



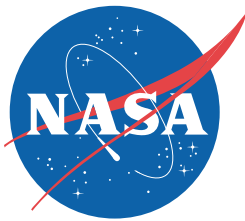
As the Sun Burns

Supplemental science materials

for grades 9 - 12



These supplemental curriculum materials are sponsored by the Stanford SOLAR (Solar On-Line Activity Resources) Center. In conjunction with NASA and the Learning Technologies Channel.



Learning Technologies Channel



Susanne Ashby

Curriculum Specialist

Paul Mortfield

Solar Astronomer

Amberlee Chaussee

Page Layout and Design



Table of Contents

Teacher Overview

- Objectives
- Correlation to the National Science Standards
- Segment Content/On-line Component Review
- Materials List

Explorations

Science Explorations

- Consumer Watchdogs: Sunscreen
- Consumer Watchdogs: Sunglasses
- Developing a UV Rating System (Hat/Fabrics)
- Science News Report
- UV
- Ozone Protection from UV Rays
- UV Index

Career Explorations

- Career Comparison

Student Handouts

- Consumer Watchdogs: Sunscreen
- Consumer Watchdogs: Sunglasses
- Developing a UV Rating System
- Science News Report
- Career Comparison

Appendix

- Solar Glossary
- Web Work





- Objectives
- Correlation to the National Science Standards
- Segment Content/On-line Component Review
- Materials List



Teacher Overview

Objectives

1. Students will understand that the sun gives us more than just rays from the visible light spectrum, that the sun gives off light we can't see such as ultraviolet radiation.
2. Students will develop an understanding of how to protect their bodies from the harmful effects of ultraviolet radiation.
3. Students will develop an understanding of how the Earth's atmosphere (stratosphere and ozone layer) shields the surface of the Earth from most of the ultraviolet rays that come from the sun.
4. Students will explore/demonstrate the effects of ultraviolet radiation on objects that react to ultraviolet rays.
5. Students will become familiar with the work of an ophthalmologist, dermatologist, meteorologist and solar scientist.
6. Students will become familiar with the electro-magnetic spectrum to understand where visible light and ultraviolet radiation fall within it.



Teacher Overview

Correlation to the National Science Standards

This segment of the Webcast *All About the Sun*, "As the Sun Burns", is brought to you by correlation to the National Science Standards for grades 2 - 4, 5 - 8 and 9 - 12 as delineated below.

Grades 9 - 12

Unifying Concepts and Processes

- Systems, order, and organization
- Evidence, models, and explanation
- Changes, constancy, and measurement

Science as Inquiry

- Abilities necessary to do scientific inquiry
 - Identify questions and concepts that guide scientific investigations
 - Design and conduct scientific investigations
 - Use technology and mathematics to improve investigations and communications
 - Formulate and revise scientific explanations and models using logic and evidence
 - Recognize and analyze alternative explanations and models
 - Communicate and defend a scientific argument
- Understandings about scientific inquiry

Physical Science

- Interactions of energy and matter

Earth and Space Science

- Energy in the Earth system

Science and Technology

- Abilities of technological design
 - Identify a problem or design opportunity
 - Propose designs and choose between alternative solutions
 - Implement a proposed solution
 - Evaluate the solution and its consequences
 - Communicate the problem, process and solution of technological design
- Understandings about science and technology



Teacher Overview

Correlation to the National Science Standards

(continued)

Grades 9 - 12 (continued)

Science in Personal and Social Perspectives

- Personal and community health
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

History and Nature of Science

- Science as a human endeavor
- Nature of scientific knowledge





Teacher Overview

Segment Content/On-line Component Review

The sun gives off much more than just visible light. Students will learn in this segment that ultraviolet radiation is part of the sun's spectrum of non-visible energy. They will become familiar with the Earth's atmosphere and the ozone layer that surrounds the Earth protecting it from the ultraviolet radiation. They will explore the effects of exposure to these rays on special UV beads. They will become familiar with the UV Index while learning about ways to protect themselves from the effects of exposure to UV rays.

