

EXPLORE ENERGY





EXPLORE ENERGY



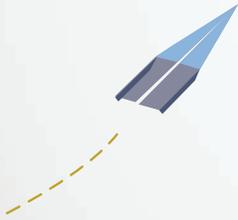
YOUR MISSION:

It's easy to take energy for granted when we can flip a switch and turn on a light. With these exhibits, we want students to be amazed by the invisible force that powers our lives. Energy use and energy sources are changing, and you can inspire these students to lead the charge!

ADVICE ON VOLUNTEERING



SAFETY CHECK: There's a lot to handle on these exhibits, but make sure students do it safely (no running, no poking each other in the eye, etc.)



ENCOURAGE EXPLORATION: Ask questions and make sure everyone gets a chance to participate. A little positive feedback goes a long way.



GEEK OUT! You don't have to be an expert. Your curiosity and enthusiasm inspire kids to learn.

AREA OVERVIEW



WHAT DO YOU USE ENERGY FOR? You use it to turn on lights, but you also use it to run fast. You use energy to cook food or to power a car. Energy is the ability to do work.

BUT WHAT DOES IT LOOK LIKE? Is it solid or liquid (neither, or both)? Is there a difference between the kind of energy that powers a light bulb and the kind of energy you get from eating a healthy meal?

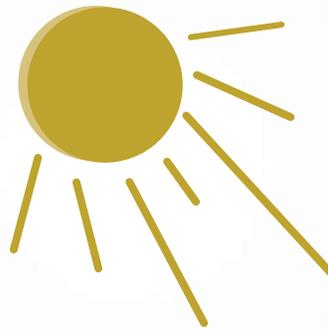
EXPLORE ENERGY



- Fossil fuels (oil, coal, and natural gas) are the remains of plants and animals from millions of years ago. The oil we use today started forming before the dinosaurs lived on Earth. And those dinosaurs are slowly turning into fuel!
- The sun is almost halfway through its life. It formed 4.57 billion years ago, and has about 5 billion years before it becomes a white dwarf.
- Enough energy comes from the sun every hour to power 2,880 trillion light bulbs.

GRAND CHALLENGES

If you could do one thing to make life on Earth better, what would that thing be? Here's a **GRAND CHALLENGE**: according to some of the world's smartest people, this is a challenge that humans will face in the next 100 years. **What would you do to help solve it?**



THE SUN is an excellent source of power, but so far, solar energy is only providing 1% of the world's energy. Can you improve solar technology to help capture and use more of the sun's energy?

JOKES

Why did the gardener plant a light bulb?

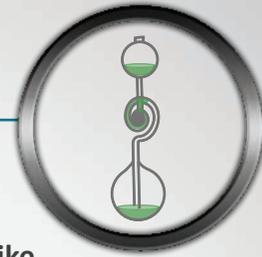
She wanted a power plant.

What happened to the wire whose behavior was shocking?

He was grounded.



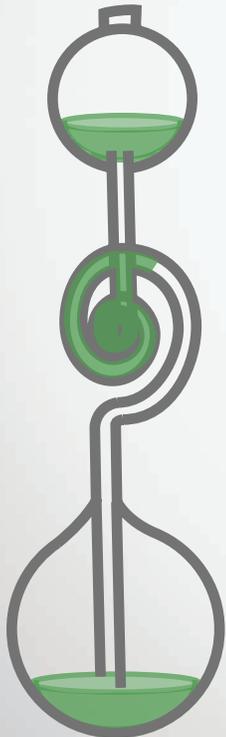
HAND BOILER



SAFETY FIRST: HOW TO USE

- Okay for students to touch with supervision, but **be careful as the Hand Boiler is fragile**. Suggest that students **hold it like an egg** and **don't squeeze or drop it**.
- Have them put one hand under the glass bottom, and ask them to very gently wrap their hand around (but do NOT squeeze).
- Hold one hand nearby, as the Hand Boiler is glass and can break if dropped.
- Watch as the liquid travels up the glass tube and ask the related questions.

