Sustainability Science Sleuths

Day 9

DiscoveryCube

This guide accompanies *Sustainability Science Sleuths Day 9*

PRIOR TO TEACHING

Subject

Renewable Energy

Program Length

45 minutes – 1 hour

Program Objective

You don't need to be an electrician to understand circuits! In this lesson, you will power on a lightbulb and harness the power of the sun to make a s'more or some nachos as you learn about renewable energy.

Next Generation Science Standards

3-PS2-3: Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

4-ESS3-1: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

4-PS3-2: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-4: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

5-PS1-3: Make observations and measurements to identify materials based on their properties.

What I Need Today

FROM SCIENCE KIT:

Per Student:

- ☐ 1.5 volt light bulb
- ☐ AA battery
- ☐ foil (about a 6" length)
- ☐ Graham Crackers
- ☐ large marshmallow

Per Group of 3-4 Students:

- ☐ foil
- ☐ 8"x8" small aluminum baking dish
- ☐ masking tape
- ☐ black construction paper (3-4 sheets)
- ☐ chocolate bar
- ☐ plastic cling wrap

SUPPLIED BY TEACHER/STUDENTS:

- ☐ cardboard box – 1 per group
- ☐ ruler or stick – 1 per group
- ☐ scissors
- ☐ a sunny day
- ☐ hot mitt/pot holder (optional)
- ☐ box cutter (optional)

Vocabulary

Electricity – A type of energy that can build up or flow from one place to another.

Circuit – For electricity to flow from one place to another, there needs to be a complete circuit, or path or loop around which the electric current can flow.

Battery – A way to store electricity.

Conductor – A material that allows electricity to flow freely, such as copper, aluminum, and salt water.

Open Circuit – Also called a "broken" circuit, the path or loop of a circuit is not fully connected, or broken.

Closed Circuit – Also called a "complete" circuit, the path or loop of a circuit is fully connected and allows electricity to flow.

Stored Chemical Energy – Potential energy that is stored in the bonds between atoms and molecules. Chemical energy can be converted into moving mechanical energy, heat energy, or electrical energy.

Electrical Energy – The form of energy that results from the flow of electrons and protons (an electric charge); moving energy.

Electrons – A negatively charged particle inside an atom.

Protons – A positively charged particle located inside the nucleus of an atom.

Neutrons – A particle inside the nucleus of an atom that doesn't have any charge.

Particles – Tiny bits of matter – in fact, the smallest possible unit of matter. Atoms are made up of particles.

Nucleus – The center of an atom; made up of protons and neutrons.

Atom – The basic building block for all matter in the universe, made up of proton, neutron, and electron particles.

Renewable Energy – Energy made from resources that nature will replace in 1-2 human lifetimes, such as wind, water, and sun.

Solar Energy – Energy that comes directly from the sun. Even if energy isn't powered directly through the heat of the sun, the original source of that energy most likely came from the sun.

Geothermal Energy – A form of renewable energy; energy in the form of heat that comes from the inside (or core) of the Earth. Usually seen as volcanoes or hot springs, the power of geothermal energy can be harnessed as a clean form of electrical energy.

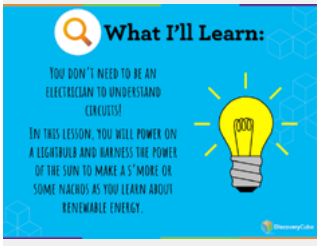
Instructor Prep

☐ Divide students into groups of 3 or 4 students per group for today's activity.

PROCEDURE

What We'll Learn

Renewable energy is energy created from the Earth's natural resources that cannot be used up or exhausted. There are several different forms of renewable energy, including energy generated from the sun, wind, and water. Most renewable energy is turned into electricity, which can be used (for example) when you flip a light switch on and create a closed electrical circuit.



What Will Happen?

Scientists ask questions and make predictions before they start investigating. Have your students hypothesize: how few materials can I use to create a closed circuit?

- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5+

What to Do

REVIEW - DAY 8: AIR QUALITY

Last time you met, you learned that we can harness the power of the wind and use it as energy. Today, you'll learn about other forms of renewable energy and you'll learn about circuits and electricity.

VIDEO - HIDDEN WORLDS: EARTH POWER

To start learning about renewable energy, first watch *Hidden Worlds: Earth Power*:
https://vimeo.com/502711280/e3249090f3

EXPERIMENT - FLIP THE SWITCH: SIMPLE CIRCUITS

1) It doesn't take a lot to make a simple electrical circuit. All you need is a power source (batteries work great), something to power on (a small lightbulb, such as a Christmas light or flashlight bulb), and a conductor (such as foil, metal paperclips, binder clips, or electrical wire) to carry the electricity from the power source to the light bulb. If you are using foil as your conductor, try rolling or folding it into a long strip.

Fun Fact: A battery is a container of stored chemical energy. When electricity can flow through a material, that material is called a "conductor". Most metals, such as iron and copper, are electrical conductors.

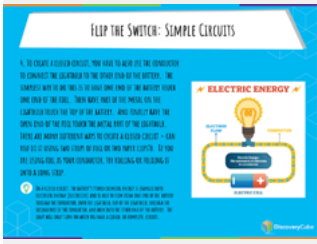
2) Hold one end of your foil (or other conductor) so it is touching one end of the battery.

3) Then have the bottom of the lightbulb touch the other end of the foil. Does your light turn on?

Fun Fact: This is called an open circuit. The electricity is leaving the battery and flowing through the conductor until it reaches the lightbulb, but then it stops. Electricity only flows in one direction and there is nowhere else for it to go. When your bedroom light switch is flipped off, this is an open circuit as well.

