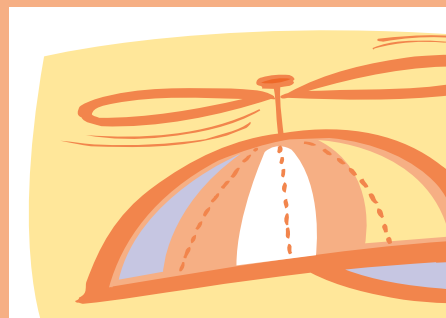
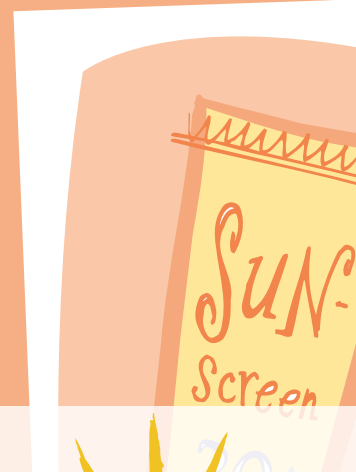
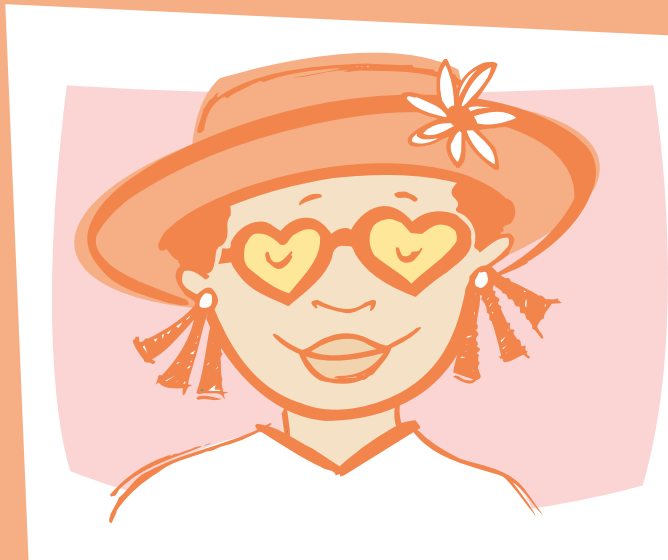
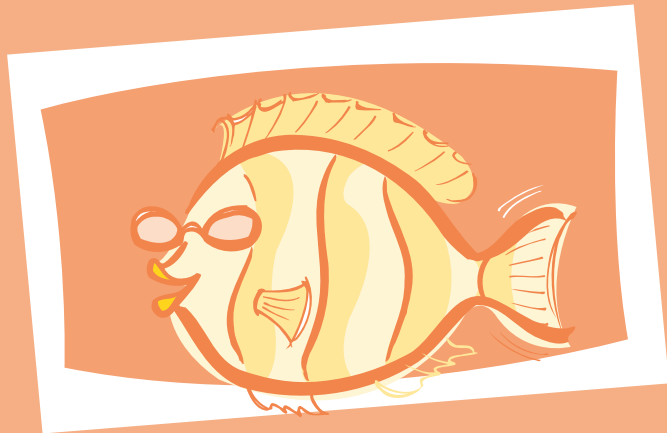
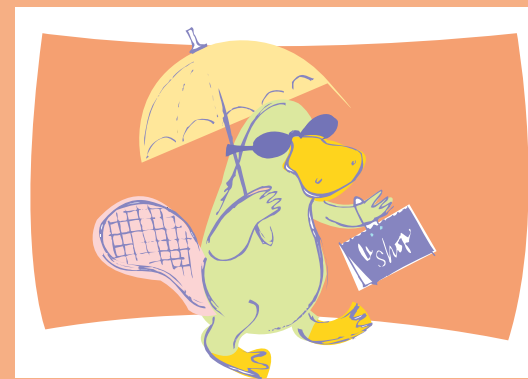
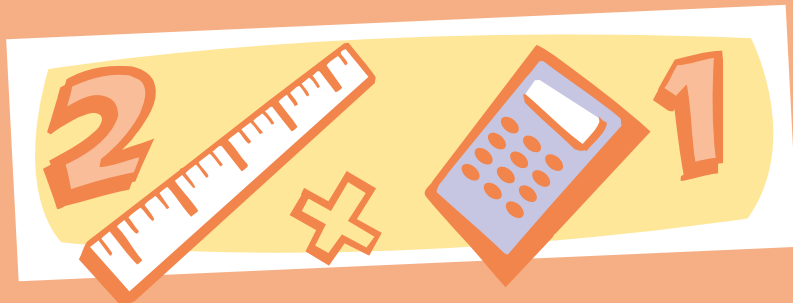
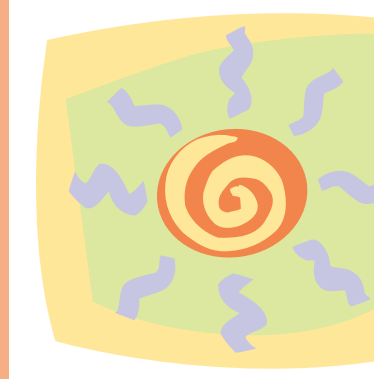
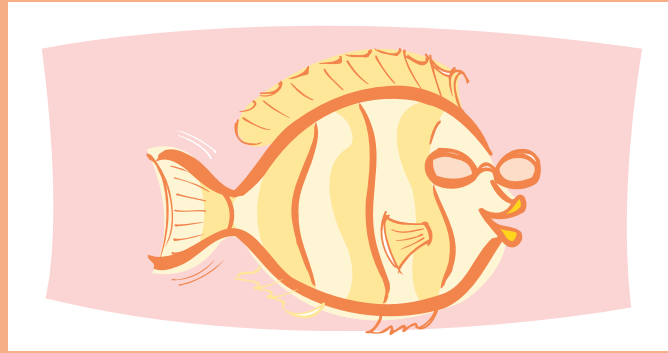


