Explorations

Science Explorations

- UV Rays

Purpose: To demonstrate that the sun gives off energy that we can see (visible light) as well as energy that we cannot see (ultraviolet rays). To observe the effects of ultraviolet rays.

Take the beads (covered) out on a sunny day, expose them to the direct sunlight and have the students observe and record the beads' reaction. Discuss or hypothesize what has caused the beads' color to change.

Take another set of beads (covered) into the shade and expose them. Have the students observe and record the beads' reaction. Discuss or hypothesize what has caused the beads' color to change.

Using another set of beads (covered), hold them beneath lamplight from the classroom (away from any sunlight) and expose them to the artificial light source. Have the students observe and record the beads' reaction. Discuss or hypothesize what has caused the beads' color to change.

On the next overcast or cloudy day, take a set of beads (covered) outside and expose them. Have the students observe and record the beads' reaction. Discuss or hypothesize what has caused the beads' reaction.

This can lead to further exploration of UV rays and the full spectrum of energy that the sun emits.

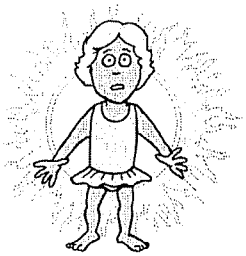
- SPF Safe

Purpose: To demonstrate the effectiveness of sunscreen in protecting people from the harmful rays of the sun. To observe the differences in protection from among the different SPF ratings.

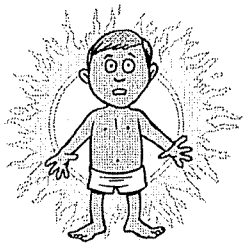
Take 3 sets of UV beads and soak one set each in sunscreen SPF 15, SPF 30+, and SPF 45+. Let each dry for about 60 minutes before beginning the exploration (This is optional, as the beads can be exposed to the sun while they are still wet with lotion.). Take another set of UV beads and do not apply any sunscreen to that set. Place each set of beads on a sturdy paper plate and cover each with a dark cloth as you position them outside. Do not tell students which beads have had which SPF sunscreen applied to them. Expose each set to direct sunlight and after 10 seconds have students observe and record the beads' reaction. Have them discuss the effects of sunscreen and try to identify which set of beads had had which SPF sunscreen applied.

Student Informational Reading

You Can Be UV Safe



Have you ever been outside during the day and at the end of the day noticed that your skin is painful to touch? You have a sunburn! A sunburn causes the skin to turn red or become tender. It can also cause your skin to swell or blister.



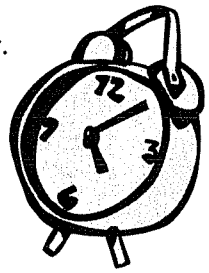
Have you ever been outside for a long time on a cloudy or overcast day and gotten a sunburn? This can happen! It is not the sunlight we can see that gives us a sunburn. It is the energy from the sun we cannot see that can harm us.

The sun gives off energy. This energy reaches Earth in the form of light that we can see. It also gives off energy in ways that we might not notice. One type of energy that the sun gives off is ultraviolet rays. We cannot see UV rays with our eyes. We can see the effects of UV rays on our bodies. Too much exposure to UV rays on our skin can give us a sunburn. Even on an overcast day, 30% to 60% of the sun's rays can penetrate to the Earth's surface. It is the UV rays that can harm our skin and our eyes.

It is the Earth's atmosphere that protects us from overexposure to the sun's more harmful rays. The stratosphere (a layer of air 11 to 50 kilometers above the Earth's surface) contains the ozone layer. The ozone layer was formed when water vapor drifting in the Earth's upper atmosphere was chemically broken down by sunlight into oxygen and hydrogen gases. The hydrogen gas escaped into space because it is so lightweight. The oxygen atoms started to combine with each other to form another substance, ozone. A molecule of ozone is made up of 3 oxygen atoms joined together. This recombination resulted in a layer of ozone forming in the stratosphere.

The ozone layer protects us from the effects of ultraviolet radiation with a complex chemical reaction. As the ultraviolet radiation is absorbed by the ozone molecules, the oxygen molecules are broken apart. The freed oxygen atoms eventually recombine into ozone molecules, and the chemical recombination continues. The ozone layer through this absorption process shields us

from the ultraviolet rays. Decreases in the ozone level of the stratosphere over a long period of time could cause increases in skin cancer and cataracts in people as less and less ultraviolet radiation is being absorbed by the ozone molecules.