CONCEPT BREAKDOWN



- Although it is called the Hand Boiler, **the liquid is not actually boiled**.
- The liquid inside is Ethyl Alcohol, which boils at 173.1° F. The temperature of the human body is 98.6° F.
- The "boiling" is caused by the relationship between the temperature and pressure of a gas. As the temperature of a gas in a closed container rises, the pressure also rises.
- The heat in our hand transfers through the glass. As the gas inside warms up, the molecules move faster, causing the gas to expand and push the liquid upwards. This chain of events is known as Charles' law.
- **As the gas continues to expand, the gas then bubbles through the liquid, making it appear to boil.**

RELATE TO REAL LIFE!



Test Charles' law at home by inflating two balloons to the same size. Put one in the freezer, and leave one out on a table overnight.

The next day, take out the balloon in the freezer and compare it to the balloon left out.

Spoiler alert: the frozen balloon will have shrunk! This happens because the gas inside the balloon takes up less space when it's cold than when it's room temperature, making the frozen balloon shrink down.

HAND BOILER



QUESTIONS

How do you feel after you exercise: colder? warmer? or the same as when you started?

- You probably feel warmer. Our bodies transform chemical energy into mechanical and heat energy when we move around.

Have you ever felt the hood of a car after a long drive?

- When a gas-powered car burns the fuel in the engine, the energy is converted from chemical energy in the gasoline to mechanical energy (the car moving) and heat.

How do we use thermal energy in the kitchen?

- When the burner of a stovetop is very hot, it is a source of heat energy. Anything placed onto the stovetop, whether a pot of tea or a skillet for frying eggs, also becomes a temporary source of heat energy.



CAREER

THERMAL ENGINEERS design systems to convert energy from thermal sources into chemical, mechanical or electrical energy. Some find ways to heat homes sustainably using geothermal power, and others create technology to keep computers, phones, and tablets cool.

AVERAGE SALARY: \$81,000

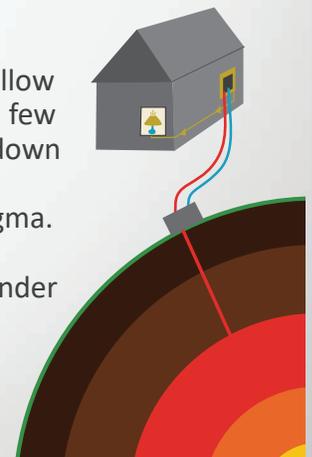


----- ADDITIONAL INFORMATION -----

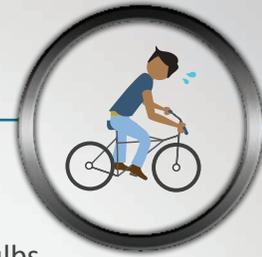
GEOTHERMAL ENERGY is the heat from the Earth. It's clean and sustainable!

Geothermal energy comes from the shallow ground, hot water, and hot rock found a few miles beneath the Earth's surface, and down even deeper, from the extremely high temperatures of molten rock called magma.

Small-scale geothermal power plants (under 5 megawatts) have the potential for widespread use in rural areas to bring sustainable electricity to homes, businesses, hospitals, and more.



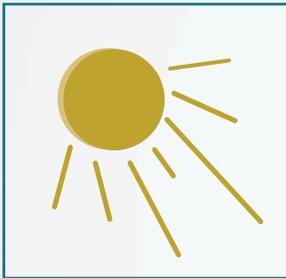
ENERGY BICYCLE



SAFETY FIRST: HOW TO USE

- Okay for students to handle.
- Give each student a turn to pedal the handle and light the bulbs.
- Note that students should ONLY touch the bike pedal.

CONCEPT BREAKDOWN



- There is a fixed amount of energy in our world.
- You can't make energy. You can't destroy energy. You CAN transform energy.
- You get energy from the food you eat, and this energy is stored as calories.
- You can convert food calories into mechanical energy, for instance, by using your body to push the bicycle pedals.
- The heavier the load, the harder you have to push.
- The generator converts that mechanical energy into electrical energy.
- The light bulb converts electrical energy into light and heat.



RELATE TO REAL LIFE!

