South Carolina STEM Education Month

DUKE ENERGY SCIENCE NIGHT

Air Power

Big idea

Explore how powerful air can be, even though we can't see it.

You will need

WHAT WE GAVE YOU:

- Airzooka
- cups
- Air Power instruction sheet

STUFF YOU PROVIDE:

- sticky notes and a marker (optional)

Fun options

Use sticky notes to create a tic-tac-toe grid on a wall. Have individuals take turns aiming the Airzooka at the grid and firing. Whichever sticky note moves the most is where they get to mark their X or O. Continue taking turns until someone wins or there's a tie game.

Set it up

Make a pyramid out of cups, either on a table or on the floor. It's a good idea to test out the Airzooka to be sure you know how to use it and to see how far away you can stand while still knocking over the cups. Place the Air Power instruction sheet near the Airzooka.

It's showtime!

As families approach your table ask them, "Can you throw air?" Let them know that they are going to use an Airzooka to do just that. Explain that the Airzooka is an "Air Vortex Cannon," which applies force to the air inside the chamber to get the air molecules to move in a single direction and fire out of the cannon with great force.

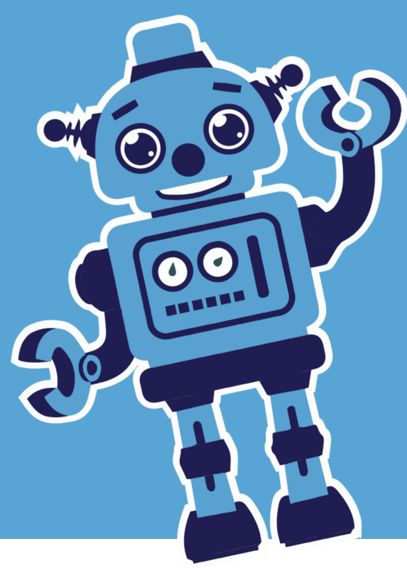
Help students use the Airzooka to shoot air at a stack of cups. The force of the air is powerful enough to knock them over.

If they love It...

Have them step back further to see if they can still knock over the cups.

Take it back to the classroom

Students can make their own Air Vortex Cannon using a paper cup, a balloon, and a rubber band. Activity directions are available at **www.sciencefriday.com/educational-resources/design-a-better-vortex-cannon**



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SCIENCE FOR ALL • CIENCIA PARA TODOS •

DUKE ENERGY SCIENCE NIGHT

Air Power

Why is this science?

Even though we can't see it, air is **matter.** It is made up of tiny particles called **molecules**, takes up space, and has mass. An empty balloon is small but when you blow up a balloon it gets bigger and a little bit heavier. The Airzooka works by applying force to a bunch of air molecules to move them in a single direction. Air, like all matter, can move in response to force and it can exert force on other objects.

Air is moving around us all the time as something that we call wind. The power of moving air can be captured by wind turbines and converted into electricity that we use to power our homes. Wind-powered machines have been around for centuries, but in 1887 a professor in Scotland figured out how to use a windmill made of wood and cloth to produce electricity. Modern wind turbines are hundreds of feet tall and are often found on wind farms, with dozens of other turbines. Any time the wind speed is between about 7 and 55 miles per hour, the turbines will spin and produce electricity. If the wind speed gets any higher, it can become dangerous for the turbine so they actually have to put on brakes.

South Carolina College- and Career-Ready Science Standards 2021

Performance Expectation: 5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen.

Science & Engineering Practice: Developing and Using Models - Develop a model to describe phenomena.

Disciplinary Core Idea: PS1.A: Structure and Properties of Matter - Matter of any type can be subdivided into particles that are too small to see, but even then, the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space (and can be detected by their impact on other objects) can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.

Cross-Cutting Concept: Scale, Proportion, and Quantity - Natural objects exist from the very small to the immensely large.

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South Carolina STEM Education Month

DUKE ENERGY SCIENCE NIGHT

Binary Bangles

Big idea

Binary Code is a special language for instructing machines and can be used to represent any letter or number.

You will need

WHAT WE GAVE YOU:

- black pony beads
- white pony beads
- pipe cleaners
- plastic containers
- Binary Alphabet and Numbers guide
- Binary Place Value guide

STUFF YOU PROVIDE:

- optional: paper and pencils or white boards and dry erase markers
- optional: extra copies of the 2 Binary code guides

Set it up

Place black and white pony beads into separate containers and arrange pipe cleaners near them. Place the Binary Alphabet and Numbers and Binary Place Value guides in the center of the table. You can make extra copies ahead of time so that more than one family can use them at a time.

It's showtime!

As families approach the table let them know they're going to learn a fundamental building block of computer programming: Binary Code. Explain that the most basic commands a computer understands are On and Off. By using a series of On and Off commands we can represent any letter or number. Show them the Binary Alphabet and Numbers guide and the Binary Place Value guide.

For younger students, show them how the black pony beads represent Off and the white pony beads represent On. They can use the pony beads to either code their age or the first letter of their name onto a pipe cleaner bracelet.

For older students, use what you learned from the "Why is This Science?" section on the back of this page to help explain Place Value in a Binary system. Encourage them to try and figure out where the On or Off beads would go to code their age onto a bracelet and then check that against the Binary Alphabet and Numbers sheet.

