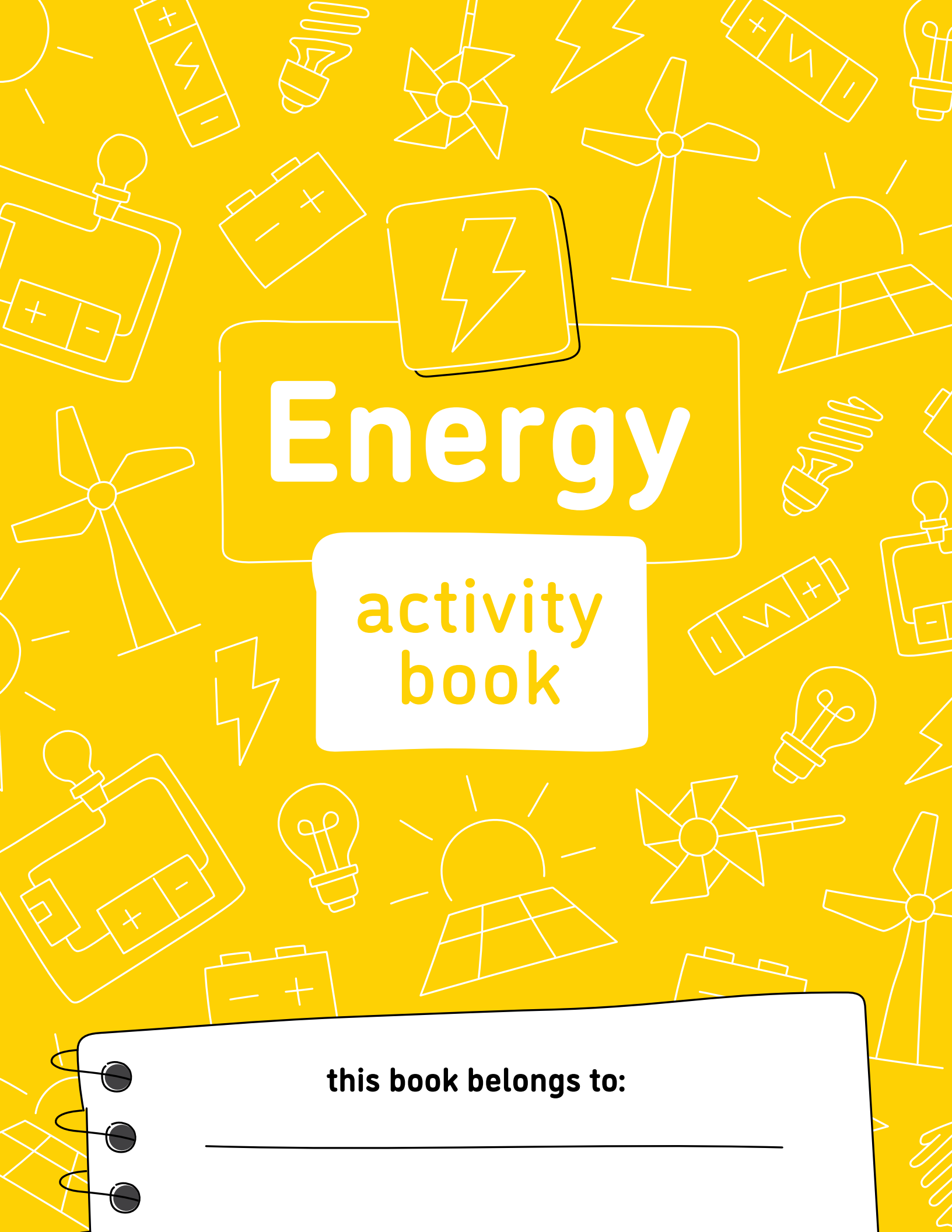


this book belongs to:

_____

Activities

Energy activity book

Hi! I'm a **solar panel technician**! I help install and fix solar panels, which allow us to use energy from the Sun to power our homes and buildings.

Welcome to your Energy activity book!

Energy is all around us. Energy from the Sun allows plants to grow, warms us up, and powers solar panels. Chemical energy is what allows us to convert food into energy so we can move around and play. Chemical energy also provides much of the energy that powers the electricity in our buildings.
You are always using energy – every moment of every day! But where does all that energy go when we aren't using it?

Energy cannot be created, and it cannot be destroyed. Instead, energy changes from one type to another. In this kit, explore how energy is transformed from one form to another as you experiment, build, and create!

activity **1**

Elastic Potential Energy

Sometimes energy is *stored*, just waiting to be used. Scientists call stored energy **potential energy**. If you tightly stretch a rubber band, it has potential energy because it has the potential to move. If you let go, it would fling across the room! When something is moving, it has **kinetic energy**. In the activity below, transform potential energy into kinetic energy!

Stretched springs on a trampoline store **potential energy.**

start here!

Use the QR code or visit **cosi.org/energykitvideos** for help with this activity.