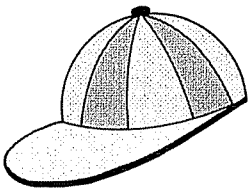


Long term exposure to the sun can take away the skin's moisture or elasticity. It can make your skin feel dry and rough, not soft and smooth. It can also cause your skin to develop spots that are red, yellow, gray or brown. Our eyes can be affected by UV rays, also. Too much exposure to UV rays can cause a painful burn on the cornea of your eyes. This can cause cataracts and later on blindness.

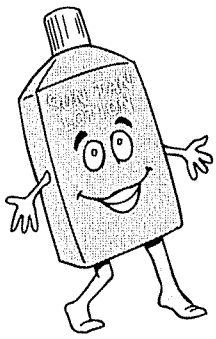
Student Informational Reading

Scientists measure how much UV rays reach the Earth's surface. They developed a special index to help make us aware of the level of radiation exposure expected for each day. We can use this as a guide to help us protect our bodies. See the chart below for a description of each rating.

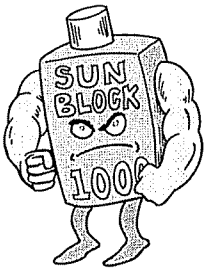
UV Index



UV Index Value	Exposure Category	Precaution
0 to 2	Minimal	Wear a hat
3 to 4	Low	Wear a hat and sunscreen (SPF 15+)
5 to 6	Moderate	Wear a hat and sunscreen (SPF 15+) Stay in shady areas
7 to 9	High	Wear a hat and sunscreen (SPF 15+) Stay in shady areas stay indoors during mid-day (10:00 AM to 4:00 PM)
10+	Very High	Stay indoors as much as possible



We can protect ourselves from the harmful effects of UV rays. We can wear sunscreen with an SPF (Sun Protection Factor) of no less than 15. This will absorb at least 85% of the UV rays before the rays reach your skin. Avoid being out in the sun for a long time during peak exposure hours (10:00 AM to 4:00 PM). Wear a hat and protective clothing to cover your skin. Wear sunglasses that are rated to block at least 99% of the UV rays.



Student Worksheet

You Can Be UV Safe

Directions: **After reading the Student Reading: *You Can Be UV Safe,* answer each question below by circling the correct response.**

1. Name the form of energy that the sun gives off which causes a sunburn.

   A. visible light B. gamma rays C. Ultraviolet radiation

2. Ultraviolet radiation can cause what kind of damage to your eyes?

   A. cataracts B. blindness C. both A and B

3. Ultraviolet rays can penetrate what percentage of the Earth's surfaceduring cloud days?

   A. 10% - 40% B. 30% - 60% C. 85%

4. This layer of the atmosphere protects the Earth's surface from UV rays.

   A. troposphere B. stratosphere C. magnetosphere

5. Decreasing levels of this will increase the incidence of skin cancer.

   A. UV rays B. gamma rays C. ozone

6. Long term exposure of the skin to the sun can reduce this in the skin.

   A. moisture B. elasticity C. freckles D. both A and B

7. Give the times for peak sun exposure hours.

   A. 8:00 AM - noon B. 10:00 AM - 2:00 PM C. 10:00 AM - 4:00 PM

8. To absorb 85% of UV rays, you can protect your skin with what factor of sunscreen?

   A. SPF 5 B. SPF 10 C. SPF 15+

9. If you are advised to stay indoors as much as possible what is the UV Index Value for that day?

   A. 10+ B. 7 - 9 C. 1 - 2

Student Worksheet

Reading a Chart: The UV Index

Directions: Use the UV Index to answer the questions below.

1. What is the Index Value for an exposure of "Low"?

2. What precaution should you take if the Exposure is "Minimal"?

3. What are the peak mid-day hours of sunlight?

4. What is the Index Value when the Exposure category is "High"?

5. What precaution should people take if the Index Value is 8?

6. What is the recommended Sun Protection Factor for the sunscreen?

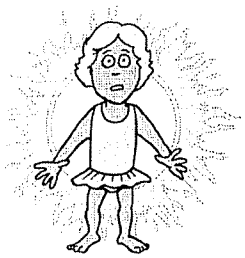
7. What article of clothing is recommended to always be worn for UV protection?

