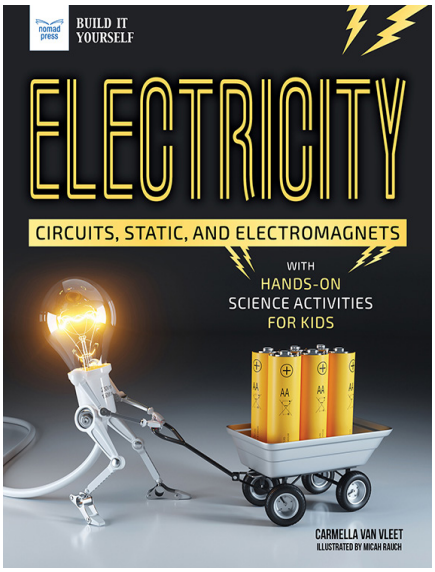
Nomad Press
CLASSROOM GUIDE



It's everywhere. In our homes, schools, offices, on the train, in our cars—even inside our bodies!

Electricity: Circuits, Static, and Electromagnets with Hands-On Science Activities explores the science of electricity and the technology we've developed to harness the energy to power our lives. By diving into the topics of static electricity, currents, circuits, electromagnetism, motors, and ways we might produce and use electricity in the future, kids ages 8 to 12 gain a full view of how electricity works and why it's so important to human society.

Hands-on STEM activities, entertaining illustrations, essential questions, fascinating sidebars, and links to online resources and videos get kids hooked on the subject they all use in their daily lives—electricity!

Learn more at nomadpress.net/nomadpress-books/electricity

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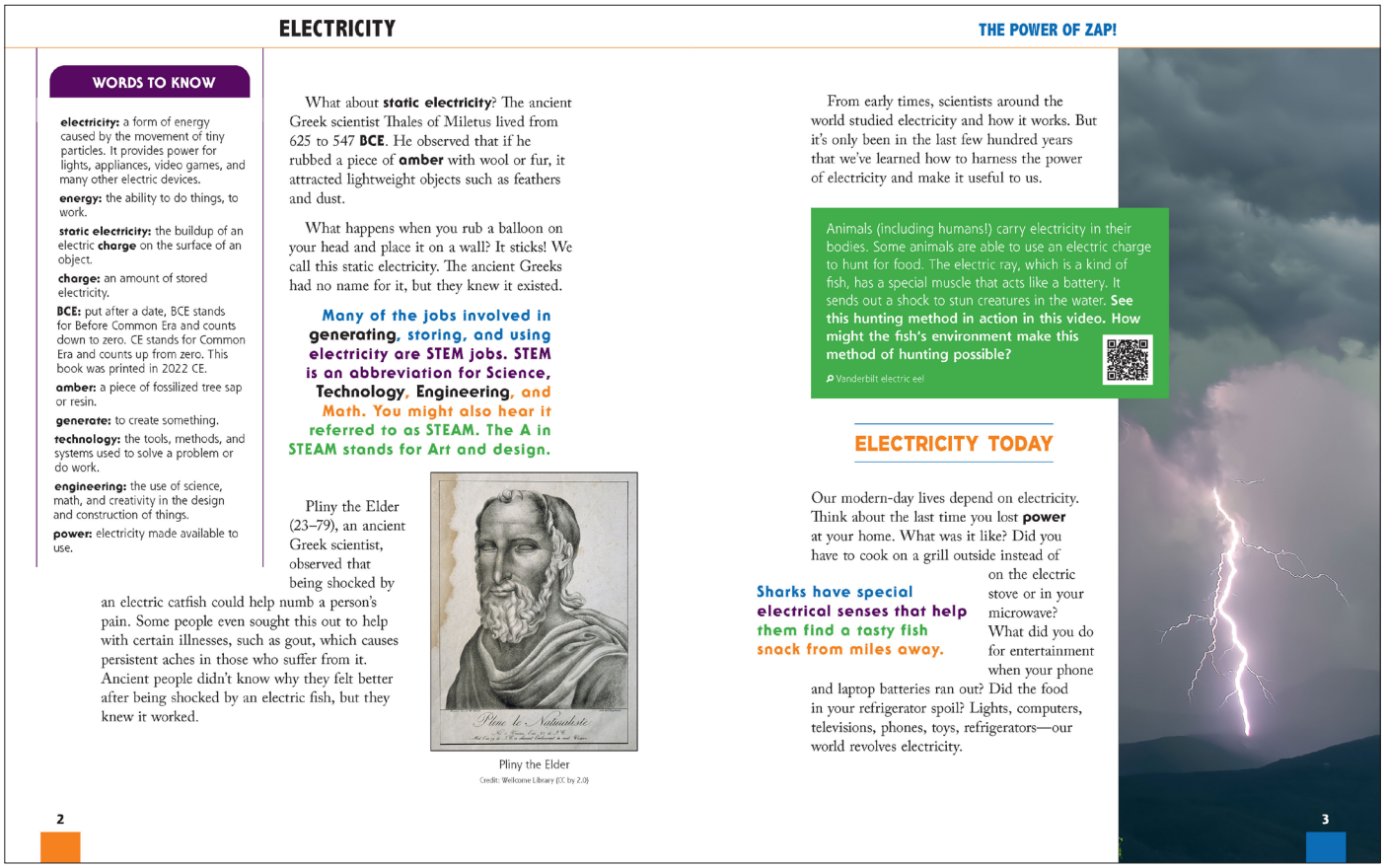
Interest Level: Grades 4–7
Focus: Science & Nature / Physics
GRL: W