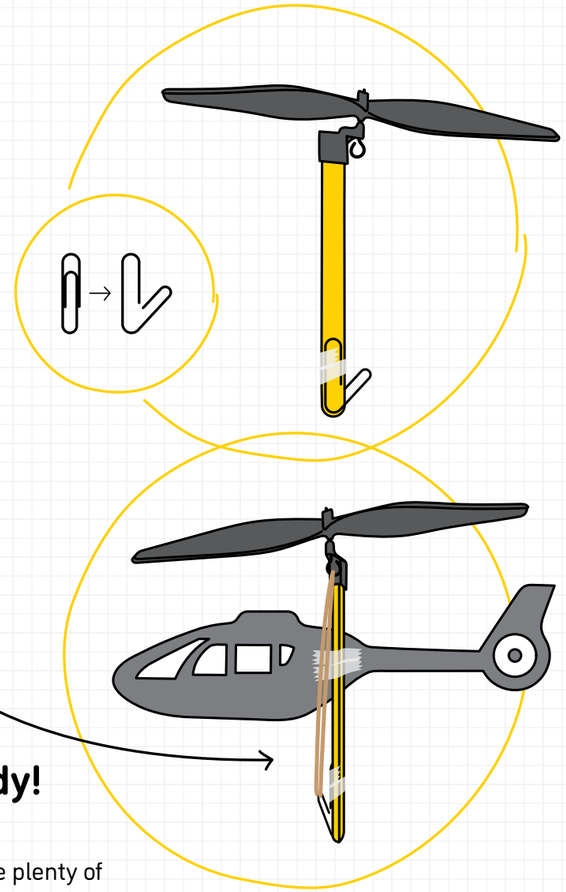
gather your supplies:

FROM BOX

- helicopter propeller
- craft stick
- two rubber bands
- tape
- paperclip
- scissors
- helicopter cutout

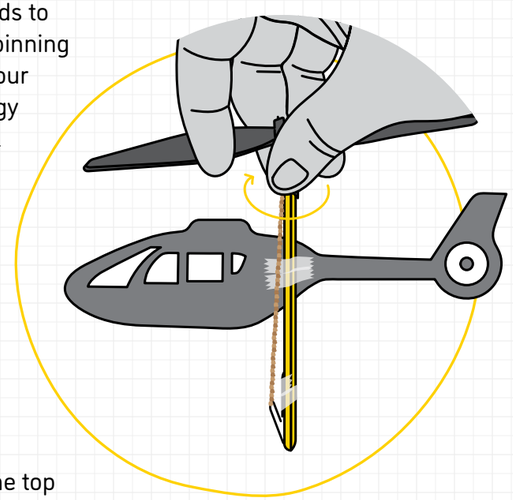
what to do:

1. Place the craft stick into the base of the helicopter blade. It should fit snugly.
2. Bend the paperclip to make a v-shape. Like the picture to the right.
3. Tape the paperclip to the base of the craft stick so that one end of the "v" sticks out on the same side of the craft stick as the hook on the helicopter blade.
4. Cut out the helicopter body and tape it to the craft stick on the opposite side of the hook.
5. Now take both rubber bands and loop them through both the paperclip and the hook of the helicopter blades.



Your helicopter is ready! Here is how to fly it:

1. Move to a location where you have plenty of room to fly your helicopter.
2. You'll need to wind up your rubber bands to give them energy. You can do this by spinning the blade on top. The more you wind your rubber bands, the more potential energy you will be giving them. More potential energy built up in the rubber bands means more kinetic energy when you release them. In other words, your blades will spin faster!
3. Once you have wound your rubber bands tightly, use one hand to hold the blade in place at the top of the helicopter and your other hand to hold the bottom.
4. To fly your helicopter, FIRST let go of the top so the blade starts spinning, THEN let go of the bottom.



draw it!
Can you draw what happened?

Did it lift into the air? Keep trying until you make your helicopter fly!

write it!
How can you get the helicopter to fly even higher?

try it

Does it work without the helicopter body? Do you notice any differences?

what's going on?
You get the energy to move your muscles from the food you eat. Your muscles twisted the rubber bands, giving them more **elastic potential energy** with each twist! When you let go of the helicopter, that elastic potential energy changes to kinetic as the blades begin to spin! The spinning of the blades pushes the air down, causing the air to push up on the helicopter and lift it into the air!

activity **2**

Chemical Energy

Chemical energy is stored in chemical bonds and released when a chemical reaction occurs. **Make your own lava lamp and see chemical energy in action!**

Chemical energy stored in wood is released when burned.

start here!
Use the QR code or visit **cosi.org/energykitvideos** for help with this activity.

