sun?* If you have an assistant, ask him/her to document the responses on chart paper, putting each child's name next to his/her statement.

If you are using a ball, introduce it as a model. It is smaller than the real Sun, but it shows the shape of the real Sun — a sphere. This may be a new word for children. Explain that a sphere is round like a ball. You can then roll the ball to each child when it is his/her turn to share something to know or wonder about the Sun.

In this introduction, you might also start out by reading a book about the Sun to focus children's thoughts on the topic. We recommend *The Sun is My Favorite Star* by Frank Asch.

2. How does the Sun help us? (5min.)
Now ask: *How does the Sun help us?* Acknowledge each child's answer. Ask further questions if needed to help them think about the light and heat that comes from the Sun. Ideas to incorporate into the discussion:

- The Earth does not have its own light.
- We need light and heat from the Sun to see, and to grow food. Light and heat are forms of energy. We need energy to live, and almost all of the energy on Earth comes from the Sun.
- The Sun seems small when we look at it because it is very far away. (See the Astronomical Science section on page 6 for more about the scale of the Sun and Earth.)
- Do you think it is hot or cold on the Sun? That's right, it's very hot! Without the Sun, the Earth would be a frozen ball of ice. (See the Astronomical Science section on page 6 for more about the temperature of the Sun.)

3.Introduce ultraviolet light (<5 min.)
Explain that a certain kind of light called **ultraviolet light** comes from the Sun and that's what causes sunburns. Sometimes we call it UV light for short. UV light is invisible to our eyes. UV light cause sunburns and can also hurt our eyes. That's why we need to wear sunscreen, sunglasses, and hats that protect us from the harmful ultraviolet light from the Sun.

Introduce the ***FLASHLIGHT*** as the Sun. Tell them to repeat after you "UltraViolet Light!" (or UV Light). Mention to chant "UV LIGHT!" every time they see the Sun flashlight turn on.

Activities

Activity 1: A Trip to the Park or Beach (10–20min)
Demonstrate the importance of protection from UV light by acting out a day in the Sun (beach, park or anywhere that might work for your location). Use the props — sunglasses, hats, umbrellas, and a tube of sunscreen — as a guide for prompting the children to speak about why they might need protection.

Use the Sun flashlight throughout the story to prompt "UV Light" chant. For example: *"Let's go to the park. Wow, look at the Sun! There is too much* *click flashlight on* *ULTRAVIOLET LIGHT! We need more protection; maybe Johnny has sunscreen! Let's call our friend."*

The nature of improvisation varies from child to child and group to group, so this will allow for creativity from both the educator and child. Feel free to add extra props and adapt the improvisation to your liking. With the props provided in the toolkit, the suggested improv structure might look like this:

1. Pick Child 1 to start the improv. Pretend to go to the beach. Child 1 is so hot and needs protection. Child 1 pretends to phone call Child 2.
2. Child 2 enters with 2 sunglasses. They put on sunglasses. Calls Child 3.
3. Child 3 enters with 3 hats. They put on hats. Calls Child 4.
4. Child 4 enters with umbrella. Opens parasol for all. Calls Child 5.
5. Child 5 enters with sunscreen. Shares sunscreen and all pretend to put all over body.

The improv can be done multiple times giving each child a turn.

This will be a guided improv that is facilitated by the educator. You might want to start by asking a child where they want to go (beach, park, lake etc). Prompt them by asking questions about their environment. Invite the children to use their imaginations while acting out and storytelling the situation. Try to physically act out as much as possible (walking to the beach, looking around at the people, shading their eyes from the sun, rubbing sunscreen on one self).

Activity 2: UV Beads

Make UV bead bracelets (5–10 min.)
Introduce the beads: *We have a special tool that can help us detect* *FLASHLIGHT ON* → children chant "UV Light!". *These beads* (show some beads) *are white when there is no ultraviolet light. Look at the beads right now. What color are they?* (White!) *But when there is ultraviolet light, the beads will show us by changing color. So this will help us know where there is UV light. Is their ultraviolet light in the classroom?* (No!) *Let's try to find out, is there ultraviolet light outside right now? If we go outside, what do you think will happen? This is what scientists call making a prediction.* (The beads will change colors!)