8. What should you do if the Exposure Category is "Very High"?

9. Which two exposure categories recommend to stay in shady areas?

Student Informational Reading

You Can Be UV Safe



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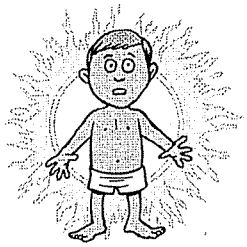

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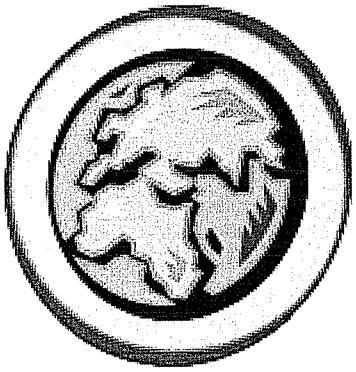

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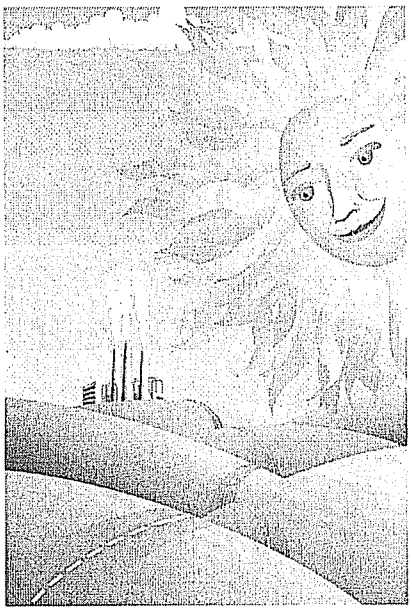
Appendix



Solar Glossary

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.

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 - A number used to describe how much protection from ultraviolet rays a sunscreen will give.

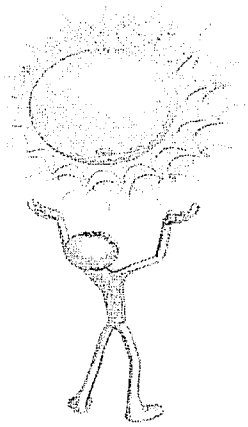
Stratosphere - A part of the Earth's atmosphere that extends from about 11kilometers above the Earth's surface to about 50 kilometers and contains the ozone layer.

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.

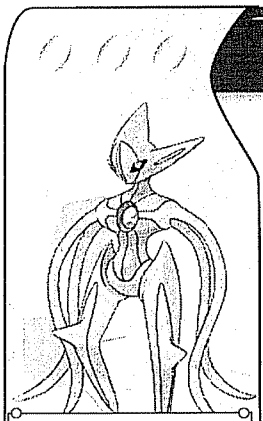
UV Index - A special scale developed by the EPA that forecasts the amount of ultraviolet radiation that will reach the Earth's surface.



What is the ozone layer?

DEOXYS
is a new Pokémon character in the Trading Card Game, and there is real world science behind its story.

For more real science visit:
http://ksnn.larc.nasa.gov/pokemon



LEARN
the real **science** behind
DEOXYS

Pokémon TRADING CARD GAME

PURPOSE

To investigate the effects of solar radiation on an object

BACKGROUND

The Sun's radiation is very powerful and can be dangerous to human beings. In space, astronauts are exposed to more ultraviolet (UV) radiation than they are here on Earth and must be particularly careful to protect themselves by wearing helmets with face shields. On Earth, we have the ozone layer and lower atmosphere to help absorb and/or scatter some of the harmful UV rays of the Sun; however, there is still enough radiation to harm us.

Have you ever been sunburned? Exposing your skin to too much solar radiation causes sunburn. People protect their skin from harmful solar UV radiation by using sunscreen. Sunscreen blocks or absorbs some of the UV light. Sunscreens offer various levels of protections and have a Sun Protection Factor (SPF), a number on the sunscreen. This number, multiplied by 10, gives you the number of minutes you can be exposed to the Sun without getting burned. For example, an SPF of 10 provides you with 100 minutes of protection from the Sun's harmful rays. Recent studies have shown that there is little difference between the protection power of SPF 30 and any of the higher SPFs.

