

# Five Stars Pathway Afterschool Science Curriculum



## Invisible Light: Ultraviolet





# Invisible Light: Ultraviolet

## Age Range

Ages 10 +

## Duration

20 minutes, indoors and outdoors

## Participants

~ 15



## Special Notes

You will need a sunny day for this activity.

## Overview

The Sun gives us light here on Earth in many different forms, some that we can see with our eyes and some that we cannot. One light form that we cannot see is ultraviolet light, or “UV” for short, but we sense it in different ways. Luckily, Earth’s atmosphere protects us from most of the UV coming from the Sun, but some of it reaches us here on our planet. If we are exposed to too much UV light, it can give us a pretty bad sunburn and other skin problems. Lots of exposure to UV light is also not good for our vision, reducing the flexibility we have in the lenses in our eyes and eventually making it hard for us to see clearly. But UV light also has some benefits—it can contribute to our health. When we are exposed to the Sun, our skin is able to produce Vitamin D, which helps our bones stay healthy, among other things.

So, we need some UV light, but not too much. How do we find a good balance? How can we go outside and get enough UV light, but still protect our skin and eyes? With the help of some little UV beads, you are going to uncover some ways to be safe in the Sun!

## Activity Goals

Participants will learn:

- That the Sun gives off different kinds of energy: visible light, and invisible light in the form of ultraviolet rays.
- That the Earth’s atmosphere protects us from most of the harmful UV rays.
- That there are several ways that we can protect ourselves from the Sun’s harmful rays.
- Why UV from the Sun is important to us.

## Notes for Preparation

Locate UV beads (<http://www.teachersource.com> is one place to order beads). We strongly recommend purchasing purple or red UV beads as their color change is the most dramatic. Collect materials listed below. If you are using the “testing stations” signs, print them out— find them at <http://multiverse.ssl.berkeley.edu/fivestars#uvbeads>). Allow 10 minutes to set up all of the materials.





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## Materials

- 5-8 beads per participant
- A couple of plastic bottles filled with water
- A cloth or other covering to prevent the Sun from hitting the beads
- Small baggies (the idea here is to squirt a small amount of sunscreen into the baggie and add a bead—this keeps the sunscreen more concentrated, but using the sunscreen in your hand works just as well and no harm in getting some sunscreen on you!)
- 15 SPF or other low SPF sunscreen
- 50 SPF or other high SPF sunscreen
- Sunglasses, hats and/or caps and materials of various opacities—4" x 4" (approximate) pieces of aluminum foil, waxed paper, construction paper in various colors, plastic wrap, black plastic bags, thin cloth, thick cloth, etc.
- Pipe cleaners
- Crayons and large sheet of paper (extension activity)
- Signage (PDFs) for testing stations (optional): <http://multiverse.ssl.berkeley.edu/fivestars#uvbeads>

## Lesson Plan

1. Begin this activity indoors, away from windows if possible. Distribute several beads to each participant and ask them what they think they are. What do they look like? What can they use them for?
2. Prompt a discussion of Sun health with the following questions:
  - Who has spent a lot of time in the Sun?
  - What happened? How did your skin feel while you were in the Sun? How did your skin feel later?
  - How about your eyes? How comfortable was it to be in bright sunlight for a long time? Why?
  - What about being in the pool or in the ocean or in a lake? How do your skin and eyes feel when you are in water?
3. Ask participants to cover their beads with their cloth covering—or they can hold them in their closed fists or in a pocket—then go outside into the Sun.
4. Once you are all outside, ask participants to take off the cloth coverings or open their fists or take the beads from their pockets and expose the beads to the Sun. Encourage them to maximize their exposure by perpendicularly angling their open palms to the Sun's rays.
5. Get participants thinking by asking:
  - What has happened and why?
  - What kind of light is causing this?
  - Is there something about this that reminds you of your own experiences outside?