# uv meter



**SunWise**<sup>®</sup>  
a program that **radiates** good ideas  
A Partnership Program of the U.S. Environmental Protection Agency  
[www.epa.gov/sunwise](http://www.epa.gov/sunwise)

Daily reporting of ultraviolet (UV) intensity data by school children will enable students to understand the scientific concepts related to ozone layer depletion and UV radiation. It will help them modify their outdoor behaviors to limit exposure and future incidences of adverse health effects.

This section includes instructions for operating your hand-held UV meter as well as three activities beyond entering your data on the SunWise Internet Site. These activities are aligned with the national educational standards as identified on the educational standards matrix cards for grades 3–5 and 6–8. Good luck with your UV monitoring efforts!

### **UV Meter Activities**

- 1** What Works? Effectively Blocking UV Rays
- 2** Chart and Graph UV Intensity
- 3** Reflecting UV Radiation

## Hand-held UV Meter: Device Operating Instructions

*The activities in this section require the use of an ultraviolet (UV) meter. If you choose to purchase a hand-held UV meter, several vendors can be found on the Internet. We urge you to check the open market for price, quality, and delivery terms before purchasing any items. EPA cannot endorse the products and services of these vendors.*

*Some hand-held UV meters measure the intensity of the sun's UV rays based upon the UV Index (UVI) scale of 0 to 11+ (low to extreme).*

### UV Index Values

UV Index values depict intensity levels on a 0 to 11+ scale in the following way:

Index Number	Intensity Level
$\leq 2$	<i>Low</i>
3 to 5	<i>Moderate</i>
6 to 7	<i>High</i>
8 to 10	<i>Very High</i>
11+	<i>Extreme</i>

While you should always take precautions against overexposure, you should take special care to adopt safeguards such as SPF 30+ sunscreen, hats, sunglasses, protective clothing, etc., as the UV Index value gets higher.

Registered SunWise schools and partners can enter daily UV forecast and intensity data by logging on to the SunWise website at [www.epa.gov/sunwise/enterdata.html](http://www.epa.gov/sunwise/enterdata.html). Detailed instructions for entering the data can be found on the site.

### Precautions

- Use your meter to monitor only the sun's natural radiation. It should never be used to measure UV from artificial sources such as tanning beds.
- Staying in the shade does not provide complete protection from UV radiation due to the scattering effect of UV radiation.
- High temperature and humidity may lead to incorrect results. Do not leave the device in conditions of high humidity or temperature for long periods.
- The meter may fail to operate correctly if the sensor window is not kept clean. Remove dirt with a piece of soft cloth moistened in alcohol (ethanol, isopropanol). Use cleaning fluids sparingly.
- Upon leaving the factory, the meter is carefully calibrated. Improper handling (water immersion, strong shocks) may alter the meter's parameters. Handle with care.

Your UV meter should not replace your common sense or current method of avoiding skin and eye damage from the sun.