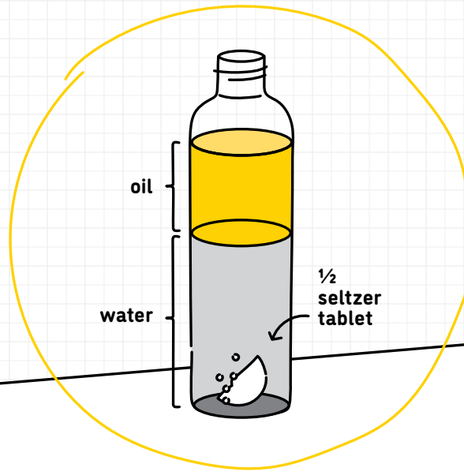
gather your supplies:

FROM BOX
- bottle with vegetable oil and watercolor
- seltzer tablets

FROM HOME
- water

what to do:
1. Set your bottle on a sturdy surface
2. Open the bottle and carefully add water until the water and oil are about an inch below the neck of the bottle. Like in the image.
3. Break a seltzer tablet in half.
4. Drop the seltzer tablet into the bottle.
5. Observe!

STOP **Don't screw the lid back on!**



draw what happened!
Before adding the seltzer tablet:

After adding the seltzer tablet:

try it

Do you have glitter at home? Add some to your lava lamp. What happened? What other items could you add to your lava lamp?

what's going on?

Chemical energy is stored in chemical bonds and released when a chemical reaction occurs. For example, when we burn fuels like coal and oil, they release energy that we can use to power our homes. In your lava lamp, the seltzer tablet contains chemicals that mix with water in a chemical reaction that produces carbon dioxide gas, among other things. That's the same gas you breathe out when you exhale! When that gas forms, bubbles rise to the surface because it is less dense than both the water and the oil. The bubbles carry some of the water with them, which drops back down once the gas is released. This creates a lava lamp effect!

activity 3

Wind Energy

People have been harnessing the power of the wind for thousands of years. Records show people sailing boats across the Tigris and Euphrates rivers 7,000 years ago! Wind energy is cheap, plentiful, and easy to harness. Want to get from point A to point B? Build a sail, catch the wind, and you will be on your way.
Today you will design your own wind powered vehicle!

start here!

Use the QR code or visit **cosi.org/energykitvideos** for help with this activity.

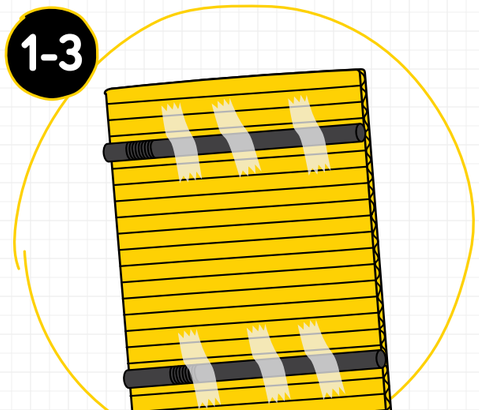
gather your supplies:

FROM BOX

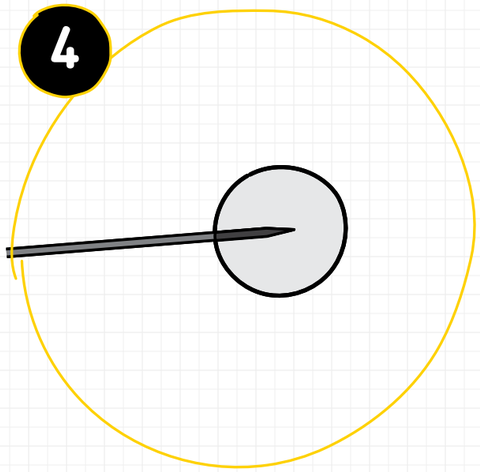
- two wrapped straws
- three wooden skewers
- cardboard rectangle
- tape
- orange construction paper
- styrofoam balls
- scissors
- ruler

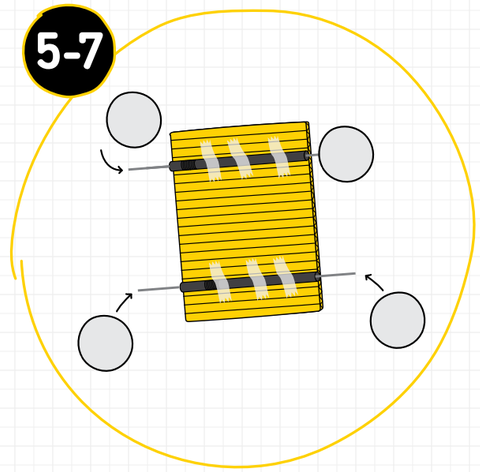
what to do:

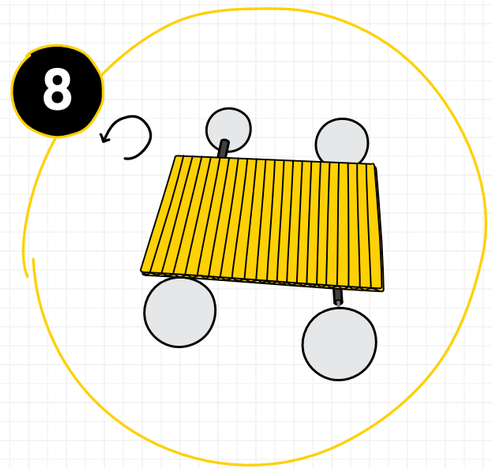
1. Lay your cardboard rectangle flat on the table. This is the body of your vehicle.
2. Lay the two straws on the cardboard parallel to each other, about one inch from either side of the rectangle. Tape them to the cardboard securely.
3. Snip the excess of the straws so that they are as long as the cardboard is wide.

