

## ***Kindergarten: Effects of Sunlight***

### **Objective:**

Students will learn about the effects of sunlight as it makes a solar bag fly and changes sunlight-sensitive paper.

Next Gen Science Standard K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface. [Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water] [Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.] Core Idea: Sunlight warms Earth's surface.

### **Docent Lab Guidelines:**

1. Schedule a date and time with your teacher and other docents to have the students come into the lab. (For this lab, morning will be best.) Estimated time for this lab: 45 minutes
2. Input the day and time into the Science Lab Master schedule. Please make sure you include set up and clean up time to the class time, and add your name.
3. Arrive early to gather supplies and set up. Decide which docent will lead the introductory discussion and who will help with which activities.
4. **Docent tip: After a brief introduction, this lab is mostly done outside, and will be most successful in the morning. You may wish to conduct the whole lab outside. Also, the experiments need to be done on a sunny day—you will need to reschedule if the weather is too cloudy/rainy.**

### **General Docent Information about the Subject Matter—For Reference and Introduction**

#### Sun's Effect on Earth

Energy from the Sun is very important to the Earth. The Sun warms our planet, heating the surface, the oceans and the atmosphere. This energy to the atmosphere is one of the primary drivers of our weather. Our climate is also strongly affected by the amount of solar radiation received at Earth.

Without the Sun, Earth's land, water, and air would all be frozen solid! Life on Earth would cease to exist. That's because almost all living things rely on the steady light and heat of the Sun. The Sun's heat makes liquid water on our planet possible. And all life that we know of—from bacteria to elephants—needs liquid water to survive.

Changes in the Sun's brightness can change global temperatures. Luckily, the Sun, like most middle-aged stars, shines steadily and reliably. People can harness the heat and light of the Sun to generate electricity. Solar energy is becoming cheaper and more widespread. You may have seen solar panels on buildings or houses.

Possible Discussion questions:

What happens to toys that are left out in the sun?

What happens to the temperature of the ground on sunny days?

Why is the sidewalk warmer in the afternoon than in the morning?

**Supplies needed:**

- Solar bag(s) and string (1 group per bag)
- Sun sensitive paper
- Objects to “print” on the paper, preferably heavy enough to keep the paper from blowing away, or you may need paper weights of some sort. Talk to the teacher about the possibility of using objects like blocks from the classroom.
- Tubs/pans of water

Other activities/objects for discussion while outside:

- Display a solar oven
- Place a thermometer on a black piece of paper, and on a white piece of paper before going outside. Feel the temperature difference after it has been in the sun for a while.
- Each student can make a bracelet with UV sensitive beads, using a pipe cleaner and 2-3 beads.
- Radiometer (that spins when sunlight shines on it)

**Instructions for Solar Bag:**

(from [stevespanglerscience.com](http://stevespanglerscience.com))

1. Notice that the bag is made out of a lightweight plastic material. Use caution when handling the bag since the plastic will tear easily.
2. Carefully remove the plastic bag from the packaging and locate one of the open ends of the bag. Tie a knot in this end of the bag.
3. The best time for a launch is in the morning when the temperature of the air outside is cool. We have not had much success with a launch attempt in the middle of a hot day.
4. Select an appropriate location for the launch. Find a park or an open field clear of any buildings, trees, and power lines to conduct the launch. Select a day to do the experiment when it's sunny and free of any wind. (At Rock Creek, use the large grassy area by the playground.)
5. Unroll the Solar Bag onto a soft surface like grass. Avoid pavement or gravel since the plastic material can easily tear. Have one person hold the bag open as you begin to run around and scoop up air. Believe it or not, you can inflate the bag in just a couple of minutes.
6. Fill the bag with air until approximately 2 feet of deflated plastic remains in your hand. Slide your hand along the plastic to make sure that the air in the inflated portion of the bag is stretching the plastic tight. Tie a knot in the end of the bag, and tether it to the ground with Solar Bag String.