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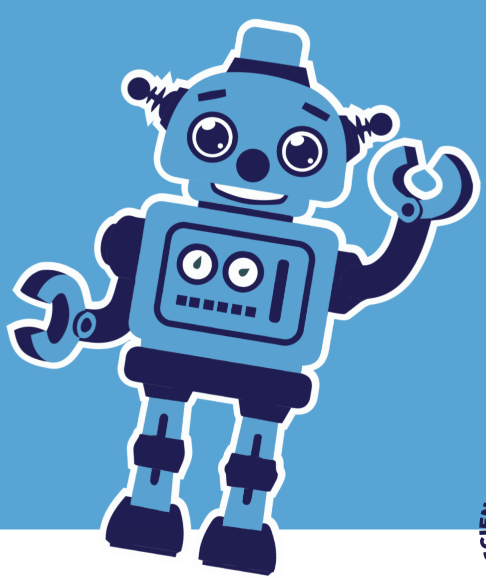

SCIENCE FOR ALL • CIENCIA PARA TODOS •

DUKE ENERGY SCIENCE NIGHT

Binary Bangles

Fun options

Have paper or white boards available for students who might want to dig deeper into the math behind binary. Let them use the Binary Place Value guide sheet to try building their own numbers in binary. Encourage students to make the biggest number they can in binary!

Why is this science?

Binary Numeric systems can seem intimidating, but have existed across ancient cultures. When we count we're used to the progression 0, 1, 2, 3, 4, 5... because we count in a Base-10 system. In a Base-10 system there are digits for 0-9 and place value is based on groups of Ones, Tens, Hundreds, etc. In a base-2 system there are only 2 digits: 0 and 1. So you count 0, 1, 10, 11, 100, 101... Place value increases differently in a Binary system because you have only two digits. Starting with Ones, it increases to Twos, Fours, Eights, Sixteens, Thirty-Twos, etc. In both systems, the way you arrange digits in the place value columns lets you make any whole number. For example: the number 12 can be written in Base-10 by putting a 1 in the Tens place and a 2 in the Ones place. We'd write this as 12. Or it can be written in binary by putting a 1 in the Eights place, a 1 in the Fours place, a 0 in the Twos place, and a 0 in the Ones place. This would be written as 1100. So 12 and 1100 are two different ways to write the same number.

South Carolina Computer Science and Digital Literacy Standards 2017

Digital Literacy Key Concept: Data and Analysis

Digital Literacy Content Standard: 4.DA.1: Identify various ways in which data is stored and represented.

Digital Literacy Indicator: 4.DA.1.2: The student will understand that computing devices have their own language (i.e., binary).

Digital Literacy Process Standard: Recognize, define, and analyze computational problems.

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DUKE ENERGY SCIENCE NIGHT

Catapults

Big idea

Explore the physics behind a simple machine by building a catapult.

You will need

WHAT WE GAVE YOU:

- jumbo craft sticks
- small craft sticks
- plastic spoons
- rubber bands
- pom poms
- Catapults instruction sheet

Fun options

BEFORE SCIENCE NIGHT

Set up a “castle wall” for participants to destroy! Launch heavier objects, like marbles, into stacks of cups or other lightweight materials. Encourage participants to experiment with the angle of the launch to deal the maximum damage to the castle walls! Then, allow them to build a structure for the next group.

Set it up

Lay out all materials on the table in order: Catapults instruction sheet, small craft sticks, rubber bands, jumbo craft sticks, and spoons. You may want to create multiple building stations, or try an assembly line. It’s a good idea to make your own catapult as an example. This way the students can see the finished product, and you get a chance to make sure you understand the instructions as well as anticipate any issues children may face when building their catapult. The trickiest part for younger children is wrapping the rubber bands, so make sure you have extra help or call on families to help with this step. Or you may want to prep some steps ahead of time to streamline the process.

Make targets for students to hit with their pom poms. Make a variety of targets: some on the wall, some on the floor, some near and some far.

It’s showtime!

Show families how your example catapult works: place a pom pom on the spoon and pull back, letting go to launch. The example will help them understand how to make their own catapult.

Help families build their catapult according to the instruction sheet. Younger children may have difficulty wrapping the rubber bands around the ends of the craft sticks. Encourage their adult or an older sibling to help them with this part, and allow the student to count out the supplies they need to build the catapult.

After participants have successfully completed their catapult, encourage them to play and experiment with it by aiming for the targets around the room. They can change the angle of the launch by sliding the fulcrum – the stack of craft sticks. How does this affect their catapult’s release?

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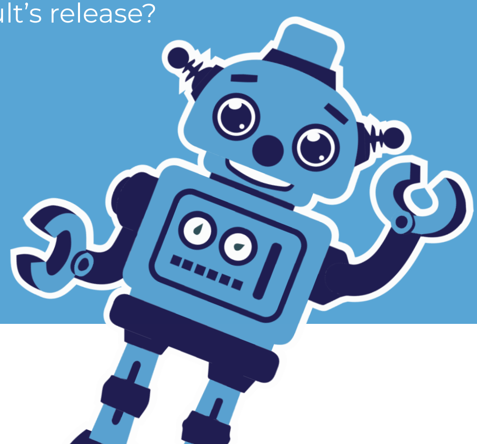

SCIENCE FOR ALL • CIENCIA PARA TODOS •

Catapults

Why is this science?

Catapults are a great example of a machine engineered to do work, using a lot less energy and force to complete a task. It uses a simple machine called a lever; in this case, the craft stick that served as the launching arm. The lever was attached to a fulcrum, the stack of smaller craft sticks, and supported the lever. When you pull down the lever, you are providing the force, but the lever magnifies this force, launching the pom pom into the air!