Less ozone would result in more solar radiation. Without the protection of the ozone layer, you would need much more than sunscreen to protect you from damaging UV rays.

Many thanks to the NASA SCI FilesTM for this activity. Visit http://scifiles.larc.nasa.gov and learn more about solar radiation and other challenges for crewed missions.

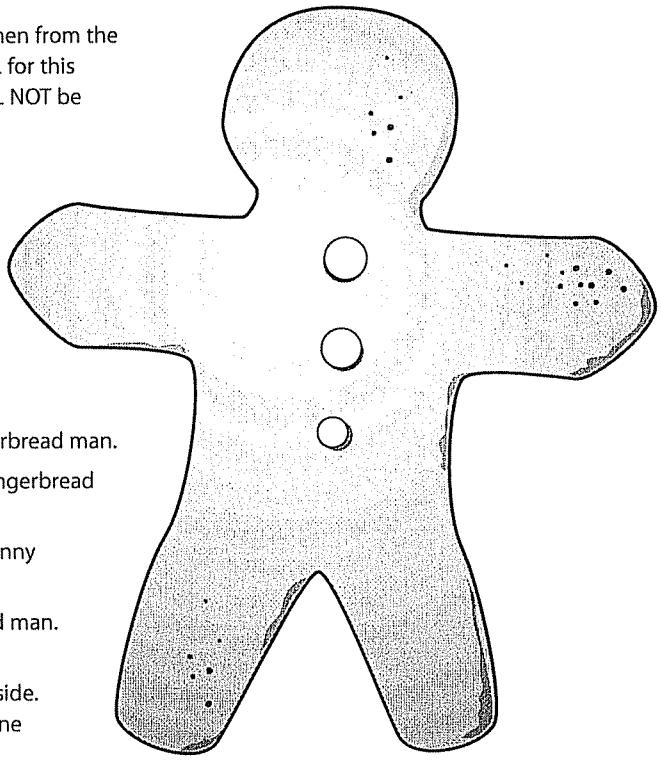
MATERIALS

For each group:

- dark construction paper *(blue, purple, or red are best)*
- scissors
- permanent marker
- sunscreen of 5 different SPFs *(same brand)*
- gingerbread man template

PROCEDURE

1. Use the template to cut two large gingerbread men from the dark construction paper. One will be a CONTROL for this activity. Put the control someplace where it WILL NOT be in the sun.
2. Using the permanent marker, divide the other gingerbread man into sections: head, arms, and legs.
3. Label each section with a different SPF number.
4. Coat the sections with the corresponding SPF sunscreen. Note: To control as many variables as possible, use the same brand of sunscreen for all samples.
5. Do not put sunscreen in the middle of the gingerbread man.
6. Predict what will happen when you place the gingerbread man outside in the sunlight.
7. Place your gingerbread man outside in a very sunny location.
8. Every 30–60 minutes, check on your gingerbread man. Record your observations.
9. After a few hours, bring the gingerbread man inside. Compare the one that's been in the sun to the one you protected.



What is the ozone layer?

CONCLUSION

1. How does the CONTROL compare to the gingerbread man that was outside?
2. What happened to the unprotected part of the gingerbread man?
3. Which SPF gave the most protection? How can you tell?
4. What conditions may change the amount of sunscreen needed?
5. If the "hole in the ozone layer" were to spread, how might your results be affected?

EXTENSIONS

1. UV beads are available from some science supply companies. They change from white to various colors when exposed to UV light. Try some of these extensions with UV beads.
   - **a.** Tie a UV bead to a string and take it, along with a ruler and a pail of water outside. Lower the bead 2 centimeters (cm) into water and watch for a color change. Repeat by lowering the bead 2 more cm each time until no color change is observed. How far down does the sunlight penetrate water?
   - **b.** Take a pair of sunglasses and place them in front of the UV bead, shading the bead from the sunlight. Do the sunglasses protect the bead from UV light?
   - **c.** Observe UV beads indoors. What happens when the beads are indoors? Place the beads in a windowsill. Does UV light penetrate glass?
   - **d.** Take the beads outside on a cloudy day. Is there UV light on a cloudy day?
   - **e.** Create other experiments with the UV beads.