Exploring Solar Energy
Materials List

1 set of ultraviolet beads

1 laminated data sheet

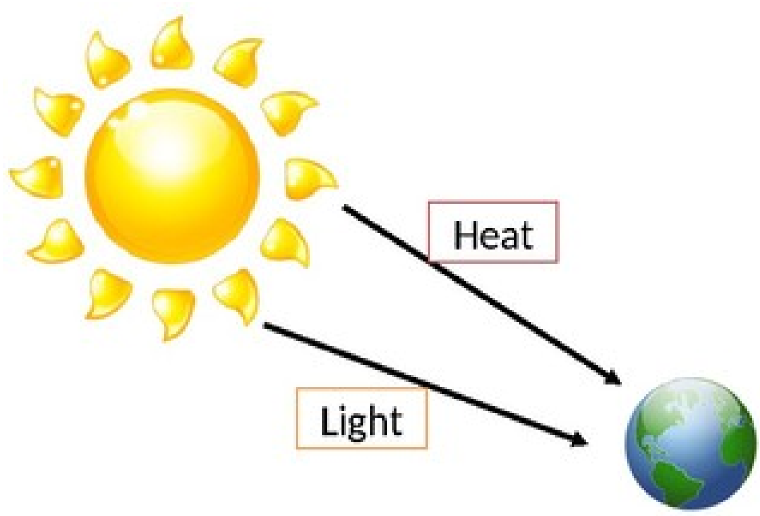
1 pair of sunglasses

1 wet-erase markers
1 set of radiation cans

2 thermometers in plastic cases

1 solar balloon and string

1 book
Catch the Sun



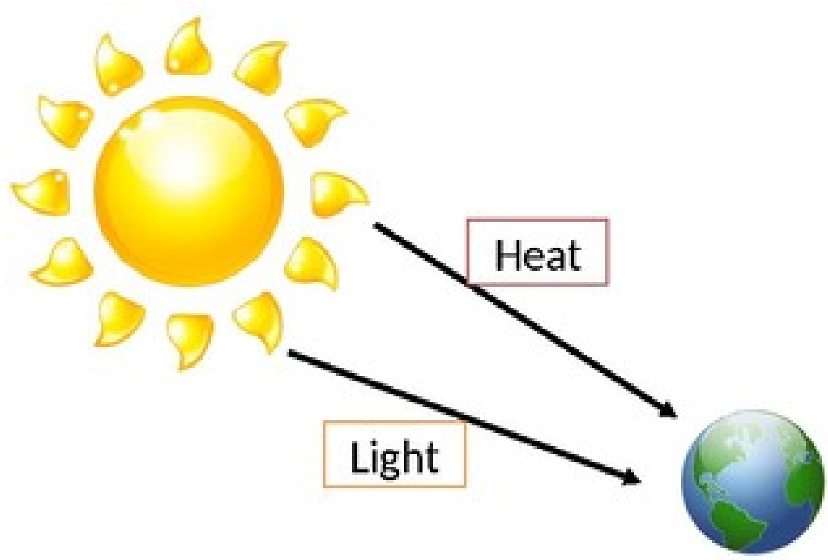
Exploring Solar Energy

Ages: Kindergarten & up

The Sun can make energy!

Energy from the Sun produces light on Earth. The Sun's energy can be felt on Earth as heat. Solar energy is a renewable energy resource.

Extension activities included: Observe the intensity of light from the Sun using ultraviolet (color changing) beads, measure heat from the Sun, and use the Sun's energy to cook a snack.

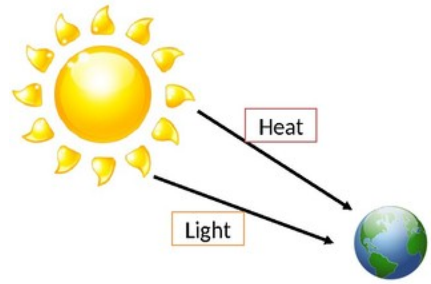


Donated by the Center for the Advancement of Sustainable Energy

CENTER for the ADVANCEMENT of SUSTAINABLE ENERGY
JAMES MADISON UNIVERSITY.

Thank you for choosing this Resource Kit from the Center for the Advancement of Sustainable Energy.