The on-line segment will include interviews with a dermatologist, ophthalmologist and solar scientist about the sun's rays and how to stay safe from their harmful effects. Students will demonstrate proper solar protection behaviors. Students will also perform a demonstration/experiment using special UV beads to determine the amount of exposure to ultraviolet rays from the sun.

Students can visit the Web site and read about the work of an ophthalmologist, dermatologist, meteorologist and solar scientist offered as a text-based interview. Students can also use the Web site to view illustrations of the following concepts: Earth's atmosphere (stratosphere with ozone layer) protecting the surface from UV rays, the electro-magnetic spectrum and the UV Index.

The Science Exploration section focuses on explorations with UV beads. These beads can be ordered from the following source:

Educational Innovations, Inc.
151 River Road
Cos Cob, CT 06807

203-629-6049

Catalog: EDI # UV-ast (assorted colors with approximately 240 beads per bag @ \$6.95, 1 bag should be enough for a class of 30 students)

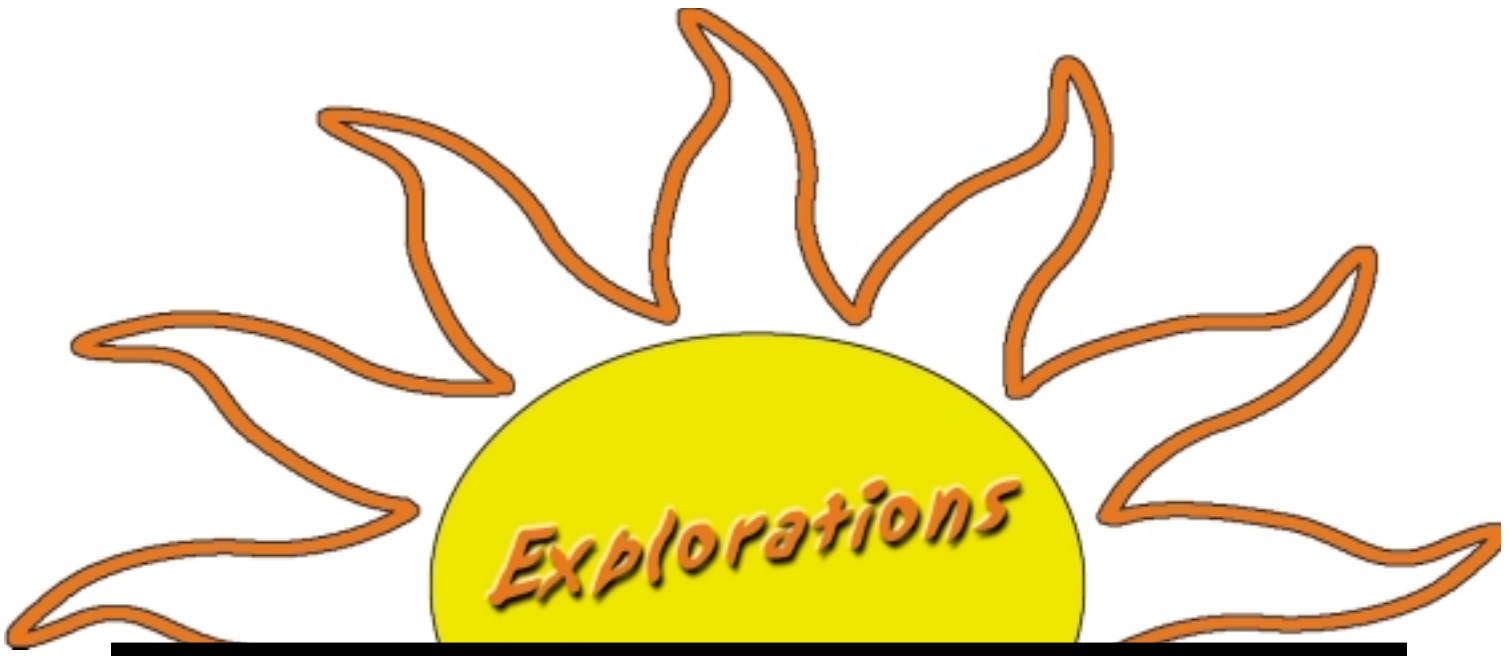
The UV explorations can be easily adapted to fit the classroom science pedagogy in use, but are structured in this document as collaborative group explorations with an accompanying student guidesheet for each exploration.