There are two types of energy: potential energy (stored energy) and kinetic energy (energy of motion). In the case of the catapult, you store up potential energy as you pull back the lever. Once you release it and it snaps back into place, the energy that was stored is turned into kinetic energy, launching the pom pom into the air.

What will happen to the pom pom? Newton's first law of motion says that an object in motion stays in motion, unless an external force is applied to it. In this case, the external force is gravity, which will eventually pull the pom pom back to the ground.

By sliding the fulcrum, participants can change the amount of potential, and therefore kinetic energy. When the fulcrum is closer to the front of the catapult, more force is needed to pull the lever back, storing up more energy and therefore launching the pom pom a greater distance. When the fulcrum is further back, less energy is stored and so the pom pom doesn't fly as far.

The levers on catapults were used in ancient and medieval warfare to throw stones to knock down walls. But levers are also found many other places: seesaws, scissors, wheelbarrows, tweezers or brake pedals on cars. Simple machines are all around us!

South Carolina College- and Career-Ready Science Standards 2021

Performance Expectation: 3-PS2-2. Make observations and measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

Science & Engineering Practice: Planning & Carrying Out Investigations – Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.

Disciplinary Core Idea: PS2.A: Forces and Motion - The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it.

Cross-Cutting Concept: Patterns – Patterns of change can be used to make predictions.

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DUKE ENERGY SCIENCE NIGHT

Climbing Robot

Big idea

Experiment with the forces of motion by creating a climbing robot.

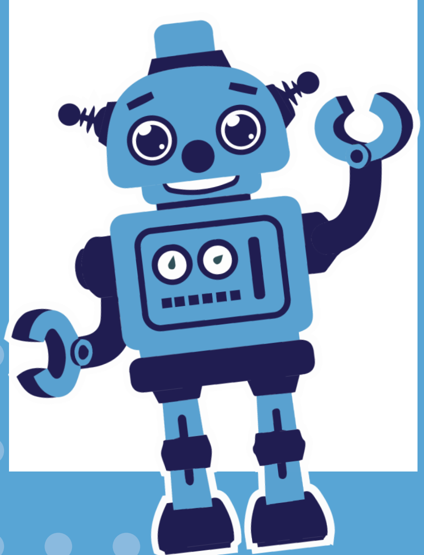
You will need

WHAT WE GAVE YOU:

- climbing robot templates (2 per sheet)
- crayons
- straws
- masking tape
- yarn
- Climbing Robot instruction sheet

STUFF YOU PROVIDE:

- scissors
- paper clips (optional)
- string (optional)



Set it up

Cut the template sheets in half. Cut the straws into 1-in long pieces, and the yarn into 2-ft long pieces. You may also want to prepare 1-in long pieces of tape. Lay out all materials on the table(s). You could create multiple building stations or try an assembly line. Using the instruction sheet, make your own climbing robot to use as an example and to be sure you understand the instructions as well as anticipate any issues children may face.

It's showtime!

Show families how your climbing robot works by pulling it to the top of the yarn and then carefully releasing so it can maneuver down. The yarn needs to be held straight up and down and pulled tight enough so that it is not slack for the climbing robot to work properly. Your example will help them understand how to make and test their own.

Help families create their own climbing robot according to the instruction sheet. They may choose to color the template prior to cutting it. Younger children may have difficulty threading the yarn through the straw and may need help with this step. After it is threaded, it's a good idea to either tie knots or place a "tape flag" on each end of the yarn so that they won't slip back out of the straw.

Fun options

After participants have successfully completed, tested, and observed their climbing robot, they can further experiment by adding paper clips to various areas of the template to see if/how it affects the motion.

Create a version of the climbing robot using string that is not as thick as the yarn. With this version, demonstrate that the robot does not experience friction and will quickly fall to the bottom rather than experiencing the give-and-take of energy that makes our robot look like it is climbing down the yarn.

Continued ›

SCIENCE FOR ALL • CIENCIA PARA TODOS •

Climbing Robot

Why is this science?

This activity provides a chance to learn about energy and the forces of motion. You may have noticed that roller coasters start with a climb up a very large hill. This is because roller coasters don't have engines that power them through the ride. Instead, the coaster is pulled to the top of the first hill and released, at which point it rolls freely along the track without any mechanical assistance for the rest of the ride. Just like a roller coaster, our Climbing Robot relies on gravity and energy for its ride down the yarn.

There are two types of energy: Potential Energy (stored energy) and Kinetic Energy (energy of motion). When the robot is pulled to the top of the yarn and held there it has potential energy. Once the robot is released, gravity pulls it down the yarn. The potential energy is changed into kinetic energy as the robot falls. As the robot slides down the yarn, kinetic energy is lost due to friction which slows it down. Without friction the robot would fall faster and faster to the bottom of the yarn. Instead, our robot is constantly experiencing the forces of gravity and friction and changes between potential and kinetic energy as it travels. This give-and-take of energy makes our robot look like it is climbing down the yarn!

South Carolina College- and Career-Ready Science Standards 2021

Performance Expectation: 5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.

Science & Engineering Practice: Engaging in Argument from Evidence – Support an argument with evidence, data, or a model.

Disciplinary Core Idea: PS2.B: Types of Interactions - The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.

Cross-Cutting Concept: Cause and Effect – Cause and effect relationships are routinely identified and used to explain change.

This activity adapted from Community Science Night Activity "Climbing Critters"

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DUKE ENERGY SCIENCE NIGHT

Computer Vision

Big idea

Computers use data to find patterns which they can use to identify objects.