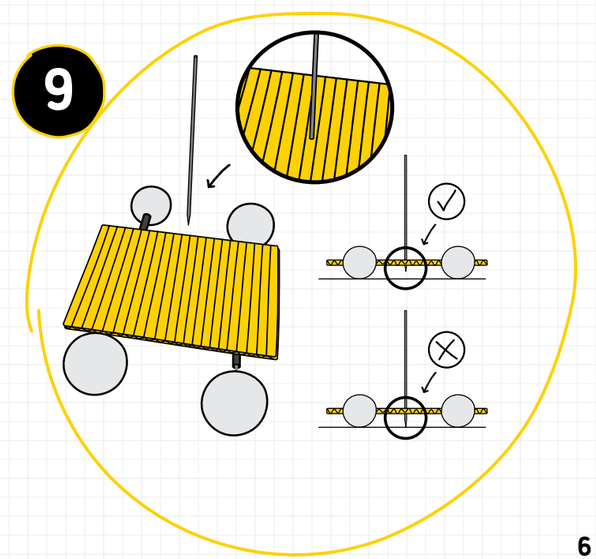


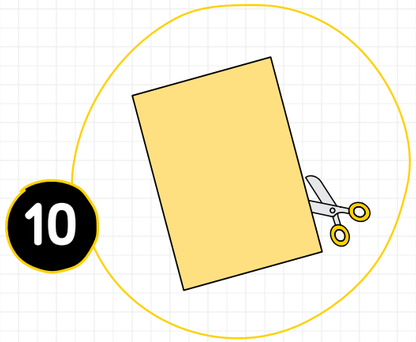
4. Take one of your wooden skewers and one of your Styrofoam balls. Insert the skewer about halfway into the ball, without poking through the other side.
5. Insert this skewer through one of the straws until it pokes out on the other side of the vehicle.
6. Add another Styrofoam ball to the other end of this skewer. You have created your first wheel and axle.
7. Repeat steps 4-6 with your remaining skewer and Styrofoam balls.
8. Now flip your vehicle over.
9. Poke your third skewer through the center of the cardboard. You want most of the skewer sticking up above the vehicle. Make sure the bottom of the skewer is not touching the ground! Optional: Use tape to secure this "mast" in place.

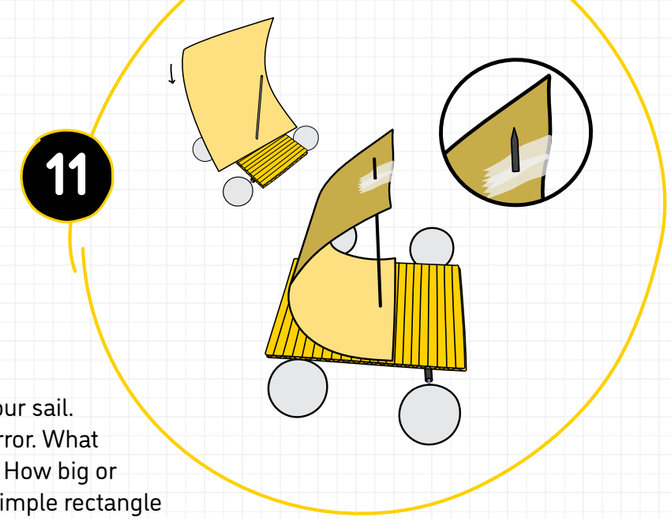












10. Take your construction paper and cut out your sail. This design step may take some trial and error. What shape do you think will make the best sail? How big or small should it be to fit on your vehicle? A simple rectangle will do the trick, but you should explore a variety of shapes and sizes to create the best sail!

11. Poke the mast (skewer) through the bottom of your sail and then through the top. Leave your sail slightly curved to help it catch the wind. Optional: use tape to secure your sail in place.

12. You've built a wind-powered vehicle! Place your car on a flat, wide-open surface. Make sure no one is within 6 feet of you before you blow air onto the mast side of the sail. Now watch your vehicle move to see wind energy in action!