LOOK Inside



ELECTRICITY

WORDS TO KNOW

electricity: a form of energy caused by the movement of tiny particles. It provides power for lights, appliances, video games, and many other electric devices.
energy: the ability to do things, to work.
static electricity: the buildup of an electric **charge** on the surface of an object.
charge: an amount of stored electricity.
BCE: put after a date, BCE stands for Before Common Era and counts down to zero. CE stands for Common Era and counts up from zero. This book was printed in 2022 CE.
amber: a piece of fossilized tree sap or resin.
generate: to create something.
technology: the tools, methods, and systems used to solve a problem or do work.
engineering: the use of science, math, and creativity in the design and construction of things.
power: electricity made available to use.

What about **static electricity**? The ancient Greek scientist Thales of Miletus lived from 625 to 547 **BCE**. He observed that if he rubbed a piece of **amber** with wool or fur, it attracted lightweight objects such as feathers and dust.

What happens when you rub a balloon on your head and place it on a wall? It sticks! We call this static electricity. The ancient Greeks had no name for it, but they knew it existed.

Many of the jobs involved in generating, storing, and using electricity are STEM jobs. STEM is an abbreviation for Science, Technology, Engineering, and Math. You might also hear it referred to as STEAM. The A in STEAM stands for Art and design.

Pliny the Elder (23–79), an ancient Greek scientist, observed that being shocked by an electric catfish could help numb a person's pain. Some people even sought this out to help with certain illnesses, such as gout, which causes persistent aches in those who suffer from it. Ancient people didn't know why they felt better after being shocked by an electric fish, but they knew it worked.

Pliny the Elder
Credit: Wellcome Library (CC by 2.0)

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THE POWER OF ZAP!

From early times, scientists around the world studied electricity and how it works. But it's only been in the last few hundred years that we've learned how to harness the power of electricity and make it useful to us.

Animals (including humans!) carry electricity in their bodies. Some animals are able to use an electric charge to hunt for food. The electric ray, which is a kind of fish, has a special muscle that acts like a battery. It sends out a shock to stun creatures in the water. **See this hunting method in action in this video. How might the fish's environment make this method of hunting possible?**
Vanderbilt electric eel

ELECTRICITY TODAY

Our modern-day lives depend on electricity. Think about the last time you lost **power** at your home. What was it like? Did you have to cook on a grill outside instead of on the electric stove or in your microwave? What did you do for entertainment when your phone and laptop batteries ran out? Did the food in your refrigerator spoil? Lights, computers, televisions, phones, toys, refrigerators—our world revolves electricity.

Sharks have special electrical senses that help them find a tasty fish snack from miles away.

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SAMPLE GLOSSARY

advantage: something helpful.

alternating current (AC): an electric current where electricity flows back and forth.

amber: a piece of fossilized tree sap or resin.

amperes (amps): the measurement of the amount of electric current.

anode: the end of a battery marked with a minus sign.

appliance: an electric device such as a toaster, microwave, or washing machine.

armature: the spinning part of a motor, made of tightly coiled wires.

arc: a curved path, sometimes made by electricity jumping from one thing to another.

atmosphere: a layer of gas surrounding Earth.

atom: a small particle of matter. Atoms are the extremely tiny building blocks of everything.

attract: to pull together.

axle: a rod on which something spins.

battery: a device that stores and produces electricity using chemicals.