Explain that we will make bracelets with the UV beads. Demonstrate how to put the beads onto the pipe cleaner. Remind them to leave some space to twist the pipe cleaners to hold the bracelets on their wrists. Then send the children to stations to make bracelets. Help them put them on their wrists when they are done. Make sure to bend down the pointy wires on ends of the pipe cleaners.

Detect UV light outdoors (5–10 min.)
When everyone is finished, go outside. Tell the children to cover the bracelet with their hands before they walk outside into the sunlight. Once you are all outside together, tell them to watch their beads closely, then count to three together and remove your hands to expose the beads to the sunlight. Ask the children: *What happened to your beads?* (They changed from white to a rainbow of colors!)

Follow-up with questions that help the children construct an explanation for what they have just observed:

- What could have caused the beads to change color? (At this point, most should chant "UV Light!", if not, encourage them by flashing on the flashlight and pointing at the sun to make the connection.)
- Where did the UV light come from? (The sun!)
- Do you think ultraviolet light is hitting us too?
- What should we do to protect our skin and eyes from the Sun's UV light?

See our website for a video of this activity in action: astrosociety.org/myskytonight

EXTENSIONS

If you have extra time with the group, you could make sun prints, using a special paper that reacts to UV light. Children arrange objects and paper cutouts on their sun print paper, and then expose it to sunlight for a few minutes. They then dip it in water, and the shape of the objects appear on the paper. Children can use this as evidence that UV light reacted with the paper but not where the object blocked the UV light from reaching the paper. For more information and supplies, see: http://www.sunprints.org

You can also create lower cost versions of these prints using low quality construction paper. Place objects on the paper and leave them in a window exposed to sunlight for several days. The paper will fade everywhere except where the object covered it, leaving the shape of the objects shadow behind. This effect is also caused by UV light.

DEVELOPMENTALLY APPROPRIATE STRATEGIES

Sun's Energy is comprised of a variety of connected activities, each offering multiple opportunities to engage children in developmentally appropriate ways. There are three primary components to the activity: expository conversation about the Sun, pretend play about ways to stay safe in the Sun, and investigation using UV-reactive beads. Many developmentally appropriate strategies can be used across these components, as described below:

Ask questions to gauge children's existing understandings of and interest in the Sun (e.g., *"Tell me about the Sun. What does it look like? What do you think it's made of? What do you wonder about the Sun?"*). Questions can also be used to encourage children to generate ideas about how the Sun helps us and how to stay safe in the Sun. Asking children open-ended questions encourages them to participate eagerly and to come up with their own ideas (e.g., *"When you want to stay safe in the Sun, what do you wear? … What are your ideas about how the Sun helps us? … What do you think will happen when we take these beads out into the Sun? … Tell me what you think will happen next."*).

Add challenge to provoke deeper thinking by encouraging children to extend their ideas and to evaluate the ideas of other participants (e.g., *"Jamie said that we could wear sunscreen to stay safe in the Sun. Touch your nose if you think wearing sunscreen is one way to stay safe in the Sun. What are some other ways we can protect our bodies from the Sun's energy?"*). In the UV Bead activity, facilitators can add challenge by prompting children to conduct mini-experiments that push them beyond their current inquiry approaches (e.g., *"Let's try putting the beads under your shirt. Do you think they will still change color? What would happen if we put the beads in water? Would they still change color? Let's try it!"*).

Model: While asking questions and adding challenge, facilitators have ample opportunities to model ways of approaching problems (e.g., *"Hmmm, the beads still changed color even though they were in water. I need to think about why they still changed color."*).

