N C SCIFEST
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DUKE ENERGY SCIENCE NIGHT

Build-a-Bubble

Big idea

Explore the properties of soapy water and geometry by blowing bubbles!

You will need

WHAT WE GAVE YOU:

- Dawn dish soap
- plastic bin
- pipe cleaners
- straws
- string
- Bubble Challenges instruction sheet

STUFF YOU PROVIDE:

- water
- large mixing container
- paper towels
- scissors
- optional: additional supplies for creating bubble wands (hangers, plastic soda rings, funnels, etc.)

Set it up

Mix Dawn dish soap and water together in a large container, like a bucket or mixing bowl, to create a bubble solution. There's no magic formula; a lot depends on humidity and temperature. If the water in your area is very hard, you may have better results with purchasing distilled water. A basic ratio to start with is 1 part Dawn to 4 parts water. Measure the water first and then slowly stir soap into the water.

Pour some bubble solution into the plastic bin (about ½ full) and save the rest in your mixing container – you'll probably need to top it off throughout the event. Set out pipe cleaners, straws, string, scissors and Bubble Challenge instruction sheet. It's a good idea to have paper towels on hand for this activity.

It's showtime!

Show students that they can blow bubbles with their hands as long as their hands are wet. They simply need to dip one or both of their hands into the bubble solution, then form a circle with their fingers and blow through it. Then, give them a pipe cleaner and ask them to construct a bubble wand. Show them the challenge sheet and see what kind of bubbles they can create. You can also encourage them to use the straws to blow bubbles within bubbles.

The string can be used to make wands that will create larger bubbles. Start with two straws. Cut a piece of string (about 3 feet long) and thread it through both straws. Then, tie the ends of the string together. Dip everything into the bubble solution. Using the straws as handles, pull the two straws apart from each other, forming a rectangle frame. Carefully pull the frame out of the bubble solution and gently wave it through the air. As you pull it through the air slowly flip the frame up or down to release the bubble. This will take a little practice.

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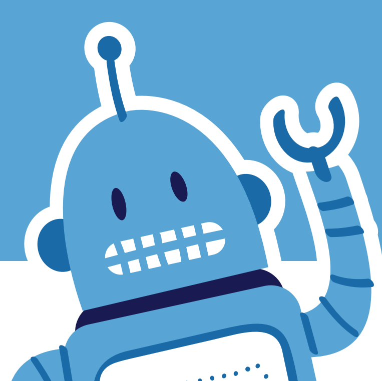

SCIENCE FOR ALL • CIENCIA PARA TODOS •

DUKE ENERGY SCIENCE NIGHT

Build-a-Bubble

Why is this science?

From physics to geometry, color to chemistry, bubbles are full of science! Bubbles are made of a very thin film of soap and water with a gas inside. The bubbles we're blowing are full of air, but they can be made with any kind of gas. You can picture a bubble like a balloon – it's a thin, stretchy skin surrounding a pocket of gas.

A single bubble that's not touching any other bubbles will always be round, because a sphere (or ball shape) contains the most gas (air) using the least amount of surface area (soap film). But once a bubble touches other bubbles, it changes shape, because they form a common wall where they touch. Bubbles touching each other create angles of 120 degrees, no matter how big the bubbles are or how many there are. Think about a beehive: the beeswax is arranged in hexagons, with angles of 120 degrees. Just like the beehive, bubbles arrange themselves in a hexagonal pattern that conserves surface area.

North Carolina connection

A man from North Carolina has made a career out of blowing bubbles. Steve Langley from Huntersville, NC, is a professional juggler and variety entertainer with the Soap Bubble Circus. He has performed in China, at Disney World, and even at the White House. In addition to performing shows, he also is known around the world for breaking records. In June 2015, he broke the Guinness World Record for the longest chain of hanging soap bubbles by creating a strand of 35 bubbles at Discovery Place Kids in Huntersville. The previous record was 30 bubbles.

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DUKE ENERGY SCIENCE NIGHT

Galilean Cannon

Big idea

Use the law of conservation of energy to make your own "Galilean Cannon."