**How Does It Work?**

The remainder of the work is done by the sun. Gather around the giant bag but try not to touch it – sharp fingernails will easily puncture the very thin plastic. Be careful, the outside of the bag also gets very hot to the touch. What is happening to the gas molecules inside the bag? Of course, as the sun warms the air molecules in the bag, their movement begins to speed up. Since the heated air inside the bag is less dense than the cooler air on the outside of the bag, the Solar Bag will float. It's important to

remember that it may take as long as ten minutes for the air inside to heat up enough to cause the bag to float. Ask: What happened? Why?

(Storage and Repair: We store the deflated bag in an old pillow case, which helps prevent accidental punctures or tears when it's not being used. If a small tear is spotted, clear packing tape can be used to repair the damage. )

**Docent tips:** While waiting for the solar bag to float, divide the students into two groups. For one group, give each student a sheet of solar sensitive paper and have them choose objects to “print.” Then they can go back to observing the solar bag while the paper does its magic. After discussing why the solar bag is floating, have the students go back and remove the objects, observe the changes to the paper and dip it in the tub of water. The other group can observe the black/white paper, the solar oven, radiometer, and make bracelets with UV beads (2-3 beads per child). You can be flexible in moving groups from one experiment to the next as you think best, depending on how fast the sunlight is working.

### **Instructions for Sun Sensitive paper:**

(from [stevespanglerscience.com](http://stevespanglerscience.com))

1. Put your name on the back of your paper. Place your Sun Sensitive Paper, blue side up, on the ground, or in a shallow tub to keep them from blowing away.
2. Place the objects you wish to “print” on top of the paper. If your objects are particularly lightweight, you can hold them in place with a piece of clear plastic wrap.
3. Expose the paper to the sun for 2-4 minutes, until the Sun Sensitive Paper turns very pale blue. Remove the objects. Ask: what happened? Why?
4. Remove the paper from the tray and soak it in water for about one minute.
5. Remove the paper from the water and let it dry flat. The image will sharpen as it dries.

### How Does It Work?

The Sun Sensitive Paper is coated with light-sensitive chemicals, which react to light waves and particles when exposed to light. When you place objects on the paper, they block the light and turn white while the paper around them remains blue. Water stops the process and fixes your images on the paper.

(In the lab, photosensitive paper is made by coating a sheet of paper with a water-soluble, bluish-green compound called iron (III) hexacyanoferrate (III),  $\text{Fe}[\text{Fe}(\text{CN})_6]$ . The common name for this chemical is Berlin Green, a well-known photosensitive chemical. When exposed to ultraviolet light (UV), a chemical reaction takes place where the water-soluble Berlin Green changes into a water-insoluble chemical called iron (III) hexacyanoferrate(II),  $\text{Fe}[\text{Fe}_4(\text{CN})_6]_3$ . The common name for this chemical is Prussian Blue. When you rinse your print in water, the water-soluble Berlin Green washes away, but the water-insoluble Prussian Blue remains fixed on the paper. The intensity of the Prussian Blue depends on the amount of time the paper is exposed to the light source and the intensity of the light source. For example, Sun Sensitive Paper doesn't work nearly as well on a cloudy day as it does on a sunny day.)

**Demonstration:**

**Estimated time 5-10 min.**

1. Brief introduction about the sun and its effects.
2. Fill up & explain how the Solar bag works. \*Make sure to tie it down to something\*
3. Discuss the differences in wearing darker colors vs lighter colors. (Darker absorbs more heat thus making your body warmer, lighter colors keep you cooler. However, brighter and more vibrant colors help protect our bodies from UV rays. UV rays come from the sun and are harmful to our skin. Too much of it is not good for our bodies)

**Activities:**

**Estimated time 10-15 min, then switch 10-15 min**

1. Divide class into two groups.
2. One group goes to the sun sensitive paper with tiles & water trays. Have students put backs to the fence, to block the sun, while making their picture. Once done, they can stand up and let the sun hit their paper. This is when you can write their names on the edge.
3. The other group goes to the sun displays where you discuss what each does. Students can then have a pipe cleaner and 3 sun beads to create a bracelet to take home.
4. Have groups switch.
5. Bring everyone back together to check on the solar bag & answer any questions.