CENTER for the ADVANCEMENT of SUSTAINABLE ENERGY
JAMES MADISON UNIVERSITY



Heat and light from the Sun

`https://www.youtube.com/watch?v=dD0ycPpUyM4

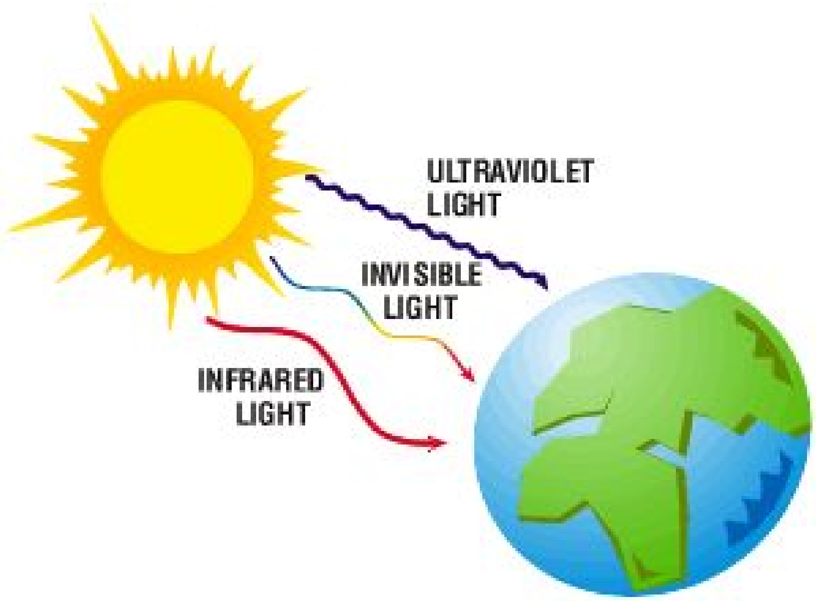
KidWind Renewable Energy Challenge

https://www.youtube.com/watch?v=n9rR9NH8l1Y

Contact Information

case@jmu.edu   www.jmu.edu/case

The major source of energy on Earth is solar radiation.



- Solar radiation is made up of different types of radiation (including infrared, visible light, and ultraviolet).

- Earth receives only a very small portion of the sun's energy, yet this energy is responsible for powering the motion of the atmosphere, the oceans, and many processes at Earth's surface. Earth's surface is heated unequally.

Source: https://www.solpass.org/science6-8-new/s6/standards6/6-4-standard-energy-2018.html

Solar Energy
TEACHER

We get most of our energy from the sun. We call it **solar energy**. It travels from the sun to the Earth in waves or rays. Some are light rays that we can see. Some rays we cannot see, like x-rays. The sun is a star. It is a giant ball of gas. It sends out huge amounts of energy every day. Most of the energy goes off into space. Only a small part reaches the Earth.

We use solar energy in many ways. All day, we use sunlight to see what we're doing and where we're going. Sunlight turns into heat when it hits things. Without the sun, we couldn't live on the Earth—it would be too cold. We use the sun's energy to heat water and dry clothes.

Plants use the light from the sun to grow. Plants take the energy in light and store it in their roots, stems, fruits, and leaves. That energy feeds every living thing on Earth. We can also burn plants to make heat.

The energy from the sun makes rain fall and the wind blow. We can capture that energy with dams and windmills. Coal, oil, and natural gas were made from prehistoric plants and animals. The energy in them came from the sun. We use that energy to cook our food, warm our houses, run our cars, and make electricity.

ENERGY CHANT

SOLAR ENERGY—
sun shine bright,
SOLAR ENERGY—
give me light!

Begin with arms over head in a big circle, swaying from side to side during "SOLAR ENERGY." Spread arms out wide during "sun shine bright." Repeat motions for second part of chant.