Teacher Overview

Materials List

- Ultraviolet Beads (Note: Special purchase information found in the section *Segment Content/ On-line Component Review*)
- Bottles of Sunscreen SPF 5, 15, 30, 45
- Various types of highly and lowly rated UV sunglasses
- Various types of material: cotton (lightweight, heavyweight), linen, synthetic
- Various styles of hats
- Student Handouts
 - Consumer Watchdogs: Sunscreen
 - Consumer Watchdogs: Sunglasses
 - Developing a UV Rating System (Hat/Fabrics)
 - Science News Report
 - UV
 - Ozone Protection from UV Rays
 - UV Index
 - Career Comparison



- Science Explorations
 - Consumer Watchdogs: Sunscreen
 - Consumer Watchdogs: Sunglasses
 - Developing a UV Rating System (Hat/Fabrics)
 - Science News Report
 - UV
 - Ozone Protection from UV Rays
 - UV Index
- Career Explorations
 - Career Comparison



Science Explorations

Each of the science explorations described below come with student guidesheets (found in the Student Handout section). These explorations are meant to provide follow-up to the Web cast viewing as well as a collaborative research project. Students can also utilize the Web Research section found in the Appendix for further information gathering.

- Consumer Watchdogs Sunscreen / Sunglasses

Working in collaborative groups have your students perform a test of the commercial sunscreens or sunglasses available on the market, checking for the accuracy of their Sun Protection Factor (SPF) rating (sunscreens) or the UV protection factor (sunglasses). The students will have to devise a methodology for testing on non-living organisms (UV beads), measuring the rating with a visual clue (akin to a pH paper test perhaps) and then the protocol for conducting their research. When finished they will publish their results for discussion with their colleagues. See the Student Handouts: *Consumer Watchdogs: Sunscreen* and *Consumer watchdogs: Sunglasses*.

- Developing a UV Rating System (Hat/Fabric)

Working collaborative groups have the students develop their own Sun Protection Factor (SPF) rating for hats, fabric or umbrellas. The students will have to devise a methodology for testing on non-living organisms (UV Beads), measuring the rating with a visual clue (akin to a pH paper test perhaps) and then the protocol for conducting their research. When finished they will publish their results for discussion with their colleagues. See the Student Handout: *Developing a UV Rating System*.

- Science News Report

Working in collaborative groups, students will utilize Web sites to research information about one of the following three topics: Ultraviolet radiation, Atmospheric protection from UV Rays, or UV Index. Upon completion of their information gathering process, students will prepare a brief Science News Report (format of their own choosing) through which their information will be presented. the report can be followed-up with a student made quiz. See the Student Handout: *Science News Report*.





Explorations

Career Explorations

- Career Comparison

Review the directions for the Student Handout: *Career Comparison*. Have the students complete the handout after listening to each of the four experts' interviews (Dermatologist, Ophthalmologist, Meteorologist, Solar Astronomer).

Students choose two of the careers and place each in the box at the top of the chart. In the box in the middle, students relate 3 ways in which these careers are similar. In the two boxes at the lower half of the page, the students will relate 3 ways in which each career is different from the other and select the appropriate criteria. For example, choosing dermatologist and ophthalmologist the criteria for a difference would be the part of the body to which each provides a service.