BCE: put after a date, BCE stands for Before Common Era and counts down to zero. CE stands for Common Era and counts up from zero. This book was printed in 2022 CE.

blackout: a loss of electric power.

breaker panel: the electric box that distributes the electricity coming into a house or other building to each outlet and switch.

brush: a soft, springy, metal wire that, with a commutator, acts as a switch inside a motor.

calibrate: to fix an instrument to a standard reading.

capacitor: a device that stores electric energy until it's needed.

carbon dioxide: a gas formed by the burning of fossil fuels, the rotting of plants and animals, and the breathing out of animals or humans.

cathode: the end of a battery marked with a plus sign.

cell: in a battery, a single unit of a battery made up of an anode and a cathode that are separated by an electrolyte.

chemical reaction: the rearrangement of atoms in a substance to make a new chemical substance.

circa: around that year. Abbreviated with a "c."

circuit: a loop that starts and finishes at the same place.

climate change: the long-term change in the earth's weather patterns.

collaboration: working with others.

commutator: the part of a motor that reverses the electric current.

compact fluorescent light (CFL): a light bulb that uses less electricity and lasts longer than an incandescent light bulb.

compass: an instrument that uses a magnetized needle to find north.

conductor: something that electricity moves through easily, such as copper wire.

current: the steady flow of water in one direction or the flow of electricity.

diameter: the straight line that goes from one side of a circle, through its center, to the other side.

diode: a semiconductor device that allows the flow of current in one direction.

direct current (DC): an electric current where electricity flows in one direction.

disadvantage: something that causes difficulty or trouble.

disc: a round, thin piece of material.

discharge: the removal of electrons from an object.

dissect: to cut something apart to study what is inside.

drought: a period of time when no precipitation falls on a region, causing problems for farms and wildlife.

dynamic electricity: the movement of an electric charge through a conductor.

efficient: wasting as little as possible.

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ESSENTIAL QUESTIONS

BEFORE READING:

Establish Background Knowledge

- What do you already know about electricity and how it works?
- Why is it important to study things like electricity?
- What devices in your house operate with electricity? Do they use batteries or are they plugged into an outlet?

Skill Introduction

- What do you do when you come to a word or phrase you do not know?
- How do photographs, videos, and charts help someone learn about a topic?

CCSS.ELA-Literacy.L.6.4c Consult reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning or its part of speech.

CCSS.ELA-Literacy.L.6.6 Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

DURING READING:

Check for Understanding

- Electricity can be very dangerous. What are some ways inventors and engineers stay safe when working with electricity?
- What are some of the different types of scientists and engineers who study and use electricity?
- What happens at your house when the electricity goes out? What are some ways you learn to live without it? What are some places where it can be very dangerous to have no electricity?

CCSS.ELA-Literacy.RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

CCSS.ELA-Literacy.RST.6.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

AFTER READING:

Summary and Expansion

- What is static electricity? Where and when can you see it?
- Who were some of the early scientists who studied static electricity? What were some of their hypotheses?
- What are some ways you can stay safe in a lightning storm?
- How do lightning rods work?
- What is the difference between static electricity and dynamic electricity?
- Why are insulators important?
- How do batteries work?
- What role does a switch play in an electrical circuit?
- Do you think the government should require people to use the most energy-efficient light bulbs possible? Why or why not?
- What is the difference between alternating current and direct current? What different things are they used for?
- What is the relationship between electricity and magnetism?
- What are some of the things electromagnets are used for?
- How does a compass work?
- How do motors work? How do they use electromagnetism?
- Why are people looking for more environmentally friendly ways to produce and use electricity?
- What are some of the careers available that work with electricity?

CCSS.ELA-Literacy.SL.6.2 Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.

CCSS.ELA-Literacy.SL.6.5 Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.

CCSS.ELA-Literacy.WHST.6-8.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCSS.ELA-Literacy.WHST.6-8.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

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BOOGIE BALLS BOX

In the eighteenth century, people used static electricity to entertain. For example, Stephen Gray (1666–1736) performed "The Flying Boy." In this demonstration, a young boy was suspended on silk cords and his feet were charged with a special ball. The static electricity would travel through his body and he could use it to turn the pages of a book without touching them! Here's a fun way to entertain your friends and family.

BBC Stephen gray

TOOL KIT

- shoebox lid
- foil
- pencil
- 5 small Styrofoam balls about the size of large marbles
- 8-by-10-inch polycarbonate sheet (Plexiglass), found at hardware stores
- dry paper towel
- science journal

Lay the shoebox lid on top of a piece of foil. Trace around it with the pencil. Carefully cut out the piece of foil and lay it in the bottom of the lid.