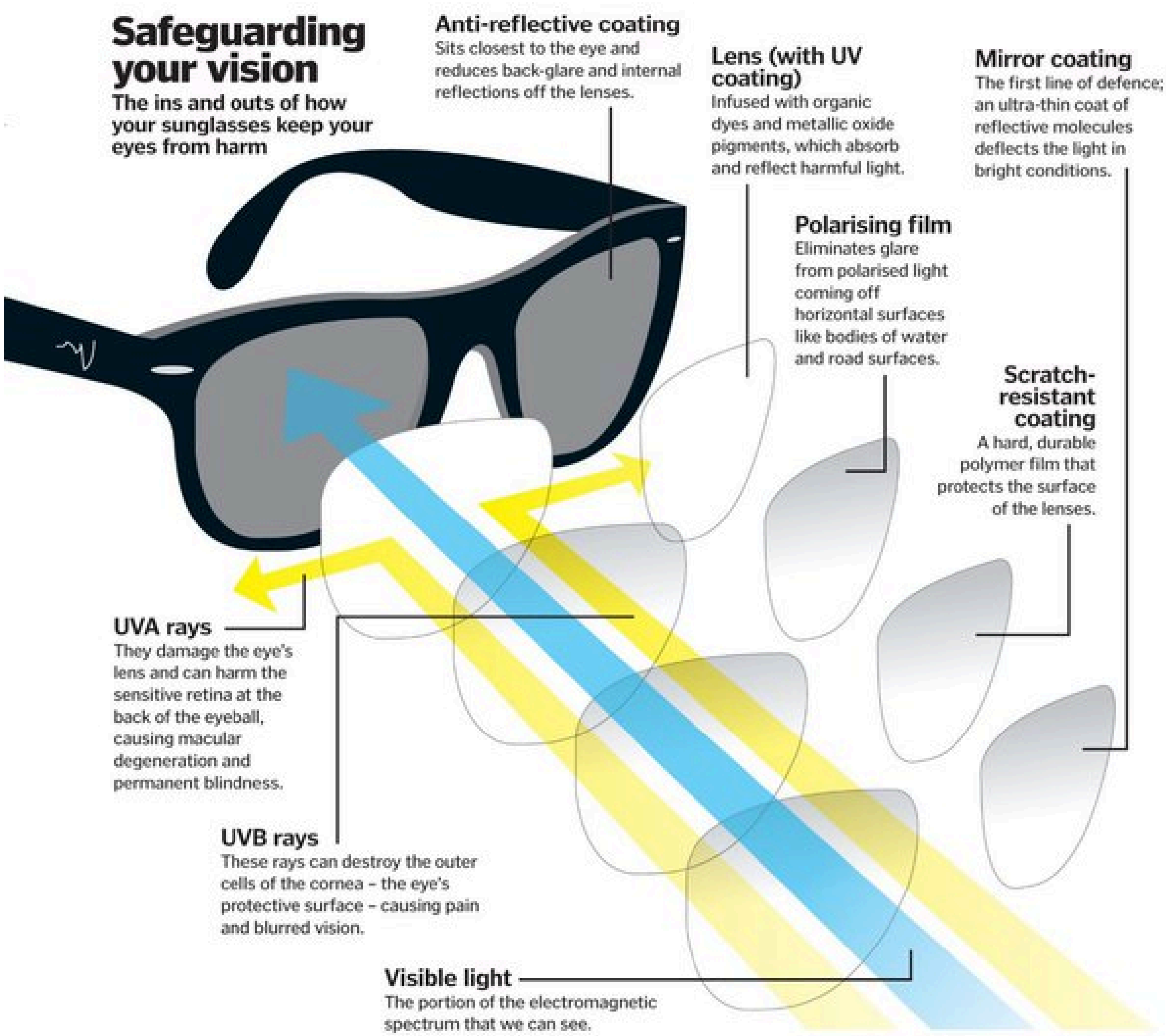
Solar energy is free and clean. There is enough for everyone, and we will never run out of it. Solar energy is **renewable**. The sun will keep making energy for millions of years. Why do we not use the sun for all our energy needs? We do not know how to yet. The hard part is capturing the sunlight. It shines all over the Earth, and only a little bit reaches any one place. On a cloudy day, most of the light never reaches the ground at all.

Lots of people put **solar collectors** on their roofs. Solar collectors capture the sunlight and turn it into heat. People heat their houses and their water using the sun's energy. **Solar cells** (solar panels) can turn light energy into electricity. Some toys and calculators use solar cells instead of batteries. Big solar cells can make enough electricity for a house. They can be expensive but good for houses far away from power lines. Today, solar energy provides a little more than 3 percent of the electricity we use, but it is growing each year as solar cells get used more. In the future, it could be a major source of energy. Scientists are looking for new ways to capture, store, and use solar energy more efficiently.