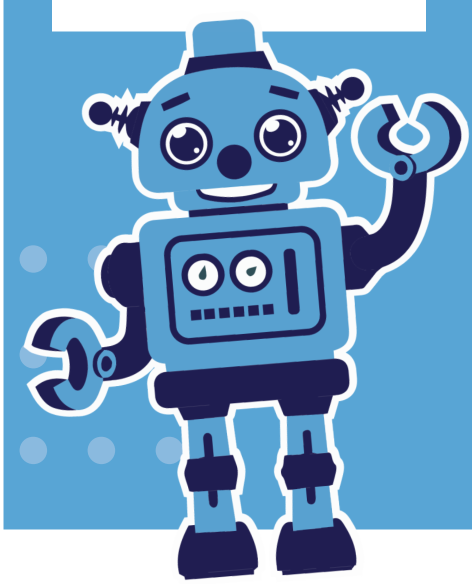
You will need

WHAT WE GAVE YOU:

- Computer Vision instruction sheet

STUFF YOU PROVIDE:

- a computer with internet access and a web cam
- 3-5 random objects such as pencils, pens, markers, cups, erasers - anything!
- different versions of the same object (e.g., pencils of different color and length)



Set it up

Place the Computer Vision instruction sheet next to the computer.

Sign in to the computer and use a web browser to navigate to this site: **https://teachablemachine.withgoogle.com**. Select Get Started, then Image Project, and Standard Image Model.

Click the "webcam" button to ensure you can see an image; adjust computer settings as necessary. (Don't worry: recorded images are not sent to the internet!)

It's a good idea to go through the activity ahead of time in order to make sure you understand the instructions as well as anticipate any issues children may have.

It's showtime!

Encourage families to have fun training the "Teachable Machine" to recognize objects, faces, and hand gestures. Instructions are included for them to follow. The website has additional resources if families want to experiment with voice or pose recognition.

Families may have fun getting the computer to recognize different versions of the same thing - such as a yellow pencil versus a red one, or a short pencil versus a long one.

Can families train the computer to correctly identify three different groups of objects? What happens when you introduce a 4th item?

Fun options

HAND SIGNALS

Train the computer to recongize your hand making "rock, paper, and scissors".

EMOTION RECOGNITION

Train the computer to recognize your emotions by smiling, frowning, and looking excited.

Continued ›

SCIENCE FOR ALL • CIENCIA PARA TODOS •

Computer Vision

If they love it

Challenge families to think broadly about how computers identify objects.

Could your program identify all kinds of dogs, for example?

How about different types of drink holders?

Try training the system to recognize sounds and poses as well!

Why is this science?

Computer Vision is a type of **Artificial Intelligence (or AI)** where people train a computer to recognize objects. Artificial Intelligence is a growing segment of Computer Science. These identification systems are used in law enforcement, at the grocery store, and as part of search programs, such as when you use Google to look for a picture.

South Carolina Computer Science and Digital Literacy Standards 2017

Digital Literacy Key Concept: Algorithms and Programming

Digital Literacy Content Standard: 5.AP.4 Develop a program to express an idea or address a problem.

Digital Literacy Indicator: 5.AP.4.1: The student will use a visual language to design and test a program that solves a simple task (e.g., online coding activity)

Digital Literacy Process Standard: Create, test, and refine computational artifacts.

This activity produced in partnership with:

North Carolina School of Science and Mathematics

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South Carolina STEM Education Month

DUKE ENERGY SCIENCE NIGHT

Gas-Powered Rockets

Big idea

Explore how carbon dioxide gas lets you blast a canister into the air like a rocket.

You will need

WHAT WE GAVE YOU:

- plastic canisters with snap-caps
- effervescent antacid tablets
- pie tins
- Gas-Powered Rockets instruction sheet

STUFF YOU PROVIDE:

- water
- paper towels
- a large area to serve as the launch zone*

*Safety notes

This experiment requires adult supervision and an area with a lot of space and high ceilings.

It may be a good idea to mark the area as a launch zone.

Never direct the rocket at another person and make sure your face and body are at a distance from the rocket.

Set it up

Set the pie tins out to serve as launch pads. (These will also help catch some of the water released during lift off.) Each launch pad should be a few feet away from other launch pads. Lay out the instruction sheet, plastic canisters, caps, antacid tablets, and water. Break the antacid tablets into quarters. It's a good idea to practice launching a rocket or two before the event begins so you will become familiar with the process as well as the launch timing.

It's showtime!

As families approach, invite them to make a gas-powered rocket. Give students a plastic canister, cap, and a quarter of a tablet. Have them fill the canister about a third of the way with water. Instruct them to QUICKLY drop a quarter tablet into the canister, snap the cap onto it TIGHTLY, put the canister on the launch pad CAP SIDE DOWN, and step back a couple of feet from the launch pad. About 10 seconds later, they will hear a POP and the canister will launch into the air.

Alternatively, an adult could snap the cap on tightly and put the canister on the launch pad cap side down.

Note: If it does not launch, wait at least 30 seconds before having an adult examine the canister. Usually the cap was not on tight enough and the gas leaked out before building up enough pressure to pop off the cap.

If they love it...

Challenge them to use more or less water to see what impact it has on the launch. Consider having a flip chart/ marker in the area to capture the observations!