You will need

WHAT WE GAVE YOU:

- seismic accelerator (Astro Blaster)
- 3 bouncy balls
- safety glasses
- Galilean Cannon instructions

STUFF YOU PROVIDE:

- a large area to serve as the launch zone*
- basketball and tennis ball (see fun options)

*Safety notes

This experiment requires adult supervision and an area with a lot of space and high (or no) ceilings.

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

The top ball can shoot off at high speeds; wear the safety glasses when using the seismic accelerator and perform the demonstration away from students.

Set it up

Mark off an area with plenty of open space - preferably with high ceilings or outdoors. Lay out the instruction sheet. It’s a good idea to practice a time or two before the event begins so you will become familiar with the process.

It’s showtime!

As families approach, ask them what happens when they drop a bouncy ball. They'll probably say it falls down, hits the ground, and bounces back into the air. You can demonstrate with one of the bouncy balls. Ask the students to observe that the ball bounces a little bit lower every time. Have them make predictions about what will happen when we try dropping the bouncy ball on top of a stack of other larger balls. Add the bouncy ball to the top of the seismic accelerator, then drop the entire contraption. Stand back - the top ball will shoot higher into the air!

Fun options

Before using the accelerator and the bouncy ball, demonstrate using a tennis ball to discuss the "law of conservation of energy" discussed on the back. You can then drop the tennis ball on top of a basketball to discuss the "elastic collision" and the Galilean Cannon.

If they love it...

Set up a mechanism to measure the height of the bounces.

Try this with different types and sizes of balls to see which Galilean Cannon bounces the top ball the highest.

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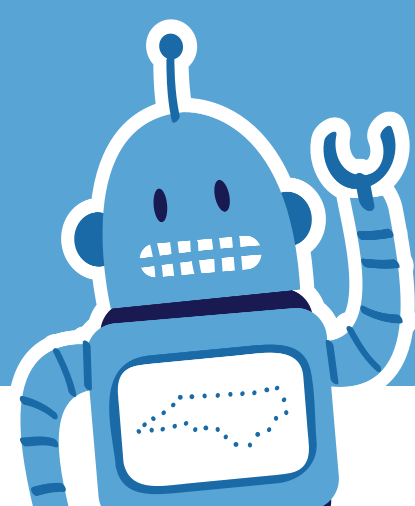

SCIENCE FOR ALL • CIENCIA PARA TODOS •

DUKE ENERGY SCIENCE NIGHT

Galilean Cannon

Why is this science?

In this experiment, we are using something called the law of conservation of energy, which states that energy cannot ever be created or destroyed, but it can be transformed. When we lift up a ball, we are giving it potential energy - the force of gravity will pull it back towards Earth, so we call this "gravitational potential energy." As the ball falls downwards, the potential energy changes into kinetic (or moving) energy. When the ball hits the ground and bounces back up, that kinetic energy changes back into potential energy. The ball bounces a little bit lower every time because some of the energy is lost to friction, sound, and heat as the ball changes shape when it hits the ground.

When we placed the bouncy ball on top of a stack of balls, we created a Galilean Cannon! When the largest ball hits the ground, it starts bouncing up into the air, but there's a smaller ball in the way. This creates something called an "elastic collision" and energy from the bottom ball is transferred to the next ball. When you stack more than two balls, you can transfer even more energy. This means that the top ball bounces upwards with its own energy plus extra energy from all the balls below it - allowing it to bounce way higher than it normally would!

North Carolina connection

The NC Science Festival team worked with members of the Department of Physics and Astronomy at the University of North Carolina at Chapel Hill to set the world record for the highest launch from a Galilean Cannon. We used a similar stack of 4 rubber balls (called a "Seismic Accelerator") to transfer all the energy into the smallest ball and designed a special device to help us maximize the results by ensuring the stack dropped perpendicular to the ground so the ball would launch straight up into the air.

When we did this experiment, we were able to launch the ball over 13 meters – or 42 feet!