Throughout, **Specific Feedback** and **Encouragement** will help children identify whether and how their ideas match scientific ideas about the Sun and support their desire for continued inquiry (e.g., *"You think the Sun is very big. You know a lot about the Sun, it is indeed very big!"*).

BACKGROUND INFORMATION

The following information about the learning sciences and astronomy is intended for the educator who will facilitate the Sun's Energy activity. The activity is a developmentally appropriate first step toward the children eventually understanding the concepts explained below, perhaps years later. We do not intend the educator to cover most of these concepts with the children during the activity. This information is provided to give the educator a good basic understanding of the scientific concepts that the activity is moving toward and the way that many children think about these topics, and preparation to answer questions from very curious children or adults.

LEARNING SCIENCES

Children's Thinking About the Sun

Several research studies conducted as part of the *My Sky Tonight* project inform our understanding about children's thinking about the Sun as an astronomical object. *My Sky Tonight* researcher Dr. Jennifer Jipson examined what preschool-aged children's engagement in *My Sky Tonight* activities revealed about their knowledge about the Sun. She found that children commonly mentioned that the Sun is hot, it is a circle, and that it is "up" during the day and goes "down" at night. A few children also described the sun as a "hot ball of gas", "made of fire" and "a star."[1] Dr. Jipson and Dr. Maureen Callanan, also a *My Sky Tonight* researcher, explored parental reports of conversations with their children about astronomy and found that families talked more about the Sun than any other astronomical object. A frequent topic of discussion among families was that the Sun is visible during the day and not at night.[2]

With regard to children's understanding of the effects of the Sun on the Earth, there are multiple examples of preschool curricula that engage children in thinking about light and energy from the Sun. Despite efforts to teach children about these concepts, prior research on children's understanding of the Sun and its effects is limited. Hickling and Gelman found that preschool children appreciate the critical role of the Sun in plant growth[3].

[1] Jipson (in preparation). *Conversations about astronomy in a preschool classroom*.
[2] Callanan & Jipson (in preparation). *Family conversations about astronomy*.
[3] Hickling, A. K., & Gelman, S. A. (1995). How does your garden grow? Early conceptualization of seeds and their

Children's Thinking About Sun Safety

Excessive Sun exposure is the most significant preventable cause of skin cancer (American Cancer Society, 2008). Current perspectives on the promotion of Sun-safe behaviors recognize that the use of sunscreen may provide a false sense of security. Intervention efforts now focus on limiting Sun exposure and wearing Sun-protective clothing.[4] Jipson investigated preschool children's understanding of Sun-safe behaviors. Children knew more about sunscreen and seeking shade than they did about wearing protective clothing.[5]

Children's Understanding of UV Energy as a Nonvisible Mechanism

Although helping children to develop multiple complementary strategies for Sun safety is an important goal, it may also be useful to help children understand the mechanism underlying the link between Sun exposure and health concerns. In order to understand the relationship between the causal agent (the Sun) and the effect (e.g., skin damage), children must learn about an intervening nonvisible mechanism (UV radiation). Prior work in other domains shows that children at the preschool age children can consider the causal role of nonvisible causal mechanisms in health outcomes (e.g., germs[6,7]). Jipson found that when families engaged in an activity very similar to *Sun's Energy*, many parents identified a relationship between the Sun's energy and the effects of the Sun (sunburn, color change of UV-reactive beads)[8]. Very few parents, however, explained UV exposure as a specific underlying causal mechanism. Engagement with the Sun's Energy activity provides children with the opportunity to learn more about the nature of the Sun itself, gain insight into how we benefit from the light and heat that the Sun provides, and better understand why we need to take precautions when exposed to the Sun's energy.

place in plant growth cycle. *Child Development, 66* (3), 856–876.

[4] Lautenschlager, S., Wulf, H.C., & Pittelkow, M.R. (2007). Photoprotection. *The Lancet, 30*, 528–537.