Solar Energy

Solar energy is light energy.
Solar energy is renewable.

Wearing **sunglasses** can protect your eyes from ultraviolet (UV) light.
Use the sunglasses in the kit to observe how they block light.



Source: How It Works ©

Experimenting with UV (color changing) beads

Objectives:

1. The Sun produces light in all wavelengths, including invisible ultraviolet (UV) light waves.
2. UV can be dangerous and can burn our skin, damage our eyes, and destroy our cells.
3. There are both ways to detect UV and also to protect ourselves from it.

Part I:

Background on UV Light and the Electromagnetic Spectrum

The beads contain a special chemical that changes color when exposed to ultraviolet (UV) light. UV is an invisible type of light from the Sun. It can burn our skin and cause cancer, damage our eyes, and destroy our cells. Most UV is blocked by our Earth's ozone layer and atmosphere, but some still gets through and can be detected. The beads will stay white when inside or not exposed to UV. Incandescent and fluorescent lights will not affect them. They will only turn bright colors when exposed to UV, usually from the Sun or a UV ("black") light. The darker the color of the beads, the more UV rays they are detecting. Once you bring the beads back indoors, they will (slowly) change to white again. This process can be repeated many times.

Although ultraviolet radiation is invisible to the human eye, most people are aware of the effects of UV on the skin, like suntan and sunburn. A small amount of UV reaches the surface and is capable of causing long - term skin damage and cancer. A smaller amount of UV reaches the surface and is responsible for sunburn and also the formation of vitamin D in humans. Thus UV light has many effects, both beneficial and damaging, to human health.

Part II

Choose a variety of locations listed on the chart. Place the string of UV (color changing beads) in the different locations and determine the presence or absence of UV rays. **Use the included laminated chart and wet-erase marker to record results during activity.**

Location	**Prediction** (Do you think the beads will be exposed to UV waves?)	**Bead results** (white, faint, or colored)	**Is this location safe from UV waves?**
In direct sunlight			
In a shady spot			
Cloudy sky			
Under a piece of paper			
Under sunglasses			
Under clothing			
Under brim of a cap			
Sun at mid-day			
Sun at sunset			