Do you think you can break that record? Try experimenting with your Galilean cannon and use #NCSciFest to share your results with us on social media!

Learn more about the Guinness World Record:

www.guinnessworldrecords.com/world-records/428375-highest-launch-from-a-galilean-cannon

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DUKE ENERGY SCIENCE NIGHT

Invisible Ink

Big idea

Write a secret message while experimenting with acids and bases.

You will need

WHAT WE GAVE YOU:

- goldenrod paper
- vinegar
- baking soda
- cotton swabs
- plastic cups
- Invisible Ink instructions

STUFF YOU PROVIDE:

- scissors
- water
- 3 trays
- tablespoon
- paper towels
- garbage bag

If they love it...

Families may also use the base (baking soda solution) to "draw," and then use the acid (vinegar) to "erase."

Set it up

Cut the sheets of goldenrod paper in halves or quarters. Place 3 cups on each tray. Fill one cup per tray halfway with water. Fill the second halfway with vinegar. Fill the third halfway with water, then add 8 tablespoons of baking soda; stir to dissolve. Place cotton swabs on the tray and set instruction sheet on the table.

It's showtime!

As families approach your table, give them each a sheet of goldenrod paper and direct them to a tray. Encourage them to explore how each of the liquids reacts with the paper. They should use a different cotton swab for each liquid.

Explain that they are drawing with chemical reactions. Chemical reactions are the heart of chemistry. There are different kinds of evidence (things you can see or feel) of a chemical reaction. Typically there is a change in color, smell, temperature or production of a gas. In this case, there was a change in color.

Ask guests if they know any examples of chemicals called acids (i.e. vinegar, lemon juice) or bases (i.e. baking soda, ammonia). Explain that they are creating their own artwork by testing how acids and bases react with the paper (bases will cause the goldenrod paper to turn red; acids will cause it to remain yellow). Therefore, the paper is an indicator.

Fun options

DURING SCIENCE NIGHT

Create a reusable secret message. Mix some of the baking soda solution in a spray bottle. Make another spray bottle with vinegar. Use a yellow crayon to write a message on the goldenrod paper. Then, spray the paper with the baking soda solution, revealing the message. To conceal the message, spray the paper with vinegar. The wax from the crayon protects the surface of the paper so that the message can be used over and over again.

Continued ›

SCIENCE FOR ALL • CIENCIA PARA TODOS •

Invisible Ink

Why is this science?

This is **chemistry** in action! Chemists study the **properties** and structure of substances. By knowing the pH and other properties of these substances, chemists can understand **reactions** and even make new substances. The **pH scale** goes between 0-14. The middle of the range, 7, is neutral. **Bases**, like the baking soda, have a pH above 7; the higher the number, the stronger the base. **Acids** are substances with a pH below 7; the lower the number, the stronger the acid.

Why does this work with the goldenrod paper? It contains a pigment that changes color when it comes into contact with bases. The baking soda solution is a base and causes the paper to change from gold to red. This chemical reaction can be reversed if an acid such as vinegar is added. No color change occurred when water was added because the water was closer to neutral, not acidic or basic.

North Carolina connection

In 1585, Sir Walter Raleigh sent a group of pioneers under the command of John White, to establish a foothold in the New World. These pioneers landed on Roanoke Island and established the Roanoke Colony, the first English Colony in the New World. Sometime between 1587 and 1590, the entire colony vanished. There was no sign of a struggle or battle, and what happened to the settlement and its inhabitants has never been discovered.

Stories about the "Lost Colony" have circulated for more than 400 years. In the 21st century, as archaeologists, historians and scientists continue to work to resolve the mystery a clue may have emerged...in the form of invisible ink!

The discovery came from a watercolor map in the British Museum's permanent collection that was drawn by John White. The map was incredibly detailed and accurate, but contained two small patches of paper affixed to the surface of the map. For centuries it was thought that these patches were just corrections to the map. In May 2012, the British Museum revealed that they had discovered a symbol of a fort beneath one of the patches of paper believed to be written in invisible ink. This discovery has led researchers to question if the Roanoke Colony settlers went, or intended to go, to that location. Though the map doesn't provide definite answers about what happened to the Lost Colony, it does give researchers a new place to look for clues.