[5] Jipson, J.L., Clark, L., Etcheverry, R., Jones, H., Lebs, J., Reid G., Slavik, L. and Ziemba, R. (2009). *Parent-child considerations of science and health*. Poster presented at the biennial meeting of the Society for Research on Child Development. Denver, CO.

[6] Kalish, C. W. (1996). Preschoolers' understanding of germs as invisible mechanisms. *Cognitive Development, 11* (1), 83–106.

[7] Solomon, G. A., & Cassimatis, N. L. (1999). On facts and conceptual systems: Young children's integration of their understandings of germs and contagion. *Developmental Psychology, 35* (1), 113–126.

[8] Jipson, J.L. & Perry-Silviera (2011). *Becoming sun (and science) savvy: Parent-child engagement at a community health fair*. Paper presented at the biennial meeting of the Society for Research on Child Development. Montreal, Canada.

ASTRONOMICAL SCIENCE

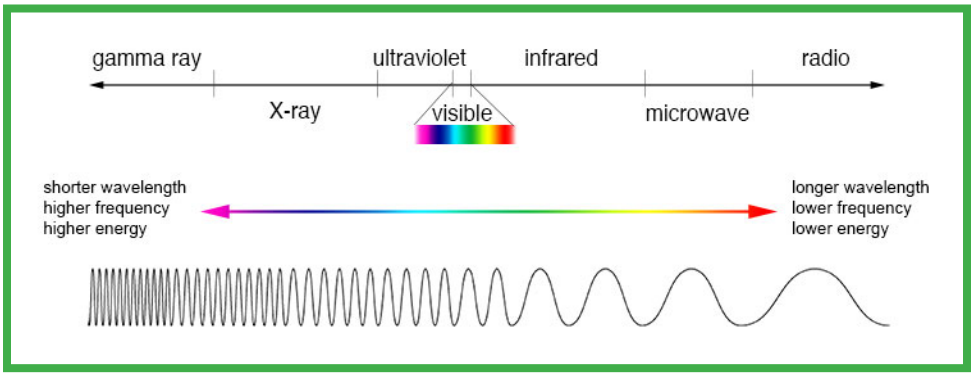
The Sun has a diameter of 864,949 miles (1.4 million kilometers), but it appears small in our sky because it is so far from us on Earth: 93 million miles away! The Sun's diameter is about one hundred times greater than the Earth's diameter. For a scale drawing, if you drew a 1-meter circle to represent the Sun, you would draw a 1-centimeter circle to represent the Earth.

The Sun is 27 million degrees Fahrenheit (15 million degrees Celsius) at its core and about 10,000 degrees Fahrenheit (5500 degrees Celsius) at its surface.

The Sun gives off different kinds of energy, including visible light and invisible light such as ultraviolet (or UV) energy. You get your energy from the food you eat, and that energy originally came from the Sun: plants use the Sun's energy for photosynthesis to create their own food, and animals and humans eat the plants and other animals that eat plants. Similarly, all your electronics and vehicles run on energy that originally came from the Sun: solar panels create electricity directly from the Sun's energy, and fuels such as gasoline and coal contain stored energy from fossilized plants that originally got that energy from the Sun. Energy from the Sun is essential to all life and activity on Earth.

UV is high in energy and can therefore be harmful to living things, but luckily the Earth's atmosphere protects us from most of the harmful UV rays. Some of it still gets through, but we can protect ourselves with sunscreen, sunglasses, and protective clothing.

Light is a form of electromagnetic (EM) energy. This light can be thought of as a wave. The shorter waves have higher frequencies and higher energies. The longer waves have lower frequencies and lower energies. Visible light, the light we humans can see, only forms a narrow band of energies on the electromagnetic spectrum, pictured below. Ultraviolet light is higher in energy than visible light, which is why it can cause damage to our skin if we do not use protection. Even higher in energy are X-rays and gamma rays. Other invisible light has lower energy: infrared, microwaves, and radio waves.



To learn more about the electromagnetic spectrum, see: http://imagine.gsfc.nasa.gov/science/toolbox/emspectrum1.html

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