Your body turns food calories into mechanical energy. If your body is like a car, then food is like gas. What happens when you run out of fuel? Maybe you sleep. Maybe you eat something to give you more energy.

If you take in more fuel than your body needs, your body stores it for future use. Do you know how? Body fat.

Athletes, for example, think very carefully about what kind of food they eat so that they get the right kind of energy. Sugar gives you a lot of energy, but it runs out quickly and leaves you more tired. Energy from vegetables lasts longer, but you have to eat a lot of vegetables! What's the best kind of fuel for your body?

ENERGY BICYCLE



QUESTIONS

What bulb lights up first? Why?

The halogen bulb lights up first because it requires the least amount of energy. However, the bulb gets very hot, so it's not safe for most houses.

What bulb lights up next? Why?

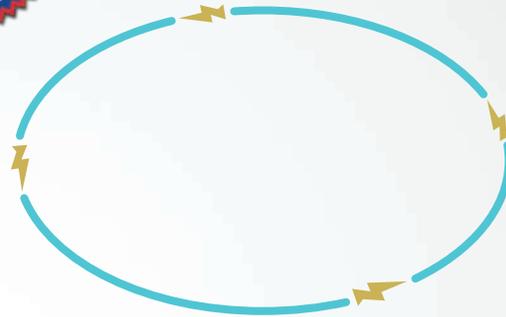
The LED bulb lights up second, because it also requires less energy to power. The LED bulb is cool to the touch, so it's safe to use in your house. Because it's still a new technology, LED bulbs are expensive. However, since they last so much longer than incandescent bulbs, they pay for themselves over time.

What bulb is the hardest to light? Why?

The incandescent bulb takes a great deal more energy to light than the halogen bulb. *(It is highly unlikely students will be able to get this bulb to light up.)*



CAREERS



ELECTRICIANS install and repair the wiring and other systems that bring electricity and communications lines into homes, businesses, and factories.

AVERAGE SALARY: \$45,000

ADDITIONAL INFORMATION

WHY SHOULD WE CONSERVE ENERGY?

Right now, most of the energy we use to power our homes, cars, and businesses comes from fossil fuels that are non-renewable, which means there's a limited amount to use. Scientists are working on renewable energy technology like solar and wind power to keep up with growing demand. Meanwhile, you can help by conserving energy: for instance, you can turn off the lights when you leave a room, use more efficient light bulbs, and ride a bicycle instead of driving.

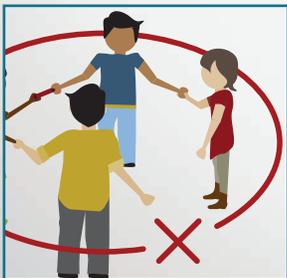
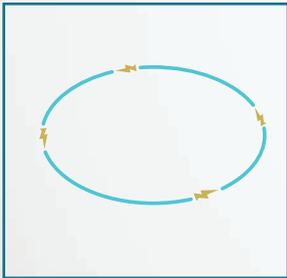
ENERGY STICKS



SAFETY FIRST: HOW TO USE

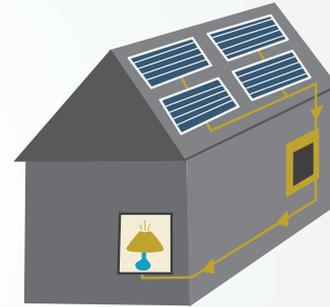
- Okay for students to handle.
- Ask the students to form a circle and hold hands. Then have two students hold opposite ends of the energy stick. When they complete the circuit, the stick will glow and make noise.

CONCEPT BREAKDOWN



- An electrical current moves from atom to atom through a material.
- Conductors are materials like most metals or water that allow a current to move freely through them.
- Your body is mostly water, so it acts as a conductor.
- When you hold the energy stick, your bodies complete an electrical circuit.
- The word “circuit” is related to the word “circle”. An electrical current travels along a closed path, or a circle. When that circle is broken, the electricity can't flow. That's why an electrical switch is sometimes called a circuit breaker.
- When you let go of your friends' hands, you break the circuit.

RELATE TO REAL LIFE!