For more information about the First Colony, check out: **http://www.firstcolonyfoundation.org**

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DUKE ENERGY SCIENCE NIGHT

Light it Up

Big Idea

Explore how to complete an electrical circuit by trying to transfer energy through different materials.

You Will Need

WHAT WE GAVE YOU:

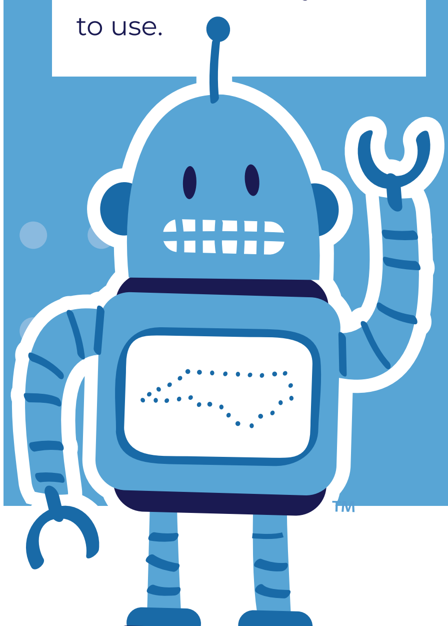
- 4 energy balls
- Light It Up instruction sheet

STUFF YOU PROVIDE:

- assorted metallic objects
- assorted nonmetallic objects

Fun Options

Collect a broad assortment of objects to use.



Set it up

Ahead of time, collect metallic and nonmetallic objects from your school that might be fun for students to test. Rubber erasers, play-doh, index cards, plastic items, wood items, paperclips, scissors, coins, aluminum foil, and old keys are a few possibilities. On the night of the event, set out the energy balls, assorted metallic and nonmetallic objects, and Light It Up instruction sheet on a table.

It's showtime!

Give students an energy ball and ask them what they think it is. Ask them if they notice anything different between the energy ball and a ping pong ball. Let them know that the two pieces of metal are connected to a battery, a light, and a noise maker... but because there is a gap between the metal the electrical circuit is not complete. When students complete the circuit, they will hear the noise and see the light. Have them try their fingers to see that they conduct electricity!

Have the students test metallic and nonmetallic items to see which items conduct electricity and complete the circuit to light up the ball. The items will need to touch both metal strips when testing. Alternatively, they will need to have their finger on one metal strip and the object on the other metal strip.

If they love it...

Since touching the metal will complete the circuit, ask them to create a large human circuit. They should hold hands with friends and family to make a circle. Place the ball between two people in the circle and ask each person to touch one of the metal strips. Several people in the circle can try letting go of each other and then hold hands again.

Continued ›

SCIENCE FOR ALL • CIENCIA PARA TODOS •

DUKE ENERGY SCIENCE NIGHT

Light it Up

Why is this science?

The energy ball lights up when you create a **closed circuit**. A closed circuit is a complete path for electricity to flow. The word circuit actually comes from the word circle. The energy ball worked when students held metallic objects on the energy ball. A **conductor** is a material that allows energy to flow through it. Metals are good conductors. Items like paper, plastic and wood are **insulators**, which are materials that do not allow energy to flow through them. People are good conductors, too. When the people in the circle stopped holding hands, it became an open circuit and the path for electricity was no longer complete.

North Carolina connection

Did you know that LED technology like the light inside this energy ball is being manufactured in Durham, North Carolina? Cree, Inc. was formed in 1987 by researchers from NC State University and is located in Research Triangle Park. Their bulbs are being used across the world. During the 2008 Beijing Olympic Games, Cree provided over 440,000 LED lights for the famous National Aquatics Center, more commonly known as the Water Cube.