Challenge: Once you've moved your wind-powered vehicle in a straight line, see if you can change the direction of the vehicle without touching it! Can your vehicle make a left turn? If you take it outside on a windy day, will the wind make it move?

try it

The sail for your wind-powered vehicle is important. What shape did you use for your sail? Can you imagine using a differently shaped sail? **Try making some different sail shapes to see which one catches the most wind.** Use your ruler to measure how far the vehicle travels each time and record your results below:

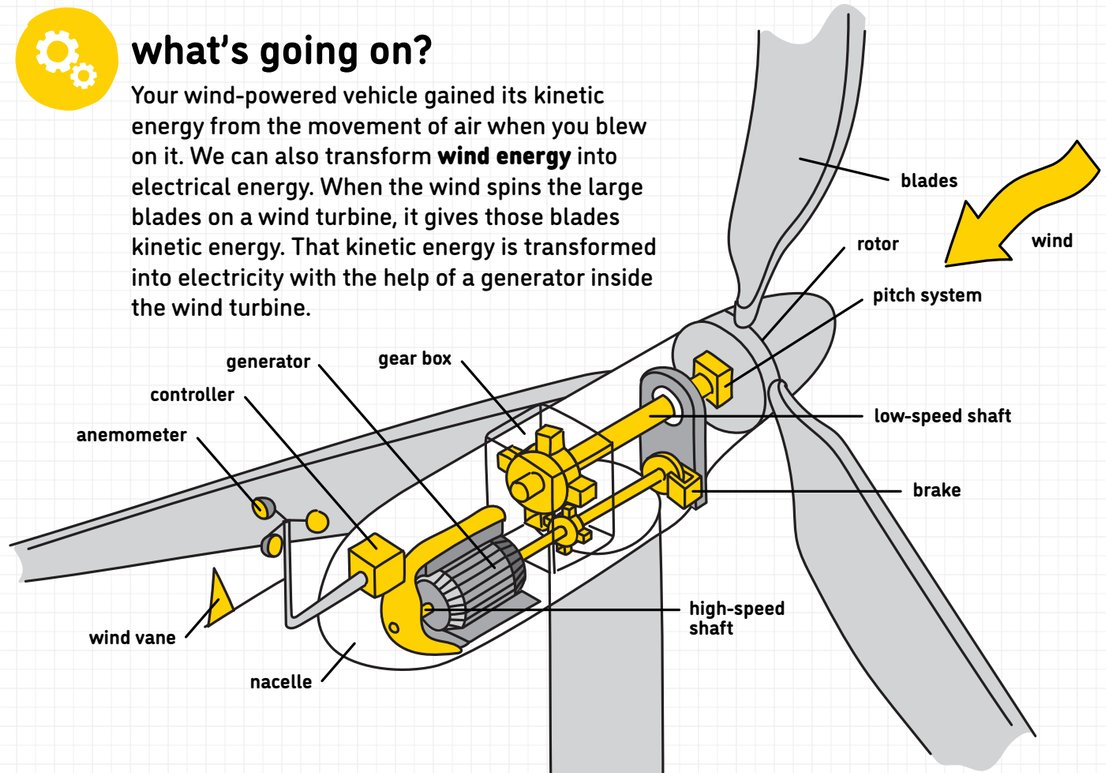
sail shape	distance traveled

draw it!

Draw the sail shape that worked best:

what's going on?

Your wind-powered vehicle gained its kinetic energy from the movement of air when you blew on it. We can also transform **wind energy** into electrical energy. When the wind spins the large blades on a wind turbine, it gives those blades kinetic energy. That kinetic energy is transformed into electricity with the help of a generator inside the wind turbine.

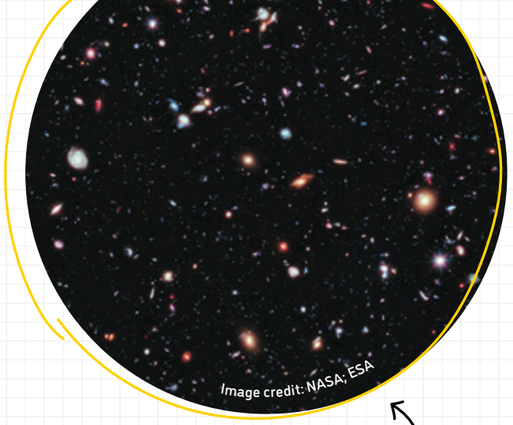


activity
4

Dark Energy

Do we know everything there is to know about energy?
We don't! Scientists are still learning more every day about the world around us. One form of energy that scientists are trying to understand is called **dark energy**.

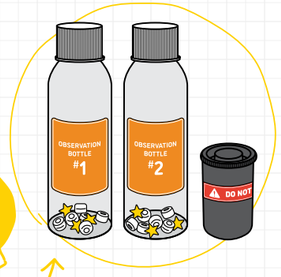
So what is **dark energy**? Scientists aren't sure. But they can observe how it affects the universe, which is why they think it exists! Try your hand at being a scientist investigating the unknown!



eXtreme Deep Field (XDF), an image created from photos taken by NASA's Hubble Space Telescope, features about 5,500 galaxies. Scientists use images like XDF to better understand our universe.

start here!