Source: http://solar-center.stanford.edu/activities/UV-Bead-Instructions.pdf

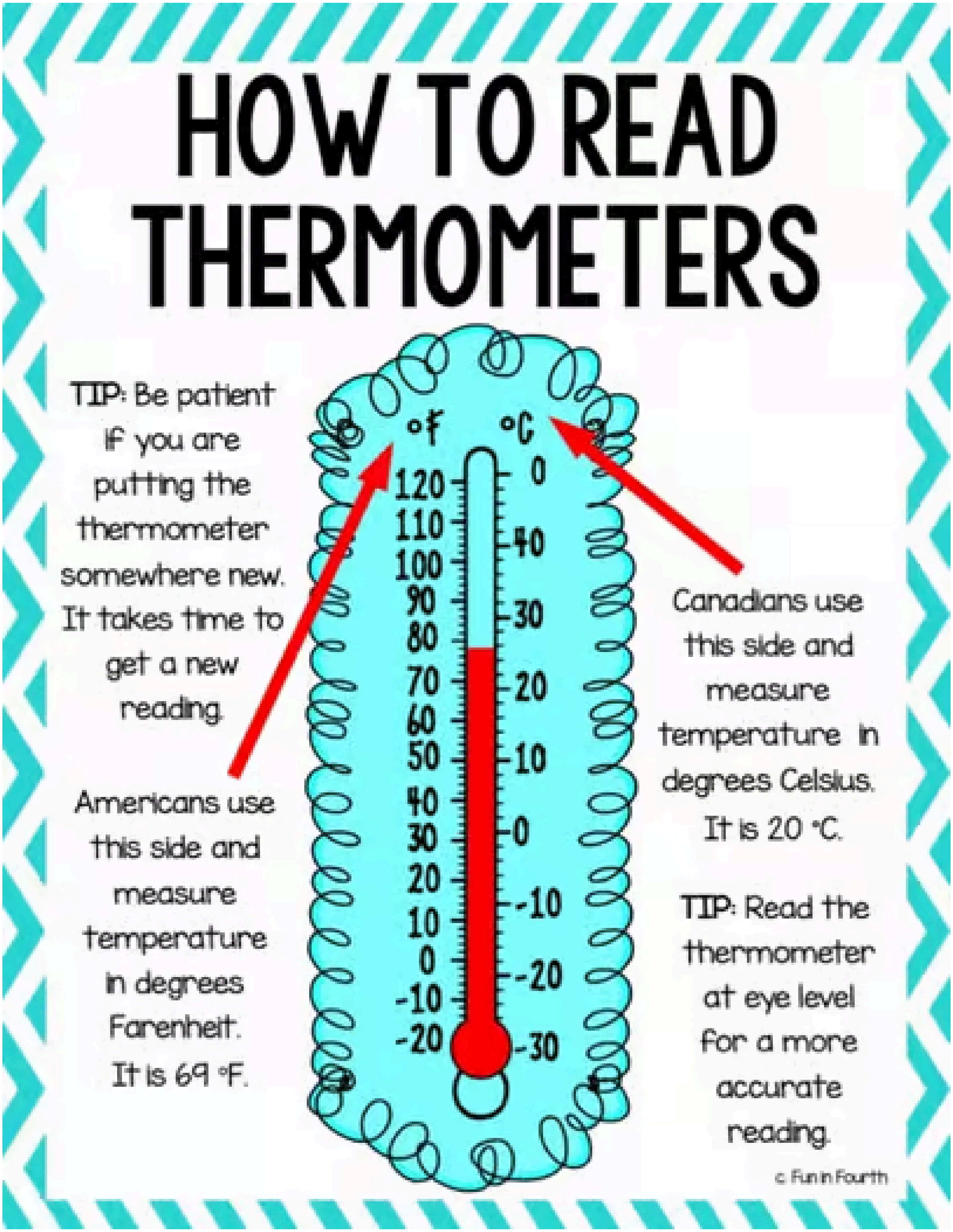
Part III:
Conclusion

Which of the materials listed are MOST effective at keeping you safe from dangerous UV light from the sun?

What time of day do you think you are most at risk? Least risk?

Solar energy heats land and water.

When solar energy comes in contact with an object, it turns into heat.



https://www.teacherspayteachers.com/Product/Thermometers-How-to-Read-a-Thermometer-2009791

Measuring Heat Activity

Use the laminated sheet and wet-erase marker to complete this activity.

Name: ____________________________

How Different are Full Sunlight and Shade?

On a hot day, everyone know that it feels cooler in the shade, but **exactly** how much cooler is it in the shade?

Predict: *The current weather temperature is:*

	In the sun	In the shade	Predicted Difference
Temperature			

- For the most accurate results, make sure you set your thermometers on the same material in both areas (such as a paper plate, or the same colored piece of construction paper).
- Make sure you measure both data points in either Celsius or Fahrenheit.

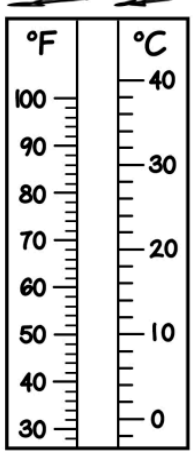
Experiment Results

	In the sun	In the shade	Actual Difference
Temperature			

Name: ____________________________

Full Sunlight and Shade Conclusions

Color the thermometers to represent your experiment results. Then complete your conclusions below:



Temperature in the sun

My conclusions:

Were your predictions correct? Explain.

____

____

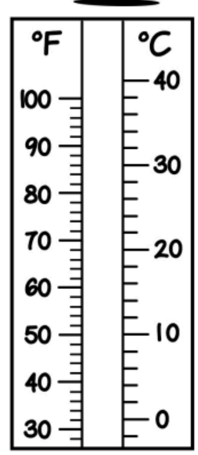
What did you learn? When might you use this information?

____

____

____

____



Temperature in the shade

Radiation Can Activity

Feel that warmth on your skin on a sunny day?
Different surfaces absorb heat differently.

Two radiation cans are required for this activity.
One can is black and one is silver.

Directions:

1. Fill both cans with the same amount of water and place a thermometer in each lid. Make sure the thermometer tip is immersed under water.
2. Place the cans the same distance from a light source (or outside in direct sunlight).
3. At set intervals, the water should be stirred with the thermometer and the temperatures observed..

Conclusion:

The black surface is a good absorber of heat and so the water in the can should be warmer than in the shiny can after a few minutes.