In 2010, there were 3.6 million households in the state of North Carolina. If each of these households were to replace one incandescent bulb with an energy-saving LED, the results would be amazing: assuming all of these bulbs were on for 4 hours a day, every day for a year, the energy saved is the amount needed to power 16,000 homes for a year! The average household has 45 light sockets. If every household replaced all their bulbs with energy-saving LED, the state could save 7% of its energy consumption. In North Carolina, much of our energy is generated from coal plants so cutting back on power production would also reduce carbon emissions and pollution.

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DUKE ENERGY SCIENCE NIGHT

Magnetic Painting

Big idea

Explore how magnetic fields can be used to pull things together… and to make art!

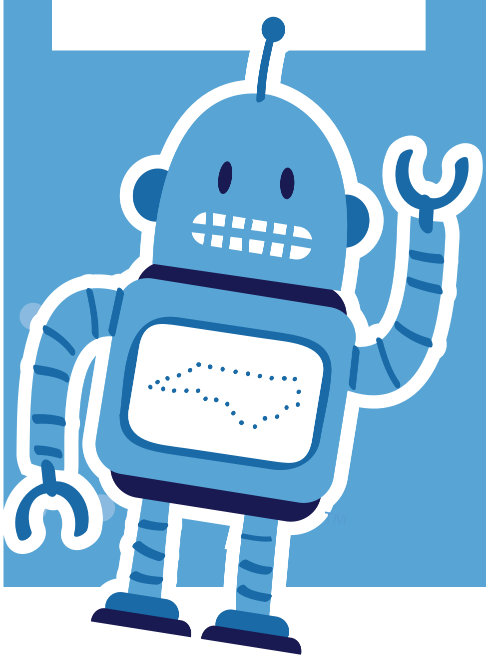
You will need

WHAT WE GAVE YOU:

- paper plates
- washable paint
- 4 magnetic wands
- Magnetic Painting instruction sheet

STUFF YOU PROVIDE:

- assorted metal objects
- additional paint colors (optional)
- paper towels/ wipes
- pens or markers



Set it up

Ahead of time, collect metal objects from your school. On the night of the event, set out the supplies in the following order: paper plates, paint, metallic objects, magnetic wands, and Magnetic Painting instruction sheet. At the end of the table you may wish to have pens or markers so that the students can write their name on the back of their plate and leave it to dry.

It's showtime

As families approach your station, ask if they've ever used a magnet to attach art or a note to their refrigerator or the classroom whiteboard. Everyone likely knows the feeling when a magnet and a magnetic material come close to each other and join together with a sudden 'snap'. This is because magnets create an invisible magnetic field around them. Metal objects that contain the elements iron, nickel, or cobalt are attracted to this magnetic field.

Now they're going to use this knowledge to create art! Give each student one paper plate. Place two to four dime-sized drops of paint on their plate (note: any more and the plate will get soggy and floppy.) Let the student pick a few of the metal objects to place on their plate. The student should hold the plate with one hand and hold the magnetic wand under the plate with the other hand. As they slowly move the wand around, they will drag the metal objects through the paint and create their own masterpiece! If younger students have difficulty holding the plate and wand at the same time, ask a parent or friend to hold the plate while the student holds the magnetic wand.

Continued ›

SCIENCE FOR ALL • CIENCIA PARA TODOS •

Magnetic Painting

Fun options

Collect an assortment of metal objects that will interact with the magnets. Students can create more variety in their artwork with items like springs and ball chains.

If they love it

Use a variety of magnetic objects in different shapes and sizes. Have students make observations about the strength of the magnetic force as well as the paint patterns created by each object.

Why is this science?

All magnets have the ability to attract other magnets or magnetic objects, such as paper clips. But a magnet doesn't necessarily have to touch a magnetic object for the object to be attracted to it. (That is why the paper plate can be between the magnet and the objects.) The invisible area around a magnet is called a magnetic field. Magnetic objects will pull towards the magnet if they are placed in this field.

Magnets attract only certain types of metals (such as iron, nickel, and cobalt.) Most metals are actually not attracted to magnets. These include copper, silver, gold, magnesium, platinum, aluminum, and more. Other materials such as glass, plastic, and wood are also not attracted to magnets.