### About the UV Index

The UV Index, developed by the National Weather Service and EPA, provides a forecast of the expected risk of overexposure to the sun and indicates the degree of caution you should take when working, playing, or exercising outdoors. The UV Index predicts UV intensity on a 0 to 11+ scale, where  $\leq 2$  indicates a low risk of overexposure, and 11+ means an extreme risk. Calculated on a next-day basis for every ZIP Code across the United States, the UV Index takes into account clouds and other local conditions that affect the amount of UV radiation reaching the ground in different parts of the country.

For more detailed information on UV radiation and the UV Index, read the fact sheets that can be found in the *SunWisdom* section of this Tool Kit or log onto the SunWise website, [www.epa.gov/sunwise](http://www.epa.gov/sunwise).



uv meter



## What Works? Effectively Blocking UV Rays

### Directions

Take the UV meter outside. Check and record the unfiltered UV level. Next, cover the meter with a plastic bag, and apply sunscreen on the outside of the bag over the sensor area. Check and record the UV level and sunscreen SPF number. Try this for a variety of sunscreens with different SPF numbers. Use a clean bag for each sunscreen application.

Next, try the same experiment with sunglasses. Cover the UV meter sensor area with different pairs of sunglasses. Record your results. Lastly, try it with different types and colors of cloth.

### Vocabulary Words

*Sensor*—The area on the UV meter that senses the UV level.

*SPF*—Sun Protection Factor; a number indicating how protective a sunscreen is against UVB rays.

### Questions

- 1 What SPF number seems to be the most protective against the sun's harmful UV rays? How much of a difference did it make?
- 2 Which pair of sunglasses filtered out the most UV rays? Were they UV sunglasses?
- 3 What kind of cloth filtered out the most UV rays? Was there any difference in similar types of cloth but with different colors?
- 4 From what you have learned from this experiment, what precautions should you take when going outside in order to protect yourself from the sun's harmful UV rays?



# What Works? Effectively Blocking UV Rays

## Estimated Time

40–50 minutes

## Supplies

- UV meter
- Plastic bags
- Pairs of UV and non-UV sunglasses
- Variety of sunscreens with different SPF numbers
- Variety of fabric pieces

## Learning Objective

This activity will show students that different sunscreens, coverings, and sunglasses can have a real effect on UV levels. This will emphasize to students the need to wear sunscreen, while at the same time helping them distinguish the effectiveness of different types. Assess student comprehension by asking them to predict what levels of protection different materials would offer, other than the ones you’ve tried in the experiment.

## Directions

Take the UV meter outside. Have one student check and record the unfiltered UV level. Next, have the class take turns covering the UV meter with plastic bags and applying different sunscreens on the outside of the plastic bag over the sensor area. Make sure the students apply an even amount, no thicker than you would apply on your body. Have the students check and record the UV reading

and sunscreen SPF number with each sunscreen. Try this for a variety of sunscreens with different SPF numbers. Use a clean bag for each sunscreen application.

Next, try the same experiment with sunglasses. Have the class cover the UV meter sensor area with different pairs of sunglasses, and record the results. Finally, try covering the sensor with different types and colors of cloth and record the results.

## Questions and Answers

- 1 What SPF number seems to be the most protective against the sun’s harmful UV rays? How much of a difference did it make? *Since SPF 15 filters out 93 percent of UVB radiation, and SPF 30 filters out 97 percent, there should be little noticeable difference with SPF numbers higher than 15; there should be a difference between 4 and 15.*
- 2 Which pair of sunglasses filtered out the most UV rays? Were they UV sunglasses? *Answers may vary. Yes, if the UV reading was low.*
- 3 What kind of cloth filtered out the most UV rays? Was there any difference in similar types of cloth but with different colors? *Your answers will vary. Generally, tighter weave provides greater protection.*
- 4 Given what you have learned from this experiment, what precautions should you take when going outside in order to protect yourself from the sun’s harmful UV rays? *Answers will vary, but students might say wearing sunscreen of SPF 30 or higher, UV blocking sunglasses, and tightly-woven clothing.*



uv meter



## Chart and Graph UV Intensity

### Directions

Working with a partner or group, take turns going outside to record the UV intensity with the UV meter and the weather conditions (sunny, cloudy, rainy, etc.) at approximately the same time each day.

Record your findings in a logbook or chart.

After all the data is recorded, graph and analyze your data.

### Questions

- 1 What difference does the weather make in the UV intensity each day?

- 2 On which days are the sun's UV rays the most dangerous? The least? Why?





uv meter



# Chart and Graph UV Intensity

### Estimated Time

This activity should take a few minutes each day for recording data. The graphing and discussion should take 40-50 minutes once the data is collected. The entire activity could last one to two weeks, depending on how the class is divided.