Use the QR code or visit
cosi.org/energykitvideos
for help with this activity.



gather your supplies:

FROM BOX
- 2 observation bottles
- 1 black mystery container (**do not open!**)

FROM HOME
- water

what to do:

Fill observation bottle #1 all the way to the top with water so there are no air bubbles inside. Close the lid tightly.

Now, for the sake of the experiment, pretend that you do not know which bottle has water in it. You are a scientist, and you don't know anything about what's inside either of these two containers.

Part 1: Observation Bottles

1. Observe Bottle 1 and Bottle 2. **What do you notice?**

2. One of the two bottles in your hand has water in it, and the other one does not.

Which one has water? _____
How do you know, based solely on your observations?

3. Now set the two bottles down in front of you and take some time to think harder about this question: based only on your observations, how do you know which bottle has water in it and which one does not? Think carefully and name **FIVE** differences between the two bottles that help to tell you the difference.

1. _____
2. _____
3. _____
4. _____
5. _____

Scientists often study things that are invisible, like gravity! We cannot see gravity, but we know that when you jump into the air, the force of gravity pulls you back down to Earth! If you fill a balloon with air, you know that the air is there even though you cannot see it. Scientists can study the way that invisible things interact with other objects and with light.

- **Did you notice any bubbles in the water?** Bubbles of air interacted with the water, and that helped you to know that the water was there.
- **Did you notice that the container with water in it was heavier than the container without water?** Scientists studying dark matter have ways of exploring "how heavy" the universe is (how much mass it holds). The amount of mass in the universe is much greater than what is visible! So there is something out there that we can't see adding to that mass. That is **dark matter**.
- **Did you notice that objects in and behind the container look a little different in the two observation bottles?** When light goes through something like air into plastic or water, it **refracts**, or changes direction. That can make objects in or behind the bottle look a little bit different than if the water was not there. When we look at galaxies that are really far away, they look a little different too, because the light coming from them has been bent and distorted by gravity. But a lot of that bending cannot be accounted for by the objects we can see. Dark matter may also be bending the light.
- **Did you notice that when you flip the bottles upside down, the objects in water move differently?** Objects cannot travel as quickly through water as they can through air because the drag force of the water slows them down. Scientists have noticed that dark matter changes how galaxies move.
- **What else did you notice?**

what's going on?

Scientists search for answers about the universe's mysteries. One way to search for answers is by making careful observations, just like you did with your observation bottles. Even if scientists don't know all of the answers, they find clues from their observations to help them get closer to the explanation! **In the next activity, use the skills you practiced in Part One for another challenge: what is inside the mystery container?**

Part 2: Mystery Container

Take out your mystery container. **Do not open it!**
Your challenge is to make as many observations as you can without opening it. Think carefully about what you can observe without opening the container. What can you learn about size, mass, density, and more? **Make all of your observations below. Try to make at least FIVE different observations:**

1. _____
2. _____
3. _____
4. _____
5. _____

Now that you have made all of your observations, take another look at your notes. As a scientist, do they give you any clues about what is inside? **Write those clues below:**

Write or draw your best guess: **What is inside the container?**

Once you have made your guess, it is time to open the container and find out what's inside! **How close was your guess?**

what's going on?

As a scientist, it is okay if your first guess is wrong. Scientists run many experiments and tests to get closer and closer to better understanding the world around us. Today, you played the role of a scientist gathering clues and making observations to understand something better!

activity 5

Solar Energy

One of our most important energy sources is the Sun. Plants use the Sun's energy to make food to grow. That energy passes to the animals that eat the plants. We can harness the Sun's energy too. Today, make a solar oven and see if you can use energy from the Sun to heat up and melt some chocolate. We'll give you the basic design – you can work to build the best solar oven!

start here!

Use the QR code or visit **cosi.org/energykitvideos** for help with this activity.

STOP

Be sure to wait for a sunny day, with no clouds and no precipitation (no rain or snow) to complete this activity.

gather your supplies:

FROM BOX

- the (empty) box your kit came in
- black construction paper
- aluminum foil
- transparency sheet
- tape
- chocolate
- thermometer

FROM HOME

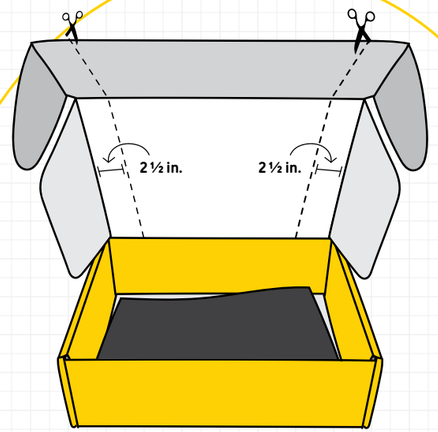
- optional: marshmallow or other food to melt