Grades 9 - 12

- Consumer Watchdogs: Sunscreen
- Consumer Watchdogs: Sunglasses
- Developing a UV Rating System (Hat/Fabric)
- Science News Report
 - Ultraviolet Radiation
 - Atmospheric Protection from UV Rays
 - UV Index
- Career Comparison

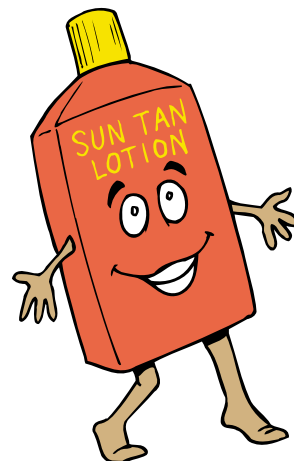


Student Handouts

Consumer Watchdogs: Sunscreen

Scenario

Your group is a Consumer Watchdog agency that independently tests commercial products to verify their stated effectiveness. Your group has been tasked to verify the Sun Protection Factor (SPF) ratings with which all sunscreen products are labeled. You must check the leading brands in 4 SPF categories and verify that they are accurately labeled for sun protection.



Test Parameters

1. No humans or animals can be used for this test.
2. Your methodology must be clearly delineated and itself calibrated for accuracy.
3. No less than 3 products should be tested at each of 3 or 4 SPF levels. The SPF levels are left to the Consumer Watchdog agency's discretion.
4. The entire test should be run again for verification of accuracy with another independent test group within the agency.

Results

1. Results should be compared with the other test group within the agency.
2. A formal report (or article for the consumer watchdog's publication) should be prepared and submitted.

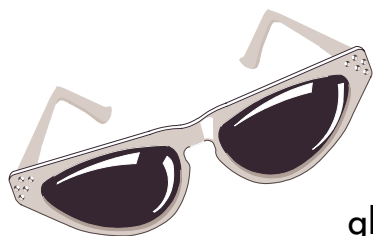




Student Handouts

Consumer Watchdogs: Sunglasses

Scenario



Your group is a Consumer Watchdog agency that independently tests commercial products to verify their stated effectiveness. Your group has been tasked to verify the Ultraviolet Rays protection ratings with which all sunglasses are labeled. You must check at least 5 of the leading brands and verify that they are accurately labeled for UV protection.

Test Parameters

1. No humans or animals can be used for this test.
2. Your methodology must be clearly delineated and itself calibrated for accuracy.
3. No less than 5 products should be tested. The UV rating levels to be tested are left to the Consumer Watchdog agency's discretion.
4. The entire test should be run again for verification of accuracy with another independent test group within the agency.

Results

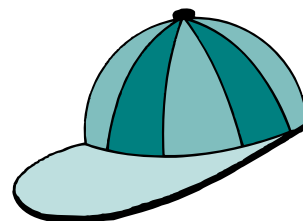
1. Results should be compared with the other test group within the agency.
2. A formal report (or article for the consumer watchdog's publication) should be prepared and submitted.





Student Handouts

Developing a UV Rating System Hats or Summer Fabrics



Scenario

Your independent agency has been instituted by the clothing manufacturers association to develop a UV rating system for hats or fabrics used for summer clothing designed for the outdoor consumer (sports enthusiasts, home gardeners, outdoor agricultural workers, construction workers, forestry personnel and other workers whose job leaves them exposed to the sun during the majority of their workday).

Test Parameters

1. No humans or animals can be used for this test.
2. Your methodology must be clearly delineated and itself calibrated for accuracy.
3. The test must consider not just direct sunlight, but also reflection.
4. The test must use at least 5 styles of hats designed for outdoor wear (nighttime fashion statements are not to be considered) OR at least 5 different types of fabric used for outdoor clothing (cotton of various weights, linen, synthetics).

Results

1. After the rating system has been developed, at least 2 other test groups within the agency should be trained in the new rating system's use and then employ it by rating a set of summer clothing.
2. After each test group assigns a rating to each article of clothing, the groups should cross check their results with each other to verify the accuracy of the rating system.
3. If the results are not similar, revisions should be made in the rating system to ensure uniformity in its use within the industry.
4. A formal report (or article for the consumer watchdog's publication) should be prepared and submitted.