### Supplies

- UV Meter
- Logbook or chart for data

### Learning Objective

This activity will emphasize that harmful UV rays are present in any type of weather, not just when sunny. Students should always be SunWise, even on a cloudy day. Assess student comprehension of this message by asking the class to make a list of the clothing they wore each day of the experiment. Ask them how they would change that behavior now, knowing that there were UV rays present even on the cloudy days.

### Directions

Divide the students into pairs or groups. Each pair will take turns going outside to record the UV intensity with the UV meter and the weather conditions (sunny, cloudy, rainy, etc.) at approximately the same time each day. Students may also use the SunWise website, [www.epa.gov/sunwise/windex.html](http://www.epa.gov/sunwise/windex.html), to retrieve current UV readings and past UV data.

Students should record their findings in the logbook or chart that you provide.

After all the data is recorded, instruct the students to graph and analyze the data.

### Questions and Answers

- 1 What difference does the weather make in the UV intensity of each day? *The sun's UV rays are less affected by the weather than many students would think.*
- 2 On which days are the sun's UV rays the most dangerous? The least? Why? *UV rays on cloudy days, as well as sunny days, can cause damage to unprotected skin and eyes. UVB rays fluctuate with time of day and season. UVA rays are consistent throughout the day and year and can pass through clouds.*





# Reflecting UV Radiation

## Directions

In this activity, you will work with your teacher to determine the changes in UV intensity by comparing UV readings between direct sunlight and a variety of reflective surfaces.

Using the chart below, record the correct values taken from the UV meter as the meter is placed in a variety of scenarios.

## Questions

- 1 In which scenario was the UV intensity the greatest? What was the UV reading?
  
- 2 In which scenario was the UV intensity the least? What was the UV reading?
  
- 3 Which surface was most UV-reflective? Which was least UV-reflective? Why?

- 4 What are some similarities between your behavior in the sun and the scenarios in which you placed the UV meter? What are some differences?
  
- 5 List some additional scenarios you participate in—sitting inside a sun-filled room or car, for example. What do you think the UV intensity would be if the meter were placed in the same scenario?

Scenarios	UV Meter Reading
In direct sunlight	
In shade	
Reflecting off sand	
Reflecting off water	
Reflecting off aluminum foil	



uv meter



## Reflecting UV Radiation

### Estimated Time

30 minutes

### Supplies

UV meter

Plastic bag (to protect the UV meter)

A large bowl, bucket, or dishpan

1 lb. of sand

1 gallon of water

Aluminum foil (enough to line the bowl)

### Learning Objective

The goal of this activity is to demonstrate changes in UV intensity by comparing UV readings from direct sunlight and a variety of reflective surfaces. Assess the prior knowledge of the students by asking them to predict readings caused by the different surfaces and why they selected those values. After the activity, discuss their results. Compare their predictions with their actual results.

### Directions

Take students outside on a sunny day. Choose a location that offers students proper shade coverage, but allows you to place the experiment materials in direct sunlight. Take a UV reading using the UV meter. Have students record the UV reading in the appropriate space on the chart provided, or one that they have constructed to collect data. Use the UV meter in the scenarios listed, and instruct the students to record the readings in the appropriate spaces on their chart. Remember, the UV meter is not waterproof. Don't forget to protect it with the plastic bag.

### UV Meter Scenarios

Take a reading with the UV meter facing down toward the sand.

Take a reading with the UV meter facing up on the sand simulating sunbathing.

Take a reading with the UV meter pointing toward the bowl of water placed in the sun.

Take a reading with the UV meter pointing toward the aluminum foil placed in the sun.

After your students have completed this experiment, return to your classroom to discuss the findings.



uv meter



### Questions and Answers

- 1** In which scenario was the UV intensity the greatest? What was the UV reading? *Answers will vary.*
- 2** In which scenario was the UV intensity the least? What was the UV reading? *Answers will vary.*
- 3** Which surface was most reflective? Which was least reflective? Why? *Answers will vary.*
- 4** What are some similarities between your behavior in the sun and the scenarios you placed the UV meter in? What are some differences? *The scenarios were designed to mimic our behavior in the sun. Differences would include the use of sunscreen, sunglasses, or protective clothing; the use of these items would add protection from the UV rays.*
- 5** List some additional scenarios you participate in; sitting inside a sun-filled room or car, for example. What do you think the UV intensity would be if the meter was placed in the same scenario? *Try it out. The answers will vary depending on whether the windows are treated to block UV rays. Car windshields generally protect against UVA and UVB, while the side windows are not as protective.*