North Carolina connection

The effects of magnetic currents on moving vehicles can be experienced firsthand at Carowinds in Charlotte, NC. Magnetic brakes are used on the Drop Tower, Intimidator Rollercoaster, and the Fury 325 Rollercoaster. Magnetic brakes are an effective way to slow down large amusement park rides and are commonly used in modern thrill ride designs. Magnetic brakes slow the movement of a ride by using magnetic eddy currents. These powerful magnetic currents safely reduce the speed before friction brakes are applied to bring the ride to a complete stop.

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DUKE ENERGY SCIENCE NIGHT

Paper Flying Machines

Big idea

It doesn't have to look like an airplane in order to fly! Build different flying machines to experiment with the 4 forces of flight.

You will need

WHAT WE GAVE YOU:

- straws
- index cards
- masking tape
- transparent tape
- Flying Machine instructions

STUFF YOU PROVIDE:

- paper
- scissors
- tape measure or yard stick
- optional: stopwatches

Set it up

Lay out Flying Machine instructions, paper, straws, index cards, tape and scissors on table. Use masking tape to define a runway on the ground and use the tape measure or yard stick to mark distances.

It's showtime!

Encourage families to have fun making and flying their paper flying machines. Instructions are included for Straw Gliders and Whirligigs. They can use the instructions or create their own designs.

They can test how far the Straw Gliders fly using the runway, and see how accurately they can aim the gliders.

Whirligigs spin rather than fly, but families can use the stopwatches (or their own smart phones) to see how long they stay in the air.

If they love it...

Challenge families to adapt the designs – what's the biggest Straw Glider they can make that still works? What happens if they add more loops to the Straw Glider? What's the craziest Whirligig design that will spin? Try moving the location of the notches on the Whirligig, or cutting the ends of the strip into points.a building with a hole big enough for your arm to fit through.

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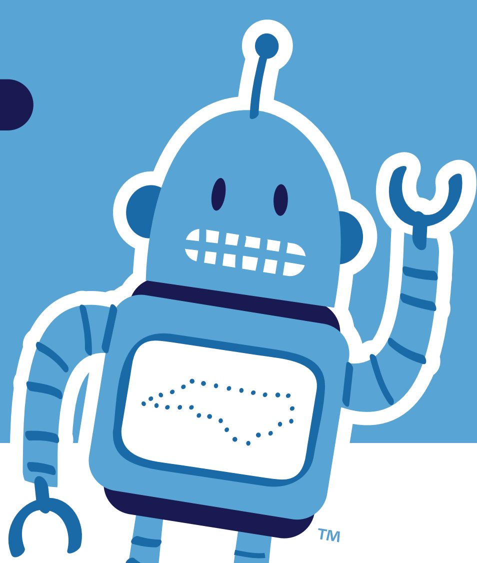

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Paper Flying Machines

Fun options

AHEAD OF TIME

Provide markers and other art supplies for children to use to decorate their Flying Machines.

DURING SCIENCE NIGHT

Challenge them to invent their own flying machine design and teach it to someone else.

Why is this science?

In order to fly, a flying machine has to overcome the force of gravity. The earth's gravity pulls things down, so these flying machines have to take advantage of other forces that temporarily override gravity's pull. Lift is a force created by air flowing over the curved surfaces of the Straw Glider's paper loops, and thrust is the force given to the glider when you throw it. Both lift and thrust help keep the flying machine in the air. Drag is the resistance met when the machine moves through the air; it slows forward motion, which reduces lift. So if lift and thrust are stronger than drag and gravity, the machine will fly.

North Carolina Connection

North Carolina is the "First in Flight" state because the Wright brothers flew the first sustained, powered, heavier-than-air human flight in Kill Devil Hills in 1903. The Wright brothers' achievement began aviation as we know it today. People have always been fascinated with the idea of flying. While flying machines like these Straw Gliders and Whirligigs wouldn't work for carrying people, they help demonstrate that there are a huge variety of shapes that will fly.