The shiny can is a poor absorber as it reflects much of the heat energy away.

Solar Balloon Activity

Let's make a solar balloon that floats with the power of hot air!

It's best to pick a sunny day with calm wind conditions for this project.

This is the perfect backyard activity for a sunny day. The black color of the bag absorbs the sun's energy, heating up the air inside. The color of an object correlates with the wavelengths of light it absorbs and reflects. Black absorbs the most wavelengths, while white absorbs the fewest. Red absorbs all but the red wavelengths, and so forth for other colors. Black is the most efficient color for converting light energy into heat energy, which is then transferred to the air inside the closed balloon. The hot air is less dense than the surrounding air, causing the balloon to float up, supporting its own weight.

Based on the principle of buoyancy — once the air inside heats up and expands, the balloon weighs less than the air it displaces because it is less dense. This activity demonstrates how solar radiation can be used to create heat.

Directions: Activity should be supervised by an adult.

Run around to fill your balloon with air.

Gather up and tie off the open end of the balloon.

Tether your balloon with some string and put it out in the sun, where it should heat up and start to float. The heat generated inside the balloon decreases the air density, which creates lift. Since the balloon heats up slowly, the increasing upthrust from the slowly changing pressure inside can be observed in the time it takes to explain the science behind it.

It's very important not to let the balloon go. When you're ready to deflate it, be careful because the surface will be hot. Reopen the balloon and release the air.

Source: https://www.instructables.com/Solar-Balloon/

Solar Oven

Objective

Students will be able to describe the energy transformation involved when using a solar oven.

Materials

- 1 Small pizza box
- Transparency sheet or plastic wrap
- Aluminum foil
- 1 Wooden skewer (12"-18")
- Marker
- Scissors
- Ruler
- Masking tape
- 1 Paper plate
- Black construction paper
- Thermometer
- Food to cook (optional)

General Directions to Build a Solar Oven Using a Pizza Box

1. On the top of the pizza box, use your marker to draw a square with edges spaced 1" from all sides of the box.
2. Use scissors to cut along the sides and front edge of the lid, leaving the fourth side along the box's hinge uncut, as shown in diagram 1.
3. Tape aluminum foil to the inside surface of the new flap you just cut, shiny side visible. This is to reflect sunlight into the box. Smooth out any wrinkles that might occur.
4. Tape plastic wrap to the original box flap so that it covers the hole you cut into the flap. Seal all four of the edges with tape.
5. Tape black construction paper to the bottom inside of the box. This will help absorb the incoming sunlight. See diagram 2 to make sure you have assembled steps 3-5 correctly.
6. Cover any air leaks around the box edges with tape, making sure that the box can still be opened to place food inside or remove it later.
7. Go outside in the sunlight and place the solar oven on a level flat surface.
8. Place food items on a paper plate and place it inside the oven. Put the oven thermometer inside the oven where you will be able to see it without moving the oven.
9. Tape one end of a wooden skewer to the reflector lid, attach the other end to the box to adjust reflector.
10. Let the food cook and periodically check the reflector angle to make sure sunlight is getting inside the oven.

Diagram 1

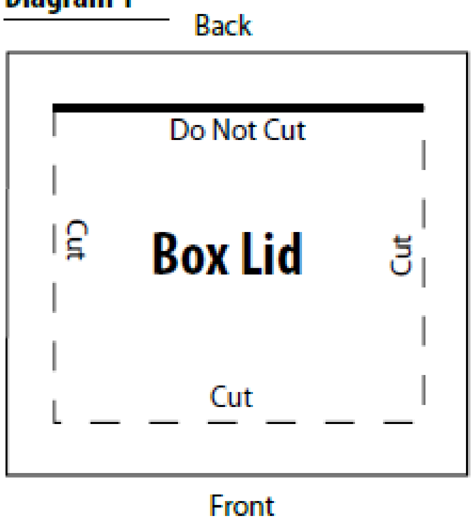
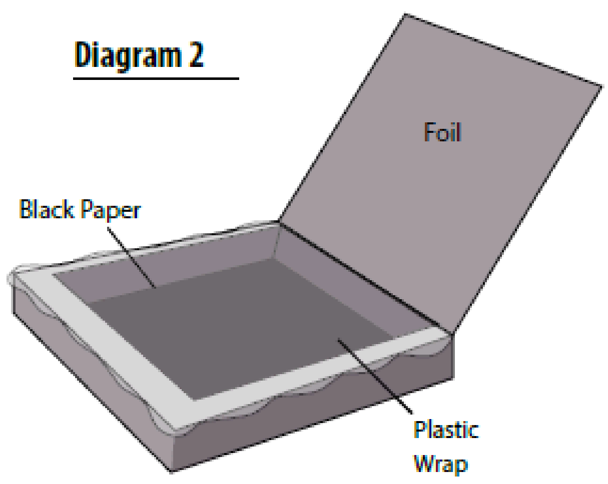