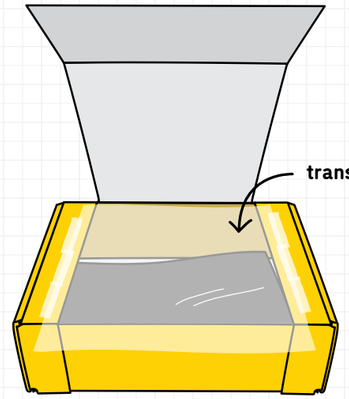
what to do: Part 1 - construct a basic solar oven

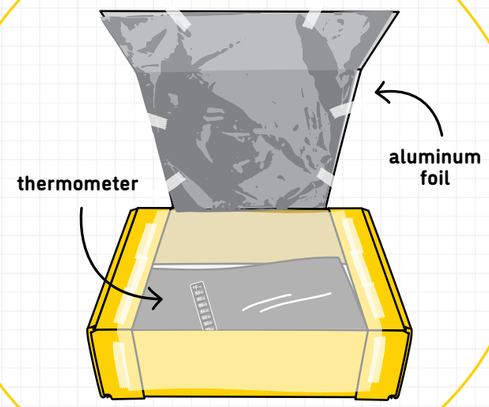
1. Use your thermometer or check the local weather to determine the temperature outside. **Record the temperature here:**

It is _____ ° Fahrenheit outside.

2. If you haven't already, empty out your box.
3. Place the black piece of construction paper in the bottom of the box. **Black colored objects absorb all wavelengths of light, so the black construction paper will help absorb the sun's heat much better than the white bottom of the box.**
4. Use your ruler to measure and your scissors to cut two straight lines down the lid of your box. These lines should be two and a half inches, or about six and a half centimeters from the side. Like the image on the right.
5. Close the box, leaving the middle part of the lid sticking up.







6. Place the transparency flat over the hole in the box, making sure that it covers any gaps. Tape the transparency along the sides to seal any leaks. It will stick out in the front.

   Light from the Sun can pass through the transparent plastic. When that light hits objects inside the box, some of it is absorbed and then radiated back as heat. The heat is trapped inside the box because it cannot pass through the plastic. This is the greenhouse effect. Leaks could allow the heat to get out, so be sure to tape over any leaks in your solar oven!

7. Carefully tape the aluminum foil over the top of the box. Make sure the shiny side faces forward. The aluminum foil will reflect light from the Sun into the oven. You can prop it up with a pen or tape it in place. Tilt it at the angle you think will reflect the most light into the oven.
8. Gently lift the front of the transparency to place the thermometer inside the box.
9. Tape the plastic transparency across the front to close any gaps.
10. Direct your box so that it faces the Sun.
11. Wait about 30 minutes and check your thermometer (without removing it from the box). **What is the temperature inside the box?**

It is _____ ° Fahrenheit inside my solar oven.

write it!

How does the temperature inside your solar oven compare to the temperature outside your solar oven?

try it

How could make your solar oven work even better? Remember what you learned about why you used the black construction paper, the clear plastic, the tape, and the reflective aluminum foil.

what to do: Part 2 - use your solar oven

1. Carefully open the plastic and remove the thermometer.
2. Open your piece of chocolate. Observe it. What does it look like? What does it feel like?

write it!

Write your observations about the chocolate before putting it into the oven here:

3. Place the chocolate inside the solar oven. It is best to do this after the solar oven has been out in the Sun heating up for about 30 minutes.
4. Leave your chocolate in the solar oven for about ten minutes. Afterwards, take it out and observe!

Write your observations about the chocolate after it has been in the oven for ten minutes. **Do you notice any changes?**

Did your solar oven work? Write your conclusions below:

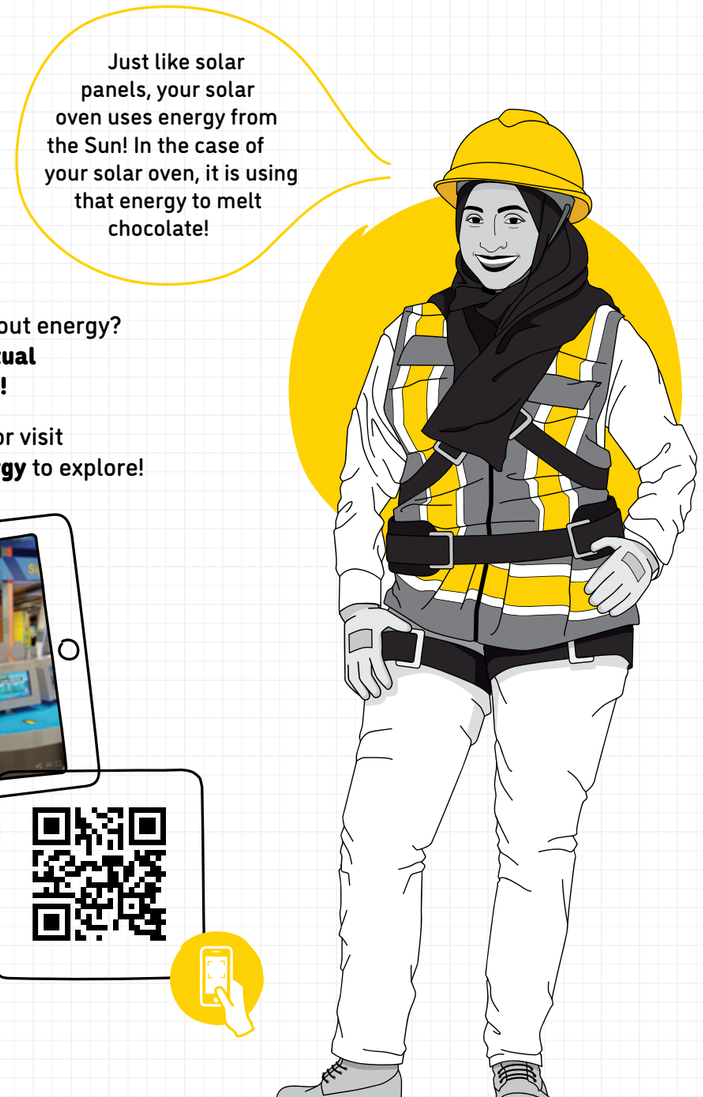
try it

What other foods can you melt in your solar oven?
Maybe you could try to melt a marshmallow or even a candy bar.

what's going on?

When light from the Sun hits an object, it makes that object warm up. Your solar oven helps to intensify that effect. First, a black piece of construction paper is sitting at the base. Black objects absorb all wavelengths of light, so the black piece of paper will heat up more than any other color would. Normally, after an object heats up, it gives off some of that heat as infrared radiation. But the transparency keeps that infrared radiation trapped inside your oven. This creates a greenhouse effect inside your oven. Lastly, the aluminum foil on the lid of the box helps to reflect light rays into the box, which increases the amount of energy going in.

Your solar oven turns light energy from the Sun into thermal (heat) energy!



Learn more!

Did you enjoy learning about energy? Learn more at the **3D Virtual Energy Explorers Exhibit!**

Scan the QR code below or visit **cosi.org/vtour/show/energy** to explore!

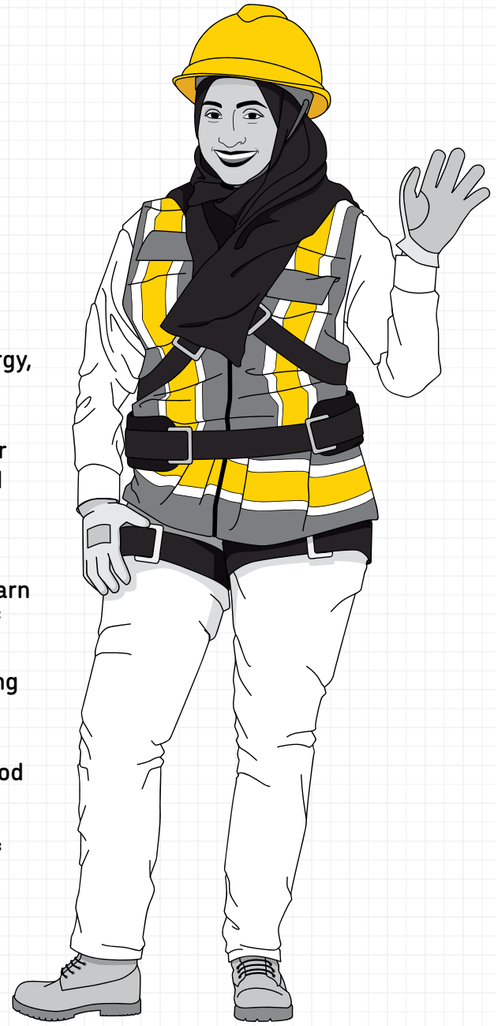
Solar Panel Technician

science careers

Solar panels are an important tool for harnessing solar energy, or energy from the Sun. By using energy from the Sun, we can reduce the amount of harmful gases that are produced when we burn fossil fuels for electricity. In order to use solar panels, we need solar panel technicians to build, install, and do maintenance on solar panel systems!

Solar Panel Technicians attend colleges and trade schools to learn the science and mechanics of solar panels. If you enjoy working outdoors, climbing ladders, building things, and solving problems, then this might be a good career choice for you!

Could you see yourself in this career? Why or why not?



Want to learn more? Or do you have questions about what you learned? Reach out to the COSI Department of Science Content at **sciencequestions@cosi.org**

Which was your favorite activity? We'd love to hear! Use **#COSIConnects** on social media to share photos or stories of what you learned with this kit.

Want more hands-on activities? Visit **cosi.org/connects** or download the **COSI App!**

COSI connects

Create a Beach Scene for your wind-powered vehicle!

Fold this booklet along the center and place the wind-powered vehicle you made into the scene! Take a photo and share it on social media using **#COSIConnects**.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