Wherever there's electricity, there's a circuit. There's a circuit in your cell phone, in your toaster oven, and in your TV. There are also circuits running in the walls of your house, which are connected to a **power grid**.

ENERGY STICKS



QUESTIONS

What materials are the best conductors of electricity?

- Copper, silver, gold, and many other metals
- Water

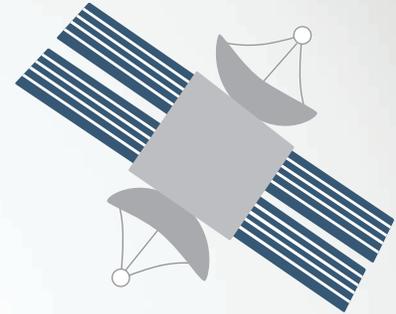
What materials are the worst conductors of electricity?

- Rubber
- Plastic
- Wood

These are also known as insulators, because they protect us from electrical currents.



CAREER



ELECTRONICS ENGINEERS design communications systems like radios and GPS systems.

AVERAGE SALARY: \$98,000

----- ADDITIONAL INFORMATION -----



Who discovered electricity? The ancient Greeks knew you could make a spark by rubbing a piece of fur, but it wasn't until the 1800s that someone figured out how to make an electrical circuit. Thomas Edison and Nicolas Tesla are both considered inventors of electrical systems, but their electrical systems are different! We are still inventing new ways of using electricity. Can you think of new ways, too?

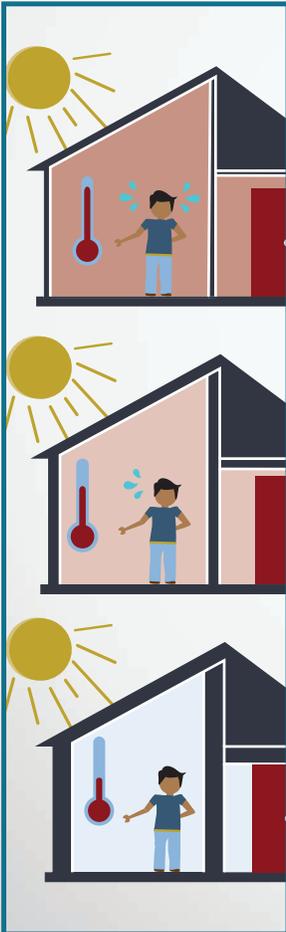
INSULATION



SAFETY FIRST: HOW TO USE

- Okay for students to handle.
- Have students pull on handle to remove segment of the wall.
- Ask them to examine the various layers of insulation and plywood, and feel the outer metal wall of the trailer.

CONCEPT BREAKDOWN



- The Trailblazer is a big metal box. How does it stay cool in here?
- The walls of the trailer are filled with 4" rigid **insulation**. Insulation traps pockets of air and prevents heat or cold from moving through building materials.
- When the weather is hot, this insulation stops heat from coming in from the outside, and keeps the air conditioner's cold air from moving to the outside. When the weather is cold, it does the opposite, keeping the cold air out and the warm air inside the Trailblazer.
- Today, most insulation is made from foam or fiberglass, but some old houses still have walls stuffed with newspaper or cotton.
- Designers continue to experiment with new insulation materials, including mineral wool, reflective surfaces, and even recycled blue jeans!

RELATE TO REAL LIFE!



When you're cold, what do you do? You wrap yourself in a blanket. The blanket helps to trap the heat coming off your body and keep it next to you.

We use insulation in our clothing – the lining of coats and down feathers used in jackets help keep us warm in the winter.

A **space blanket** is a lightweight metallic blanket designed by NASA to reflect almost all your escaping body heat back to your body. You might find one in a first aid kit to help people in an emergency when they need to warm up quickly.

INSULATION



QUESTIONS

Which is cooler, metal or plastic?

This is a trick question. Materials don't have set temperatures. They heat up according to their environment. Metal may heat up more quickly than plastic, but if you put both in the sunshine, they will both eventually reach the same temperature.

Which is warmer, a sweater or a cooler?

