Sensing Light

Revised 2/25/2026

Introduction

This activity adapts ideas from the Montana NSF EPSCoR SMART FIRES project* and its work with sensors for young learners. In science and engineering, sensors detect signals from the environment and turn them into information we can use. Some light sensors detect how much light is present (brightness); others detect what kind of light is present (its color or wavelength).

In this lesson, students use simple UV reactive materials to model those ideas. They will compare brightness-type sensing (like our eyes or a dusk to dawn light) with wavelength specific sensing focused on ultraviolet (UV)—an invisible, higher energy part of sunlight.

Objective

Students will observe, describe, and compare how different sensing approaches respond to light by:

1. Identifying bright and dark locations using their eyes as brightness sensors.
2. Using UV reactive materials (beads) to detect the *presence* of UV light (wavelength sensing).
3. Using UV test cards to measure *how much* UV light is present (UV intensity sensing).

Note

The UV beads and UV test cards in this activity are not electronic sensors. They contain UV-reactive compounds that change color when UV is present. Their predictable response makes them a good model for how real sensors detect and respond to light, even though they do not produce electronic signals or measurements the way true sensors do.

Materials (per ~10 students)

- 1 UV (ultraviolet) flashlight (“black light”)
- ~50 UV reactive plastic beads (clear/translucent when not exposed to UV)
- ~50 regular plastic beads (opaque/multicolored)
- 4 UV/UVC test cards (store them in the dark until needed; they wear out after repeated exposure, so please use sparingly)
- 1 sunscreen packet
- 2 empty plastic bags
- 10 Pipe cleaners

Educator Preparation

- Decide whether the class can briefly go outdoors to detect sunlight UV (sunlight through a window also works).

- Test a UV bead (a few extras are provided) and UV card yourself before teaching the activity so you know what to expect.
    - Bead: In a bright room, outdoors, or under the UV light, the UV bead will change to a different color. In a dark room, the bead may give off a faint glow after having been exposed to ambient light, and it will glow much more brightly when illuminated with the UV flashlight.
    - Card: The card has simple instructions printed on both sides. You'll mainly be using the side with the scale of UV intensity. *Note: If time is limited, you may skip over the UV card activities (#s 3 & 4), going straight to UV beads (#s 5 & 6).*
- Prepare sunscreen coated bag:
    - Spread a thin, even layer of sunscreen on either the inside or outside surface of the one of the two empty plastic bags. Mark the bag with a marker to indicate which is the treated bag (leave the control/untreated bag unmarked).
    - Test at least one: shine UV light on a bead under the treated bag. The bead should not dramatically change color or glow brightly if the sunscreen layer is adequate.

Procedure

1. Introduction: Finding Bright and Dark Areas (5 minutes)

Introduce the activity: **Sensing Light**

If possible, bring students outside. Ask them to find the brightest and darkest spots they can.
Explain that in this case their eyes are acting as light sensors, detecting brightness.
(If outdoors isn't possible, dim some indoor lights and repeat the task.)

Explain there are two types of light detection:

1. Brightness sensors — measure how much light there is.
2. Color/wavelength sensors — identify what type of light is present.

Ask students which kind of sensing they were doing outside (brightness sensing with their eyes).

2. Introducing UV Light (5 minutes)

Explain:

- Sunlight is made of many wavelengths (colors), even ones we cannot see.
- UV (ultraviolet) light is a high-energy wavelength that can be harmful because too much of it can damage our skin and eyes. This is why we use sunscreen, wear hats or sunglasses, and sometimes check UV levels.

The UV flashlight used in this activity gives off only a very small amount of UV light and is safe for short classroom demonstrations. However, students should never shine the light toward their own eyes or anyone else's. Always direct the beam toward materials on the table.

Show the UV flashlight and ask if students have seen similar lights (pet habitats, nail salons, black lights, etc.).

3. Using the UV Test Cards (5–10 minutes)

Give each group a UV test card. One side of the card tests for presence/absence of UV light, and the other side measures intensity.

Have them measure UV intensity in:

- The brightest location they identified
- The darkest location (optional but useful for comparison)

Record the numbers (anywhere from 0 to 3000 $\mu W/cm^2$) on a board or chart.

4. Comparing UV Sources (5 minutes)

Shine the UV flashlight directly on a test card.

Ask students to compare results and determine which source produced the highest UV reading (should be the flashlight).

5. Exploring UV Beads (5–10 minutes)

Give each student one pipe cleaner, five UV beads, and five regular beads. Ask them to string the beads onto the pipe cleaner to create a bracelet. Once finished, students can twist the ends of the pipe cleaner together to fasten it around their wrist (they may need help with this).

Either have students take the bracelets outside to observe changes in the UV beads (should change colors—different beads will turn different colors, some of which will be more noticeable), *or*, if staying indoors, let them observe beads under the UV flashlight (with lights either on or off, the UV beads will either change color or glow brightly, respectively)

When they return, have students draw and describe what they observed.

6. Sunscreen as UV Protection (10 minutes)

- Dim or turn off the lights. Place a UV bead (or a few beads) under or inside the untreated plastic bag. Walk around with it and shine the UV flashlight over the bag so students can see the bead glow brightly. *Note: although students already experimented with their beads in the light, it's important for them to notice that the plastic bag alone doesn't block much of the light. That prepares them for the next observation.*
- Repeat with the sunscreen-coated bag. Students should notice that the bead does not glow or glows much less because the sunscreen blocks most of the UV light.
- Ask students to draw and describe what they observed with each bag and explain in their own words what they think is happening.

- Explain the connection to real life: Sunscreen protects our skin the same way—it blocks or absorbs UV light so less UV reaches us.
- Discuss when each tool is useful:
    - UV beads can be helpful for quick, visual reminders (like on a bracelet to know when it's time to reapply sunscreen).
    - UV test cards are useful when you need a measurement, such as checking UV levels in reptile habitats or comparing different sunny vs. shady locations.

Wrap-Up

- Students may take the bracelet home to observe how the UV beads change with different lighting.
- You may suggest trying the bracelet under shade, sunlight, window light, covered with sunscreen, etc. to extend the concepts beyond the classroom.

Clean Up

- Discard used packets of sunscreen and marked bags on which sunscreen was applied
- Collect UV flashlights, UV test cards, and any unused beads and pipe cleaners.

For questions, contact the Montana State University Science Math Resource Center (SMRC) at smrc@montana.edu or (406) 994-7476. Please return materials to the SMRC Lending Library (Reid Hall 413, enter through 412).

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