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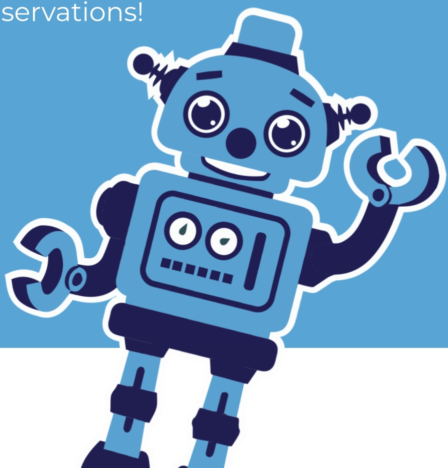

SCIENCE FOR ALL • CIENCIA PARA TODOS •

Gas-Powered Rockets

Why is this science?

When the antacid tablet is added to the water, it dissolves and reacts, releasing carbon dioxide gas. Gases like to expand to fill their containers, but the film canister containing the gas is too small. The gas keeps pushing and pushing until the pressure is finally released and launches the canister into the air. The carbon dioxide gas is then released into the atmosphere. This release of pressure provides THRUST to make our rocket soar upwards. Our legs provide thrust to send us into the air when we jump. The huge plumes of flame and smoke that we see during a real rocket launch provide thrust for rockets going into outer space. The thrust with our rockets only lasts for a moment, so earth's gravity quickly pulls them back down to Earth - while real rockets have enough thrust to keep travelling upwards until they leave earth's gravitational pull.

South Carolina College- and Career-Ready Science Standards 2021

Performance Expectation: 5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Science & Engineering Practice: Planning & Carrying Out Investigations – Planning and carrying out investigations to answer questions or test solutions to problems.

Disciplinary Core Idea: PS1.B: Chemical Reactions - When two or more different substances are mixed, a new substance with different properties may be formed.

Cross-Cutting Concept: Cause & Effect – Cause and effect relationships are routinely identified, tested, and used to explain change.

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DUKE ENERGY SCIENCE NIGHT

I Spy with my Microscope Eye

Big idea

Microscopes help us to see more than we can with our eyes alone.

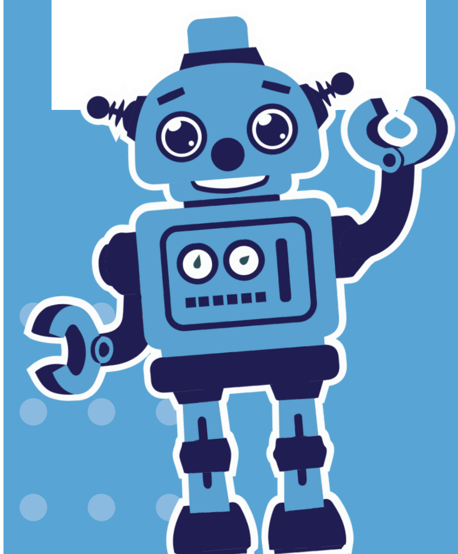
You will need

WHAT WE GAVE YOU:

- Digital Microscope
- I Spy with my Microscope Eye instruction sheet

STUFF YOU PROVIDE:

- a computer with a USB type interface
- objects to view - For example: paper, fabric, a coin, dollar, leaf, flower, seashell, anything you find interesting!



Set it up

Plug the Digital Microscope into the USB port on the computer and open the Camera (PC) or Photo Booth (Mac) application. The scope can be used when held in your hand or clipped into the stand. If using the stand, it is a good idea to tape it to the table. The buttons on the scope will not work with most computers. You can use the application to take pictures of images, if desired.

Remove the plastic cap from the end of the plastic tip. Take care to ensure objects (including fingers) do not come into contact with the microscope lens. The clear plastic tip is designed to help protect it.

Place the objects to view and the I Spy with my Microscope Eye instruction sheet next to the microscope.

It is important to review the instruction sheet and practice using the microscope so that you feel comfortable assisting participants.

It's showtime!

As families come up, ask them if they have ever seen or used a microscope before. Ask them, "what does a microscope do?" Explain that a microscope is a tool that magnifies things - makes them look bigger - so we can see tiny details that are too small to notice with our naked eyes.

This microscope may look a little different than one they have seen before. This is a digital microscope that connects to a computer, so we look at the magnified image on the computer screen instead of through an eyepiece.

Demonstrate how to use the scope, then let participants try it themselves. In addition to the gathered objects, encourage them to look at their skin, fingerprint, fingernail, hair, and clothing.

Fun options

Print photos of magnified objects to have on the table. Participants can look at them and guess what each object is while they are waiting to use the microscope.

Continued ›

SCIENCE FOR ALL • CIENCIA PARA TODOS •

DUKE ENERGY SCIENCE NIGHT

I Spy with my Microscope Eye

Why is this science?

A microscope allows you to look more closely at a specimen and see more than you could with your eyes alone. This microscope works by shining light onto an object. The light is reflected off the surface of the object and captured by the camera lens inside the scope to produce an enlarged digital image. The magnification level is determined by the distance of the object and the focus point set by the big silver focus wheel. This microscope can enlarge the image of a grain of salt (which is only approximately 0.3 millimeters) between 40 to 1000 times it's size, allowing you to see it much better!

With this microscope you are able to zoom in on the outside of objects. Stronger microscopes can magnify even more and be used to get an inside, closer look - making it possible to view cells and even atoms! There are multiple kinds of microscopes that can be used for all sorts of things!