Cover each of the Styrofoam balls with foil. Smooth them out the best you can so that they are round and smooth. Place the balls inside the lid.

Use the paper towel to rub one side of the polycarbonate sheet for 20 to 30 seconds. (Important: The sheet usually comes with a clear film on each side. Be sure to peel off the film before rubbing.) This will "charge" the polycarbonate sheet with static electricity.

Place the polycarbonate sheet over the lid, rubbed-side down. The sheet doesn't need to completely cover the lid, but it should be close to the tops of the foil balls without touching them. Observe and record what happens to the foil-covered balls underneath. Glide your finger along the top of the plastic sheet. The balls should hover, move, or "dance." Note that if the foil on the bottom of the lid pulls up, you might have to glue or tape it down.

Try This!

What happens if you add five more foil-covered Styrofoam balls? Does the charge last for the same amount of time? Are the balls just as active?

What happens if you don't cover the balls in foil?

What happens if you rub the polycarbonate sheet for only five seconds?

What happens if your paper towel is damp?

Make predictions, experiment, and record your data in your science journal.

MAKE AN ANEMOMETER

An anemometer is a device that shows how fast the wind is blowing. You can make your own anemometer and chart wind speed at your house.

TOOL KIT

- modeling clay
- block of wood (just about any size will work)
- pencil with an eraser
- 2 pieces of thin cardboard, 12 inches by 1½ inches
- 4 small paper cups
- red marker
- flat or ball-head pin
- timer

Roll the modeling clay into a mound about the size of a golf ball. Attach it to the block of wood. Push the pencil into the center of the clay with the eraser side up.

Glue or staple the pieces of cardboard together. You want them to make an X.

With the cups placed sideways and all facing the same way, staple each cup to the top of each end of the cardboard strips. Why do you think the cups should face the same way? Use the marker to color one of the cups red. Why do you think just one cup needs to be marked?

Push the pin through the middle of the cardboard X and into the pencil eraser. Gently blow on the cups to make sure they spin.

Take your stopwatch, science journal, and anemometer outside. Set the anemometer in an open space where it can catch the wind.

Use the stopwatch to time 1 minute. Watch the red cup and count how many times it completes a turn in that minute. Write down the number in your science journal.

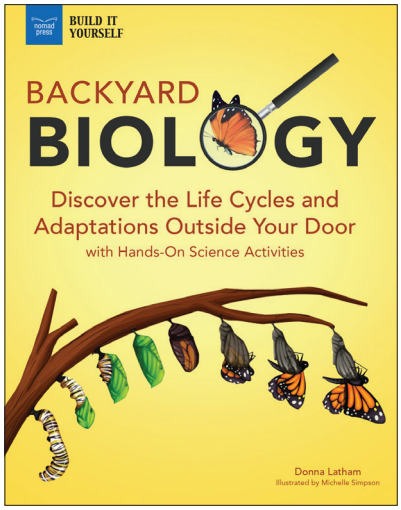
Try This!

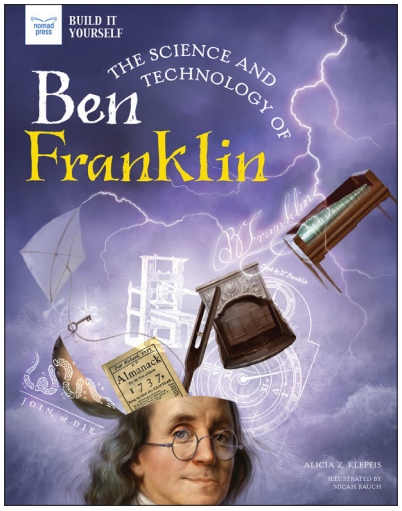
Does the time of day affect wind speed? Are some months windier than others? Test the wind speed and keep track.

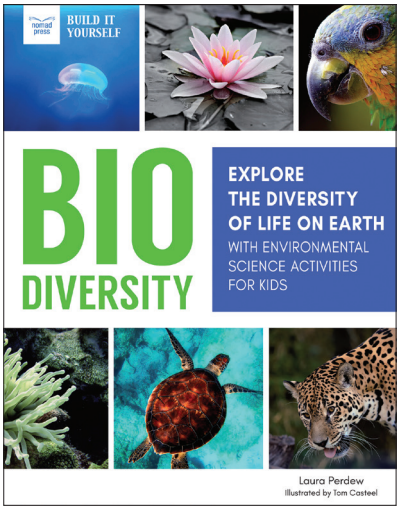
Start a scientific method worksheet and make a prediction. Then experiment. Copy the chart below into your journal and record your data.