This is another trick question! Sweaters and coolers are both insulators. They don't have their own set temperature, but they work by trapping the temperature of whatever they enclose. For instance, if you wrap an ice cube in a sweater, it will melt more slowly than it would if left unprotected at least, until the sweater starts trapping the heat from the sun!



CAREER



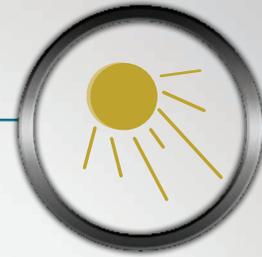
CHEMICAL ENGINEERS work on the design of materials: fabrics, chocolate, fire-resistant materials, longer-lasting medicine.

AVERAGE SALARY: \$95,000

----- ADDITIONAL INFORMATION -----

Penguins live in some of the coldest places on earth. How do they stay warm? **INSULATION!** Penguins have a layer of blubber, or body fat, that encloses their body and protects their organs from the cold.

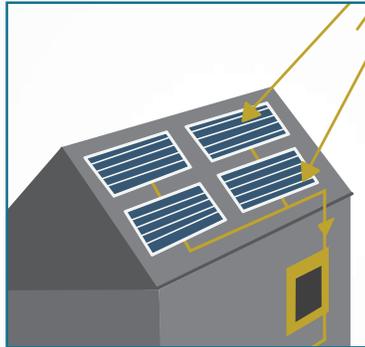
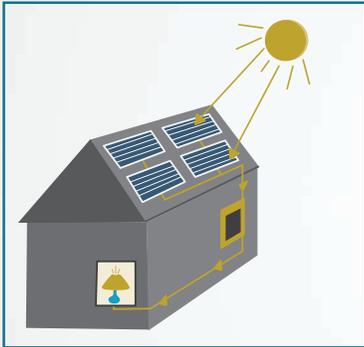
SOLAR ENERGY



SAFETY FIRST: HOW TO USE

- Okay for students to handle.
- Have student flip the switch on the right of the display.
One setting directs all of the sun's energy to the fan. When you flip the switch and the fan isn't running, the sun's energy recharges the batteries in the compartment below the panel.

CONCEPT BREAKDOWN



- Solar panels like this one collect solar energy from the heat of the sun and transform it into other types of energy, which is then stored in batteries.
- The stored energy is converted into electricity to run everything from this fan to hairdryers to computers to cars.
- Solar panels can be attached to roofs of houses and buildings, like businesses or schools. They can also be used to give shade in parking lots, providing both energy and protection from the elements for the vehicles parked below.

RELATE TO REAL LIFE!



One of the simplest examples of solar heating is the solar water heater. All you need is a black plastic bag, some water, a hose, and a flat place to set it in the sun! Fill the bag with cold water. Set it out in the sunshine. Wait a few hours. Then take a hot shower!

SOLAR ENERGY



QUESTIONS

What are some **ADVANTAGES** to solar power, compared to other energy sources?

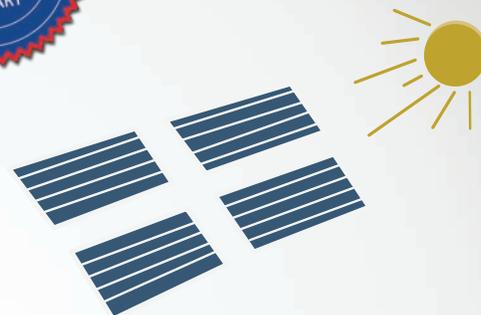
- Sunlight is a renewable energy source—it will keep on shining for the next billion years!
- Using solar energy doesn't produce air or water pollution.
- Once you pay for the installation of solar panels, it is inexpensive to operate.

What are some **DISADVANTAGES**?

- The creation of photovoltaic panels can involve the use of toxic chemicals and processes.
- The sun's rays don't reach us at night or during a thunderstorm. We need to come up with a good way to store solar energy or have an alternative source available when the sun isn't shining.
- As with any large-scale power plant, clearing a lot of land for a solar panel farm can have a negative impact on the environment.



CAREERS



MATERIALS SCIENTISTS develop new solar collection materials like thin-film cells to make solar technology more efficient.