Microscopes help many types of scientists. For example: doctors use microscopes to see bacteria, viruses, and other germs so they can figure out what is making their patient sick; forensic scientists use microscopes to get a closer look at evidence from a crime scene; and engineers use microscopes to help them build the tiny microchips that go inside computers.

South Carolina College- and Career-Ready Science Standards 2021

Performance Expectation: 2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

Science & Engineering Practice: Planning and Carrying Out Investigations – Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.

Disciplinary Core Idea: PS1.A: Structure and Properties of Matter - Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.

Cross-Cutting Concept: Patterns

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DUKE ENERGY SCIENCE NIGHT

Magnetic Racers

Big idea

Magnetic currents can be used to pull things together or push them apart.

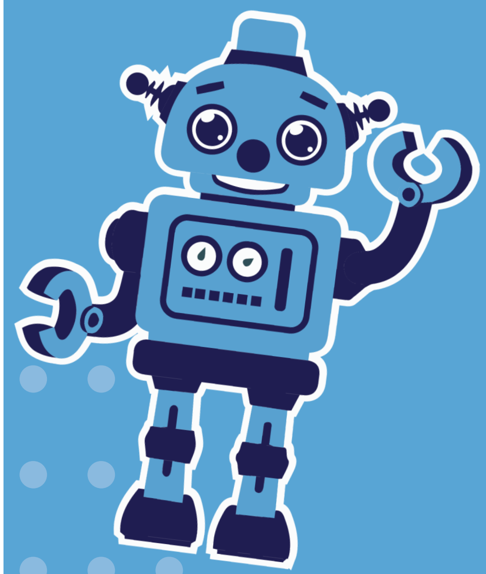
You will need

WHAT WE GAVE YOU:

- 12 bar magnets
- 6 toy cars
- masking tape
- Magnetic Racers challenges

STUFF YOU PROVIDE:

- an open, flat surface
- additional magnets (optional)



Set it up

Tape 6 of the bar magnets to the top of your toy cars. Make sure the wheels can still move freely.

Set up the masking tape racetrack. Start with 2 or 3 equal parallel lines about 2.5 feet long as a racetrack and a separate track with turns and curves that students can add to throughout the night.

A hard surface works best for this, such as a wood or linoleum floor. Carpet will present more resistance making the cars more difficult to drive.

It’s showtime!

As families approach your station, ask if they’ve ever used a magnet to stick some art or a note to their refrigerator or the classroom whiteboard. They know the feeling when a magnet and a magnetic material come close to each other and join together with a sudden SNAP. Explain this is because magnets have 2 differently charged poles, a negative pole and a positive pole. Opposite poles attract one another, while the same poles will repel one another. Let them use the additional magnets to experiment with what happens when they bring like and unlike poles together.

Now they’re going to use this knowledge to make something move! Show them your magnet racecars and have them experiment with what happens when they bring a magnet near the car. Refer students to the activity card for challenges. Once they’ve finished a few races, encourage them to add to the collaborative masking tape track. Make sure they test out the track as they go.

Fun options

AHEAD OF TIME

Collect an assortment of different shapes, styles, and strengths of magnets for students to use on the night. Each magnet will interact with the magnetic racers slightly differently, giving students different results. You can challenge students to determine which magnet is the strongest by testing how far they’re able to roll the car from just one “push” with the magnet.

Continued ›

SCIENCE FOR ALL • CIENCIA PARA TODOS •

DUKE ENERGY SCIENCE NIGHT

Magnetic Racers

Why is this science?

Magnets! How do they work? Magnets have two ends called poles; one is called the north pole and the other the south pole. Opposite poles attract while similar poles repel. If you have 2 magnets and slowly move their north and south poles towards each other you'll start to feel a force pulling them towards each other. Poles that are the same repel each other; when you move two North or South poles towards each other you'll feel them pushing back!

You're probably familiar with the names North and South pole as they relate to the Earth, and that's because the Earth has it's own magnetic field. The Earth is full of magnetic materials, such as molten iron, which makes the Earth a giant magnet. Due to the movement of this molten core the North and South pole can move as much as 10 miles a year.

South Carolina College- and Career-Ready Science Standards 2021

The forces we can't see are fun to explore. Grab a magnet, let's race!

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

Science & Engineering Practice: Asking Questions & Defining Problems – Ask questions that can be investigated based on patterns such as cause and effect relationships.

Disciplinary Core Idea: PS2.B: Types of Interactions - Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other

Cross-Cutting Concept: Cause and Effect – Cause and effect relationships are routinely identified, tested and used to explain change.

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South Carolina STEM Education Month

DUKE ENERGY SCIENCE NIGHT

Marshmallow Towers

Big idea

Explore an engineering concept by using simple building materials to investigate which shapes are the strongest.

You will need

WHAT WE GAVE YOU:

- mini marshmallows
- toothpicks
- Marshmallow Towers instruction sheet

Fun options

AHEAD OF TIME

Provide a stuffed toy as a weight to test the stability of the structure.

You can also provide small gumdrops (like Dots) or colored toothpicks to make the towers more colorful.

Set it up

Set out the mini marshmallows and toothpicks on your table along with the Marshmallow Towers instruction sheet. Leave the optional stuffed toy in a safe place until some structures have been built.

It's showtime!

Encourage families to build structures using marshmallows to connect toothpicks. Once they have built on their own for a while, you can point out the shape diagrams and suggest that they build triangles and squares and see where that takes them. Suggest that families add on to a communal effort to build a really giant tower. Challenge families to see if they can build something that supports the weight of a stuffed toy.

If they love It...