Student Handouts

Science News Report

Directions: Working in collaborative groups, perform research on one of the three topics described below and prepare answers for each of the essential questions listed. Develop your own format and present a "Science News Report".



Ultraviolet Radiation

Ultraviolet radiation is emitted by the sun and without the protection of the Earth's atmosphere could have a catastrophic effect upon the Earth. Investigate this topic by answering the essential questions below:

- What is ultraviolet radiation? Relate it to the electromagnetic spectrum.
- Are there different types of ultraviolet rays? If so describe them.
- What are its effects on humans?
- What are its effects on agricultural crops and forests?
- How can humans protect themselves from the harmful health effects of UV radiation.

Stratospheric Ozone and UV Rays

We know that because of the protective layer of atmosphere called the stratosphere which contains the ozone layer, the Earth receives much protection from ultraviolet radiation. Investigate this topic by answering the essential questions below:

- Chemically what happens in the ozone layer that screens out the ultraviolet radiation?
- How much protection does the ozone layer offer the Earth?
- What role does depletion of the ozone layer play in the amount of ultraviolet radiation that the surface of the Earth receives?
- How is the ozone layer and ultraviolet radiation being monitored?

UV Index

The UV Index which was developed by the National Weather Service and the Environmental Protection Agency gives the public helpful information to prevent overexposure to the sun's rays. Investigate this topic by answering the essential questions below:

- How and why was the UV Index developed?
- What does the UV Index mean?
- How does one use the UV Index?
- How is the UV Index calculated?





Student Handouts

Career Comparison

Directions: Choose 2 of the careers covered on the Web site <http://solar-center.stanford.edu> or during the Webcast, and list 3 ways in which the two careers are similar and 3 ways in which the two careers are different.