Then ask them:

- What could we do to have the beads return to their white stage? They will probably say something like “put it in my pocket or cup my hands.” You can suggest at this point that you are going to investigate other things that they can do.
6. Bring out the materials and have participants set up “testing stations” with the sunglasses, water in bottles, pipe cleaners, various sunscreens and baggies, and various screening materials (aluminum foil, waxed paper, construction paper, cloth, plastic etc.). Invite participants to experiment to see what makes the most effective screen to make the beads turn white. There are some handy optional pre-made signs for “testing stations” that you can download from this site. You'll find a link to the PDFs in the materials list.

**lesson plan continued on next page...**



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## lesson plan continued from previous page...

7. Let pairs or small groups of participants try out all the options for about 10 minutes or so.
8. Rotate through the groups and suggest ideas that might not be immediately apparent:
  - Does the color of the paper seem to matter?
  - Is the bead still changing color under the paper? What do you think is happening with the light?
  - Use a pipe cleaner to keep the bead submerged in the water not floating on top of it. Does it matter if the bead is under the water or floating?
  - Is the bead still changing color in a shady spot? Why do you think that happens?
  - Is it cloudy today?—why are the beads still changing color?
  - How does the SPF rating of the sunscreen affect the beads?
  - Do you notice that the bead is not a single color, but variations of a color—what do you think that tells us about the light that is hitting the bead?
9. Ask participants to share with the group what they thought was the best filter. Encourage them to explain how they used the filter and what might be at work to make the bead a light color.
10. Distribute more pipe cleaners and several more beads to each participant to make “UV detector” bracelets or ankle bracelets and take them home.
11. Reflect on what you all saw happening with the beads, followed by a whole group discussion of what seems to be the best way for someone to protect themselves in the Sun. Ideas might include wearing protective clothing along with a hat to keep the Sun off your skin, wearing sunglasses and sunscreen, staying out of the Sun and staying in the shade. Discuss the need to be protected in water and when swimming! Ask participants to think about our atmosphere as our first line of defense—it blocks a lot of UV, but not all of it, so we need to take other precautions. Also remind all participants with all skin types need to take care with the Sun! Encourage participants to share what they have learned with their family and friends.

## Extension

- Use the video “How the Sun Sees You” to discuss Sun safety and your skin.  
<http://multiverse.ssl.berkeley.edu/fivestars#uvbeads>  
Introduce the video by light-heartedly asking participants “Do you like scary movies?” Many of them will likely get excited and curious. Then show the video. Ask follow-up questions like, “Do you think skin damage is ‘scary?’” “Is skin damage avoidable?” “What can you do to share this message with others?”
- If you have more time, create a poster with the group’s top ideas for staying safe in the Sun. Include simple illustrations and written messages for staying healthy in the Sun! Post it somewhere where everyone can see it.
- Try this activity at different times of the day and see if the results are markedly different.
- Use UV nail polish as an additional, fun “detector.” It can be found at:  
<http://www.teachersource.com/product/uv-color-changing-nail-polish/light-color>



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## How Do UV Beads Work?

If your participants ask how these beads work – here’s a simple answer: UV energy from the Sun excites the atoms in the beads, causing them to glow in color. For more information on the chemistry of UV-detecting beads visit the link below and look at the tab marked “Lesson Ideas.”

<http://www.teachersource.com/product/ultraviolet-detecting-beads/light-ultraviolet>

## Further Resources

- **Ultraviolet Light From Our Sun**—  
[http://missionscience.nasa.gov/ems/10\\_ultravioletwaves.html](http://missionscience.nasa.gov/ems/10_ultravioletwaves.html)
- **Skin Safety:**  
American Academy of Dermatology—  
[http://www.aad.org/public/publications/pamphlets/sun\\_sunscreens.html](http://www.aad.org/public/publications/pamphlets/sun_sunscreens.html)  
UCSF Dermatology—  
[http://www.dermatology.ucsf.edu/skincancer/General/prevention/UV\\_Radiation.aspx](http://www.dermatology.ucsf.edu/skincancer/General/prevention/UV_Radiation.aspx)
- **Sun Safety: Environmental Protection Agency**—  
<http://www2.epa.gov/sunwise>
- **Where To Get UV Beads and How They Work** —  
<http://www.teachersource.com/product/ultraviolet-detecting-beads/light-color>



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