Encourage families to check out the challenges and try to build:

- the tallest tower
- the tower with the narrowest base
- a bridge
- a structure that adds onto someone else's building
- a building with a hole big enough for your arm to fit through

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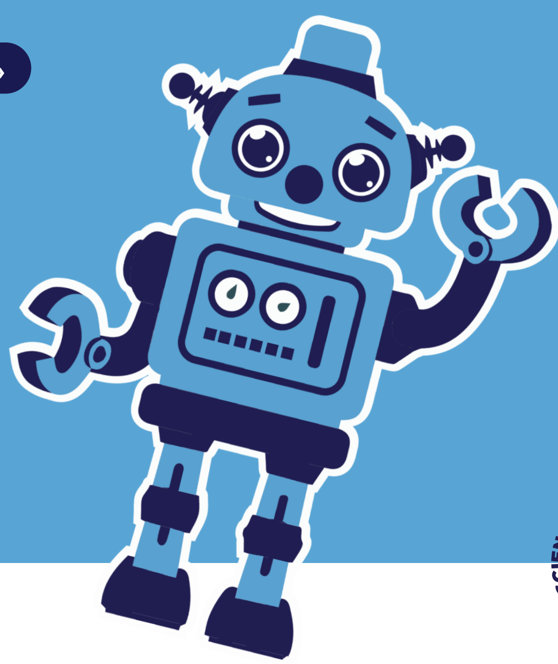

SCIENCE FOR ALL • CIENCIA PARA TODOS •

Marshmallow Towers

Why is this science?

This is **engineering**! Comparing the stability and weight-bearing ability of different shapes is what engineers do. A triangle is the most stable shape that can be made with straight lines, because when pressure is added to one point, the corners (or vertices) stay at the same angle and the triangle doesn't change shape. In contrast, pressure added to one corner (vertex) of a square will squish the square, changing its shape. This means that squares aren't as good for building strong supports. It is easy to see triangles in structures such as power-line pylons, radio towers and some bridges.

South Carolina College- and Career-Ready Science Standards 2021

Disciplinary Core Idea: Engineering, Technology, and Applications of Science - ETS1: Engineering Design – students engage directly in the engineering design process.

Engineering Design Process:

- Define (Empathize – define the problem, Research- understand the problem)
- Develop (Brainstorm – design solutions, Build – create a prototype)
- Optimize (Test – evaluate solutions, Gather Data – refine the solution)

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DUKE ENERGY SCIENCE NIGHT

Paper Circuit Robot

Big idea

Learn how to use aluminum foil to complete a circuit that transfers energy from a battery to an LED, lighting up our robot's antenna in the process!

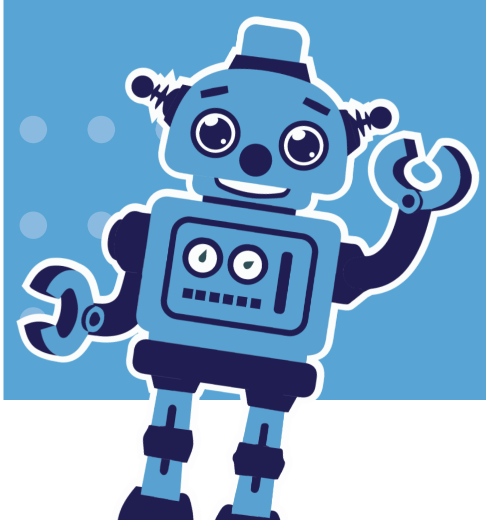
You will need

WHAT WE GAVE YOU:

- paper circuit robot templates (4 per sheet)
- aluminum foil sheets
- LED lightbulbs
- CR2032 Lithium button batteries
- clear tape
- Paper Circuit Robot instruction sheet

STUFF YOU PROVIDE:

- pencils
- additional batteries (optional)



Set it up

Cut the template sheets in quarters. Cut the aluminum foil into strips that are approx. ½-in wide and 5-in long. You may also want to prepare 1-in long pieces of tape. Lay out all materials on the table(s). You could create multiple building stations or try an assembly line. Using the instruction sheet, make your own paper circuit robot to use as an example and to be sure you understand the instructions as well as anticipate any issues children may face.

It's showtime!

Show families how your paper circuit robot works by touching the horizontal aluminum foil strip onto the positive (+) side of the circuit and on the top (+) side of the battery. This creates a closed circuit which allows the electricity to flow and the LED light bulb to convert electrical energy into light energy. Lifting the foil out of contact with the battery will break (or open) the circuit so the LED is no longer lit.

Help families create their own paper circuit according to the instruction sheet and invite them to borrow one of the batteries to test it when they are ready.

Younger children will likely need help with this activity. Be sure that the LED leads, foil strips, and battery are oriented exactly as shown in the instructions. It is important that the short lead is in contact with the negative (-) side of the battery and the long lead is in contact with the positive (+) side of the battery. There can be no breaks in the connections along the circuit for the transfer of electrical energy to work properly. Be sure that the foil is wrapped tightly around the leads. Aluminum foil is a conductor of electricity, but tape is an insulator and will stop the energy flow if it is accidently placed on the circuit.

Continued ›

SCIENCE FOR ALL • CIENCIA PARA TODOS •

DUKE ENERGY SCIENCE NIGHT

Paper Circuit Robot

Why is this science?