Diagram 2

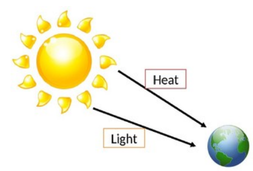


Kits available from

CENTER for the ADVANCEMENT of SUSTAINABLE ENERGY
JAMES MADISON UNIVERSITY

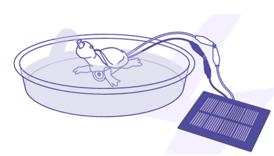
Exploring Wind Energy

Exploring Solar Energy



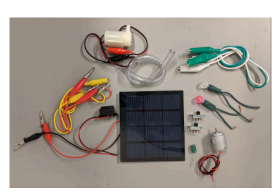
Wind Powered Light (Firefly)

Solar Powered Water Fountain



Educator Kit: Wind Energy

Educator Kit: Solar Energy



UV (color changing) Bead Activity

Choose a variety of locations listed on the chart. Place the UV (color changing) beads in different locations and determine the presence or absence of UV rays.

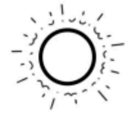
Use a wet-erase marker to record results during activity.

(Use a damp cloth to completely clean the laminated sheet before returning kit.)

Location	**Prediction** (Do you think the beads will be exposed to UV waves?)	**Bead results** (white, faint, or colored)	**Is this location safe from the Sun's UV waves?**
In direct sunlight			
In a shady spot			
Under brim of a hat			
Under a piece of paper			
Under sunglasses			
Under dark fabric			
Under light fabric			
Under regular glasses			

Source: http://solar-center.stanford.edu/activities/UV-Bead-Instructions.pdf

Name: ____________________________



How Different are *Full Sunlight* and Shade?

On a hot day, everyone know that it feels cooler in the shade, but **exactly** how much cooler is it in the shade?

Predict: *The current weather temperature is:*

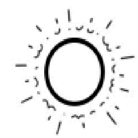
	In the sun	In the shade	Predicted Difference
Temperature			

- For the most accurate results, make sure you set your thermometers on the same material in both areas (such as a paper plate, or the same colored piece of construction paper).
- Make sure you measure both data points in either Celsius or Fahrenheit.

Experiment Results

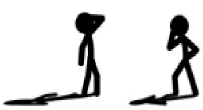
	In the sun	In the shade	Actual Difference
Temperature			

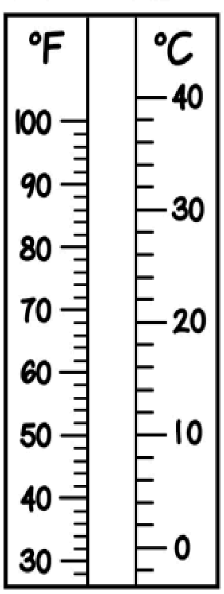
Name: ____________________________



Full Sunlight and Shade Conclusions

Color the thermometers to represent your experiment results. Then complete your conclusions below:





Temperature in the sun

My conclusions:

Were your predictions correct? Explain.

____

____

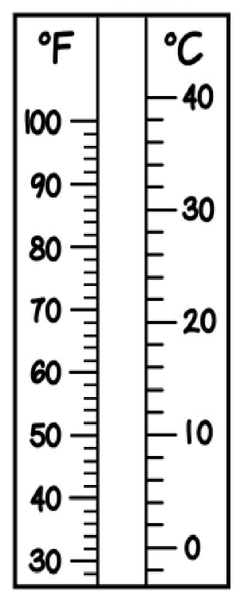
What did you learn? When might you use this information?

____

____

____

____



Temperature in the shade