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DUKE ENERGY SCIENCE NIGHT

Pinwheel Power

Big idea

Learn how to harness wind energy by making a pinwheel.

You will need

WHAT WE GAVE YOU:

- pinwheel templates
- pencils with erasers
- push pins
- Pinwheel Power instruction sheet

STUFF YOU PROVIDE:

- scissors
- electric fan (recommended)

Fun options

AHEAD OF TIME:

Provide markers and other art supplies for children to use to decorate their pinwheels.

DURING SCIENCE NIGHT:

If an electric fan is available, participants can hold their pinwheel in front of the fan and watch the pinwheel whirl!

Set it up

Place a Pinwheel Power instruction sheet on the table along with pinwheel templates, pencils, push pins, and scissors. Plug in the electric fan.

It's showtime!

As families approach, ask, "Do you want to make a machine that captures the energy of the wind?" Ask if they know what a pinwheel is. Explain that a pinwheel is a lot like a windmill or wind turbine, because it can change wind energy into mechanical energy. Mechanical energy makes the pinwheel spin!

Give each student a pinwheel template, a pencil, a push pin, and scissors. (If the student is very young, ask an adult family member to be in charge of the push pin.) The student will need to cut out one square template and then cut along the four dotted lines.

Have the student bring the four corners marked with an X to the center of the template. The tips of the corners should then overlap each other. Advise the student not to fold the paper—but instead make a loop, so it can catch air.

Guide the student or adult family member as they push the pin through the center of the pinwheel, being sure the pin also goes through the tips of the four corners to hold them in place.

The pencil will be the pinwheel's handle. Have the student or adult push the pin into the side of the pencil eraser.

Invite the student to hold out the pinwheel so the front of the pinwheel is at a right angle to their body. They will need some space so they can swing their arm from side to side, pushing the pinwheel through the air to make the blades spin.

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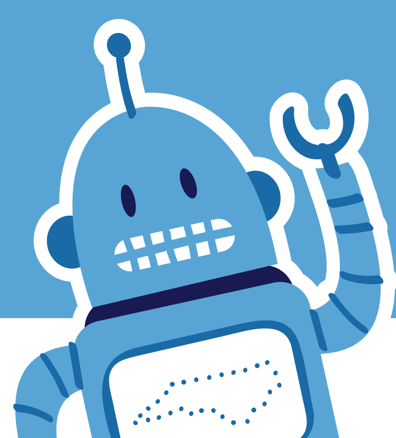

DUKE ENERGY SCIENCE NIGHT

Pinwheel Power

Why is this science?

Wind is a source of kinetic energy, the energy of motion. We see the effect of wind energy when a gust blows an umbrella inside out. We hear the effect of wind energy when leaves rustle on trees. We experience the effect of wind energy when we feel a cool breeze against our skin.

Your pinwheel is a machine that converts wind energy into mechanical energy, the ability to do work, and makes the blades turn. The same concept is used in windmills. For centuries, windmills have helped people around the world with tasks like pumping water and turning grain into flour.

Though wind turbines are more complicated than pinwheels, they also use rotating blades to capture wind energy. Wind turbines convert wind energy into mechanical energy—and then convert that mechanical energy into electrical energy. Electrical energy created from wind energy, a renewable resource, can be used in homes and communities. Wind energy supplied more than 8% of total U.S. electricity generation in 2020.

North Carolina connection

Pinwheels are a kind of whirligig. A whirligig is a toy or decoration that spins or whirls, usually because the wind blows on it or someone has set it spinning like a top. (Whirligig originally meant "spinning top.")

Some famous whirligigs were made by North Carolinian Vollis Simpson. After he retired from his job as a farm machinery repairman, Mr. Simpson used his engineering skills to make gigantic sculptures with wheels, propellors, and other moving parts that spin in the breeze. One sculpture, called "Mule Train," is 50 feet tall! Mr. Simpson recycled metal and other scrap materials into his artworks, which he called his "windmills." Sculptures that move are also called kinetic sculptures.