In this activity, you used a battery, aluminum foil, and a LED light bulb to complete a circuit that transfers electrical energy into light energy. The battery is the source of the energy. A conductor is a material that allows electricity to flow through it. Aluminum foil is a good conductor and allows the electrical current to flow through it from the positive to the negative side of the battery. Light bulbs convert electrical energy into light energy. The robot's antenna lit up when you created a closed circuit - a complete path for electricity to flow.

The word "circuit" comes from the word "circle." Electricity needs to have a closed circuit to work. If there is a gap, the circuit is open, and the electricity can't flow. When you lift the aluminum foil from the battery you open the circuit, and the LED is not lit up. Some materials are insulators which do not allow energy to flow through it. Tape is an insulator. If the tape is not properly placed in our circuit the flow of electricity will stop, preventing the LED from lighting up.

South Carolina College- and Career-Ready Science Standards 2021

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

Science & Engineering Practice: Constructing Explanations and Designing Solutions – Apply scientific ideas to solve design problems.

Disciplinary Core Idea: PS3.B: Conservation of Energy and Energy Transfer - Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light.

Cross-Cutting Concept: Energy and Matter – Energy can be transformed in various ways and between objects.

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DUKE ENERGY SCIENCE NIGHT

Reading Trees

Big idea

Gather around and read the story of a tree! Count the annual rings to see how old it is, learn about changes in the environment where it was growing and when it had slow growing year, or a giant growth spurt – just like people!

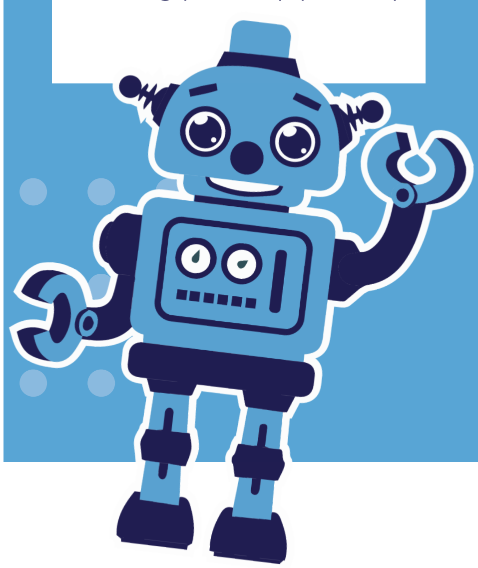
You will need

WHAT WE GAVE YOU:

- Tree Ring poster
- tree rounds
- hand lenses
- paper plates
- markers
- Reading Trees instruction sheet

STUFF YOU PROVIDE:

- easel to display Tree Ring poster (optional)



Set it up

Lay out the tree rounds and hand lenses on the table - spaced out to allow multiple participants to join. Place the Tree Ring poster either in the middle of the table, or on an easel so everyone can see it. Place the markers and plates on the table so they are available for participants to use after they investigate the tree rounds.

Make an example Tree Round of your own timeline, showing how many annual rings you would have, any major events like a moving to a new house or city, any broken bones, new siblings, etc.

It's showtime!

Reading Tree Rounds: These cross sections of trees allow you to tell the age of the tree. Each ring has two parts: the lighter (and often wider) part is the spring growth, and the darker (usually much thinner) part is later summer/fall growth. To count the rings, only count the light **or** only count the dark part but not both. Use the Tree Ring poster as a guide so the group can all see. There are also different marks on tree cookies that can explain events in tree's life such as scars from a fire or narrow growth rings from insect infestations or drought.

Ask participants to examine the different tree rounds at the table and discuss their observations – age, events, how much it has or has not grown, etc.

Next, invite them to make a tree round of their own life. Instructions are included for students to enable them to make their timeline unique to their own experiences.

Encourage participants to compare their annual rings to others (adults and children). Even though all the plates are the same size, they will all have different numbers of rings. Trees are similar in that they may be the same size but different ages, or different sizes and the same age! This is because some tree species grow faster than others, and some trees grow at a different rate depending upon where they grow (on a mountain top, in a valley, etc.).

Continued ›

SCIENCE FOR ALL • CIENCIA PARA TODOS •

DUKE ENERGY SCIENCE NIGHT

Reading Trees

If they love it

Recommend the book "In a Nutshell" by Joseph Anthony. This story follows an acorn that falls from an oak, sprouts and grows, and sees many changes in the forest during its lifetime.

Encourage families to check out the ecoEXPLORE incentive program*. Spring is Botany Season and participants are encouraged to take photos of plants and trees in order to earn prizes.

*www.ecoexplore.net

Why is this science?

Scientists use very old trees to learn about past climates using a science called **dendrochronology** – the study of tree time. To look at a tree's annual rings without cutting it down or harming it, foresters and forest scientists use a tool called an **increment borer**. This makes a long narrow cylinder of wood called a core sample, and the rings appear as lines. Dendrochronology is used not just by climate scientists and tree scientists (dendrologists), but by archeologists to date materials and artifacts made of wood and by chemists to calibrate radiocarbon dates, i.e. carbon dating!

Check out this link for more information:

www.environmentalscience.org/dendrochronology-tree-rings-tell-us

South Carolina College- and Career-Ready Science Standards 2021

You've read books, now prepare for reading trees!

Performance Expectation: K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.

Science & Engineering Practice: Analyzing & Interpreting Data – User observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.

Disciplinary Core Idea: LS1.C: Organization for Matter and Energy Flow in Organisms – All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow.

Cross-Cutting Concept: Patterns – Patterns in the natural and human designed world can be observed and used as evidence.

This activity produced in partnership with: The North Carolina Arboretum

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