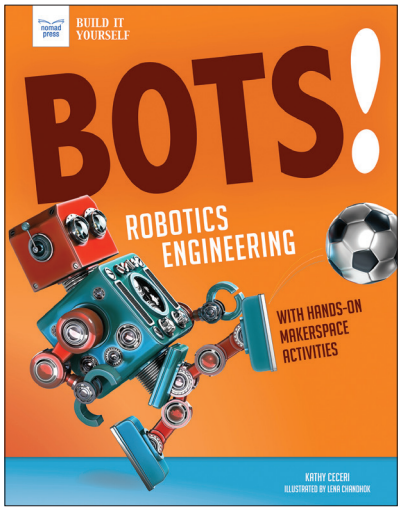
Time of Day or Month	Wind Speed

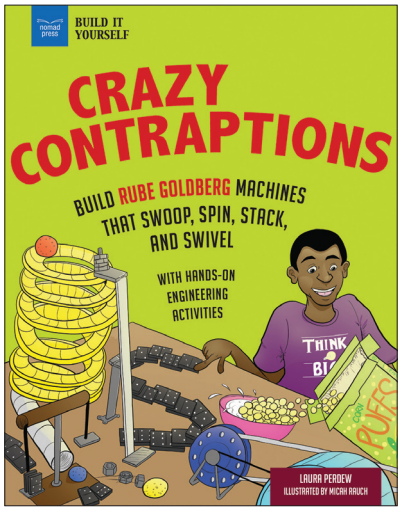
MORE SCIENCE TITLES FROM NOMAD PRESS

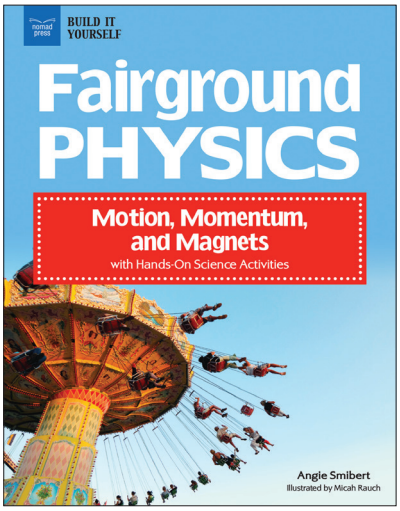


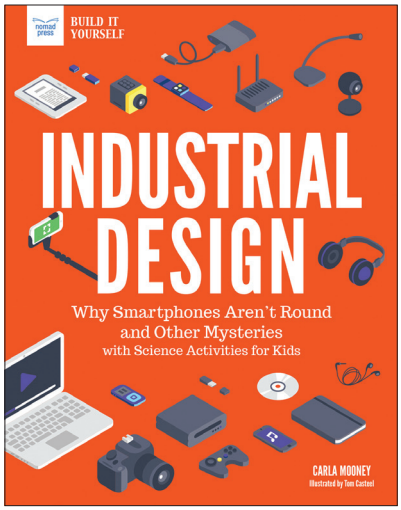


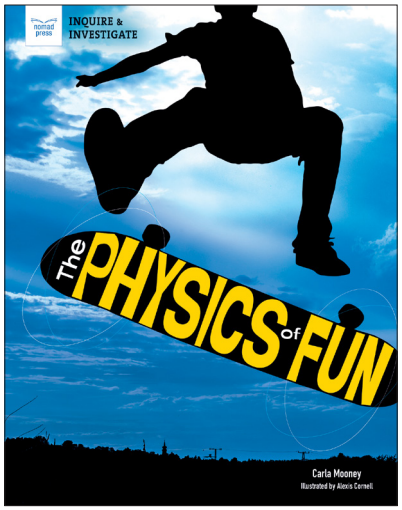


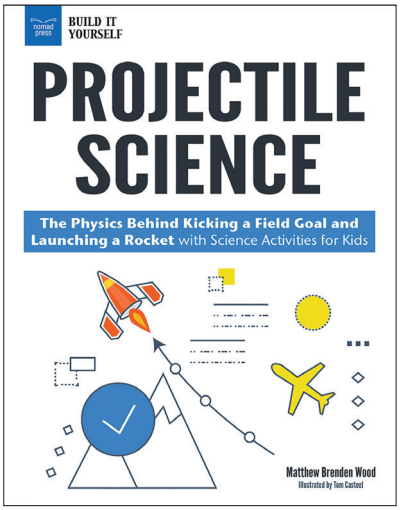












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