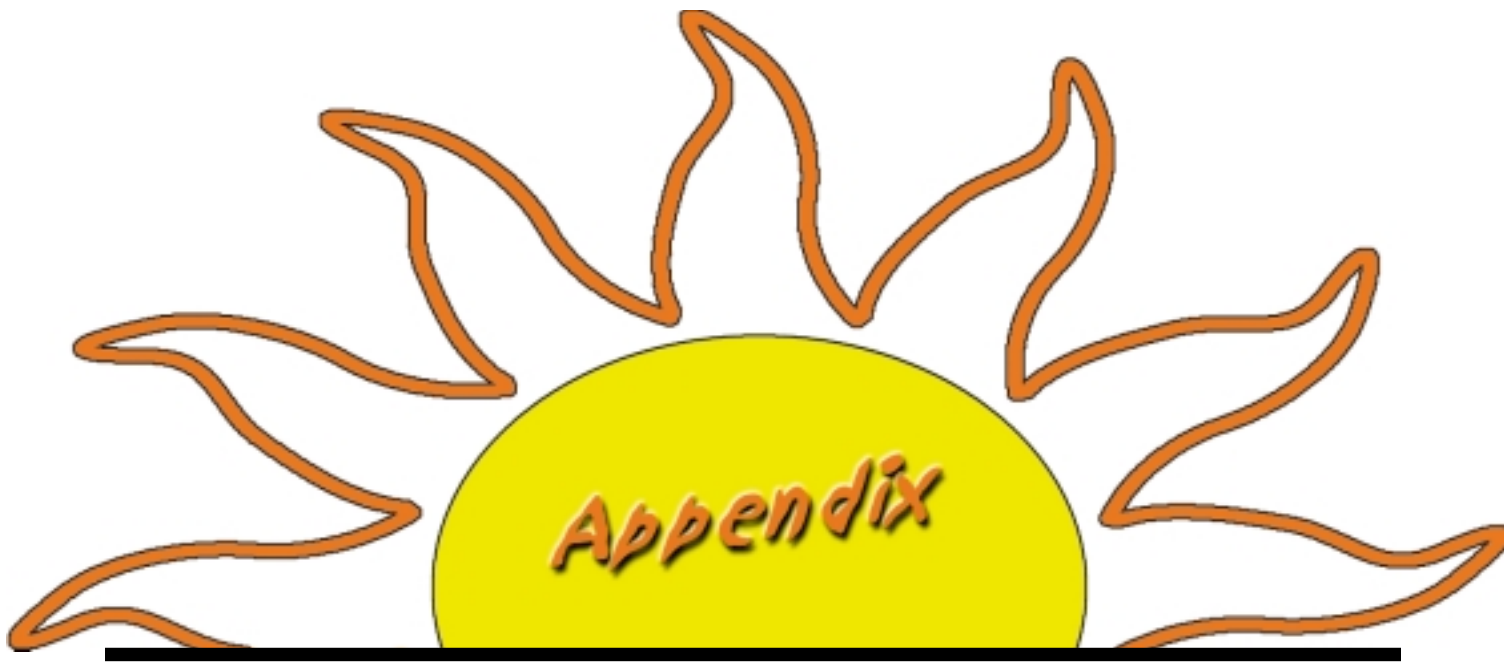
career

career

How Are They Alike?

In What Ways Are They Different?





- Solar Glossary
- Web Work



Solar Glossary

Directions: An interactive vocabulary crossword puzzle and word search can be found on the Web site: <http://solar-center.stanford.edu> using the following words and their definitions.

atmosphere	A thick mass of air that surrounds the Earth contain many layers.
cataracts	A clouding of the lens of the eye that prevents light from passing through the membrane. Can cause blindness.
cloudy	Having many of a visible mass of particles of condensed vapor in the atmosphere.
cornea	The transparent part of the membrane that covers the pupil and allows light to enter the eye.
dermatologist	A doctor who studies the skin, its structure, its function and its diseases.
energy	The capacity for producing power such as heat or light.
exposure	To allow to be unprotected and risk harm from that.
meteorologist	A scientist who studies the weather
ophthalmologist	A doctor who deals with the structure, functions, and diseases of the eye.
overcast	A thick layer of clouds that obscure some of the sun's energy.





Appendix

Solar Glossary

ozone layer	A form of oxygen formed naturally in the atmosphere by a photochemical reaction and located mainly in the stratosphere.
solar	Having to do with the sun.
solar astronomer	A scientist who studies the sun.
SPF	Sun Protection Factor that is a number used to describe how much protection from ultraviolet rays a sunscreen will give.
stratosphere	A part of the Earth's atmosphere that extends from about 11 kilometers above the Earth's surface to about 50 kilometers and contains the ozone layer.
sunburn	An irritation of the skin caused by too much exposure to ultraviolet rays.
sun	The star nearest to Earth that gives off the energy (heat and light) that affects the Earth.
UV	Ultraviolet radiation or energy given off by the sun that cannot be seen.
UV Index	A special scale developed by the EPA that forecasts the amount of ultraviolet radiation that will reach the Earth's surface.



Appendix

Web Work

<http://solar-center.stanford.edu>

This site contains an interactive vocabulary crossword puzzle and word search using the solar glossary words.



<http://www.epa.gov/ozone/uvindex/uvhealth.html>

This site contains lots of information on the ozone layer, ultraviolet radiation, the effects of ultraviolet radiation on humans, the UV Index and how it is calculated.

<http://www.sola.com/professional/techtips/tip78.html>

This site discusses the types of UV radiation and its effects.

<http://www.aoanet.org/ia-ocular-uvrad.html>

Introduces the effects of UV radiation on the eyes.

<http://www.opticalaccess.com/uvrays.htm>

Explains the invisible part of the electromagnetic spectrum and the effects of reflection on the eyes.

www.ConsumerReports.org

The Web site for the organization *Consumer Reports* which can be used to provide your students with examples of product testing.