4) To create a closed circuit, you have to also use the conductor to connect the lightbulb to the other end of the battery. The simplest way to do this is to have one end of the battery touch one end of the foil. Then have part of the metal on the lightbulb touch the top of the battery. And finally have the open end of the foil touch the metal part of the lightbulb. There are many different ways to create a closed circuit – can you do it using two strips of foil or two paper clips?

Fun Fact: In a closed circuit, the battery's stored chemical energy is changed into electrical energy (electricity) and is able to flow from one end of the battery through the conductor, into the lightbulb, out of the lightbulb, through the second part of the conductor, and back into the other end of the battery. The light will only turn on when you have a closed, or complete, circuit.



5) Once you've created a full circuit, your light bulb should turn on (the larger the battery, the stronger the light). If your bulb hasn't turned on, double check your connections or try changing the conducting materials. If it still doesn't turn on, try using another battery (batteries can only store so much energy before they run out) or another bulb (lightbulbs also have a life span and do wear out).

Fun Fact: Electricity is produced by the movement of electrons, which are tiny particles that revolve around the nucleus of atoms. When you have a closed circuit, these electrons are able to flow from your energy source to your lightbulb to light it.

EXPERIMENT - COOKING WITH THE SUN: SOLAR OVENS

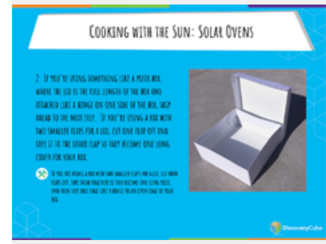
1) Most ovens are heated using electricity or gas (such as natural gas or propane). But you can create an oven using

energy from the sun! On a sunny day, gather your materials so you can make a delicious, sunbaked treat.

Fun Fact: The sun is a very powerful source of renewable energy.

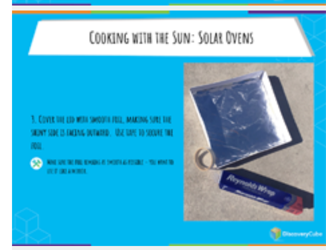
2) If you're using something like a pizza box, where the lid is the full length of the box and attached like a hinge on one side of the box, skip ahead to the next step. If you're using a box with two smaller flaps for a lid, cut one flap off and tape it to the other flap so they become one long cover for your box.

Tips & Tricks: If you are using a box with two smaller flaps for a lid, cut both flaps off, tape them together so they become one long piece, and then tape one edge like a hinge to an open edge of your box.



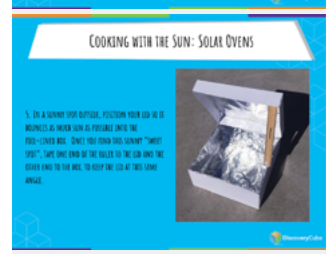
3) Cover the lid with smooth foil, making sure the shiny side is facing outward. Use tape to secure the foil.

Tips & Tricks: Make sure the foil remains as smooth as possible – you want to use it like a mirror.



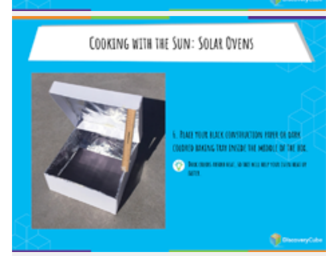
4) Line the inside of your box with smooth foil, again taping it down with the shiny side out and keeping it as smooth as possible.

5) In a sunny spot outside, position your lid so it bounces as much sun as possible into the foil-lined box. Once you find this sunny "sweet spot", tape one end of the ruler to the lid and the other end to the box, to keep the lid at this same angle.

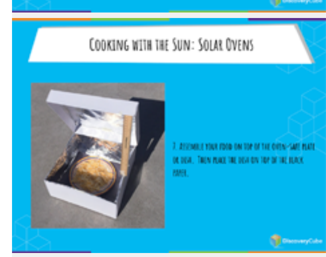


6) Place your black construction paper or dark colored baking tray inside the middle of the box.

Fun Fact: Dark colors absorb heat, so this will help your oven heat up faster.



7) Assemble your s'mores inside the 8"x8" baking dish. Stack half a Graham Cracker, a piece of chocolate, and then a marshmallow, so you have an "open-face" sandwich. Once all students have put their open-face s'mores in their baking dish, have them cover the dish with a layer or two of plastic cling film.

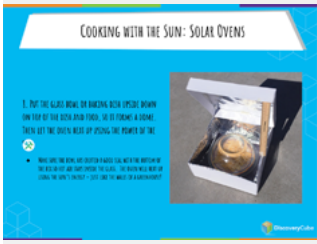


8) Have the groups move their baking dishes so they are on top of the black paper in their box.

9) Let the oven heat up using the power of the sun.

10) Check in on your food every few minutes. When your s'mores have started to melt, they are ready to eat. If the dish is hot, use hot mitts to remove it from the oven, or move the box into the shade to let it cool down a little.

Fun Fact: The oven is heated when rays of light travel from the sun, bounce off the foil, and hit the plastic cling film. These rays of light then heat up the air trapped inside the baking tray. The black paper underneath absorbs the heat from the bottom of the oven, making the oven hot on all sides. Since you're relying on solar energy to heat the oven, the hotter the day, the faster your food will heat.



CONCLUSION

What I Discovered

To earn a portion of the Power Up badge, have your students use their journals to help them reflect on what they discovered. We would love to see pictures of their simple circuits or solar ovens. Please email pictures to educationemail@discoverycube.org.

Supplies for Next Time

SUPPLIED BY TEACHER/STUDENTS:

- ☐ paper
- ☐ pencil
- ☐ scissors