AVERAGE SALARY: \$125,000

----- ADDITIONAL INFORMATION -----



The very first **SOLAR-POWERED HOUSE** in the US was designed by two women, physicist and solar-power pioneer Dr. Maria Telkes and architect Eleanor Raymond. They built the single-story house, called Solar 1, on the MIT campus in 1939. It used solar radiation as a heat source for the winter, and also helped them study summer air conditioning, which was still considered an expensive luxury at the time.

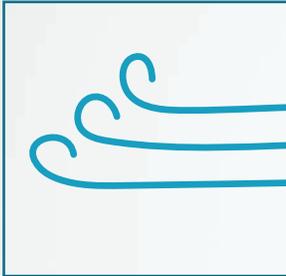
WIND GENERATOR



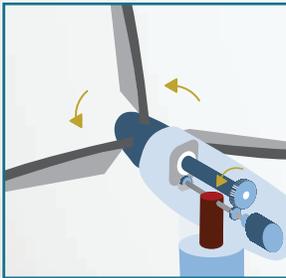
SAFETY FIRST: HOW TO USE

- Okay for students to handle.
- Give each student a turn to push the button to release air and turn the turbine.

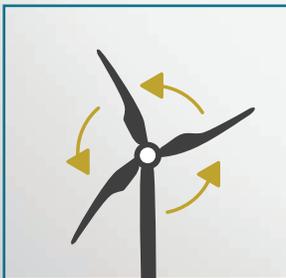
CONCEPT BREAKDOWN



- Wind contains kinetic energy—the energy of motion.
- Wind turbines use blades to collect that energy.
- Wind flowing over the blades creates lift that causes the blades to spin. This is similar to the effect on airplane wings.



- The blades connect to a drive shaft that turns a generator, which converts the mechanical energy into electricity.
- Wind turbines currently generate about 4% of all the electricity in the U.S. — a small percentage, but enough to power about 17 million households.



- A single 3-bladed wind turbine, like the ones you see in Texas, produces enough energy to power between 500 and 1000 homes.

RELATE TO REAL LIFE!

Humans have been using wind power for a very long time.

Sails catch wind to push boats across water. Windmills catch wind to turn cranks to grind grain or pump water. Now, wind turbines transform wind power into electrical energy.



WIND GENERATOR



QUESTIONS

What are some **ADVANTAGES** to wind power, compared to other energy sources?

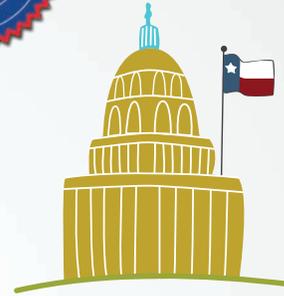
- Wind is a renewable energy source.
- Wind power does not create air or water pollution.
- Though they are expensive to build, once the initial installation of equipment is complete, it doesn't cost much to produce this type of energy.

What are some **DISADVANTAGES**?

- Wind turbines are very visible because they are tall — about the height of a football field!
- Wind turbines can be loud, which is disturbing if you are a person (or a bird or animal) living nearby.
- The wind does not always blow so we need to figure out ways to store this energy or have an alternative source when it isn't windy.
- Some types of wind turbines and wind projects can hurt bats and birds.



CAREERS



ENVIRONMENTAL ENGINEERS develop cleaner ways to power buildings and cars.

AVERAGE SALARY: \$80,000

--- ADDITIONAL INFORMATION ---



WHERE IS THE BEST PLACE TO CATCH WIND?

Texas, for one — we are one of the top wind power producing states.

Wind speed is generally faster at higher altitudes. Speed also increases over open areas without windbreaks. Some good sites for wind turbines include the tops of smooth, rounded hills; open plains and water like coastlines; and mountain gaps that funnel and intensify wind.

THANK YOU!

Thank you for inspiring students and encouraging them to explore careers in STEM. We could not do this work without you, and we truly appreciate your support.

If you took photos today and plan to post to social media about your experience, please consider tagging the TAME State Office. We would like to recognize your hard work and may share images and stories on TAME.org or with our corporate partners who help bring this experience to different communities around Texas.



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