The community so loved the colorful sculptures spinning on Mr. Simpson's family farm that they built the Vollis Simpson Whirligig Park and Museum in Wilson, North Carolina. Since the park opened in 2017, people from around the globe have visited to enjoy Mr. Simpson's creations and learn from them.

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DUKE ENERGY SCIENCE NIGHT

Stomp Rockets

Big idea
Stomp Rockets let you blast rockets high into the air. And you can make your own rockets!

You will need
WHAT WE GAVE YOU:
- Stomp Rocket kit
- construction paper
- markers
- transparent tape
- masking tape
- Stomp Rocket instructions

STUFF YOU PROVIDE:
- scissors

Fun options
AHEAD OF TIME

Provide foam sheets as well as paper – the stiffness makes for great fins and nose cones, but the extra weight does affect the flight.

Set it up
Set up the Stomp Rocket launcher according to directions in the box. Use masking tape to draw two or three targets on the ground or on a wall, approximately 15-25 feet away. Each target should be about 5 feet away from other targets. The goal is to provide a couple of different challenges. Consider safety: aim all rockets away from people passing by. Lay out instructions, markers, construction paper, scissors and transparent tape on tables.

It's showtime!
Show families how the Stomp Rocket works: place the rocket on the launcher and stomp! Have them aim for the target or work on improving their distance. They can vary the angle of the launcher or how hard they stomp. The challenge increases when they aim for different targets.

Students can also make their own rockets. Tightly roll a piece of construction paper around a marker and tape the edge shut. This creates a paper tube that's the correct size for this launcher. Then use more paper and tape to add an air-tight nose cone to one end of the paper tube. Rockets need a nose cone so that the air from the launcher doesn't whoosh out the front. Fins aren't necessary, but are nice because they stabilize the rocket and make it fly better. Once the nose cone and fins are added, slide the paper rocket off the marker and practice launching the home-made rockets!

If they love It...
Challenge students to build a rocket that separates into two parts, like many rockets designed to go into space.

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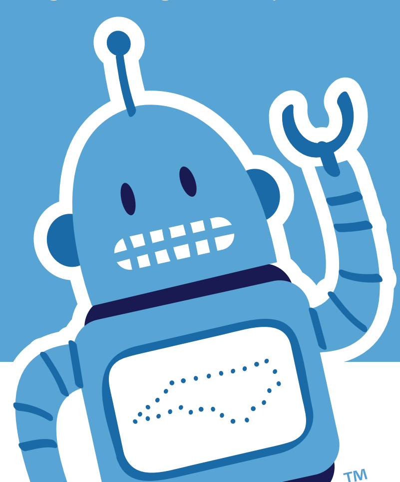

DUKE ENERGY SCIENCE NIGHT

Stomp Rockets

Why is this science?

This is aerospace engineering! For Stomp Rockets, the force of stomping on the rocket launcher provides a large push of air that launches it. For rockets that are launched into space or low-earth orbit, igniting massive amounts of fuel creates this pushing force. For both kinds of rockets, the pushing force has to be strong enough to overcome gravity in order to launch the rocket. Aiming the rockets is a challenge in real life just as it is for the Stomp Rockets, and aerospace engineers use both mathematics and physics to help them aim, guide and time the launches correctly.

North Carolina connection

Want to become an Aerospace Engineer? North Carolina has three schools that offer programs in aerospace engineering and general aeronautics: North Carolina State University, Elizabeth City State University, and Lenoir Community College.

North Carolina has a long and rich history in aerospace engineering that started with the Wright brothers experimenting in Kitty Hawk, NC and their first flight in 1903. NC is now an ideal location for aviation and aerospace companies with the largest military presence on the east coast and over 200 aerospace companies across the state.

UTC Aerospace Systems (UTAS) is headquartered in Charlotte, NC and is one of the world's largest suppliers of aerospace and defense products with approximately 150 sites operating in 25 countries. For more than 50 years, UTAS has provided critical life support technologies to help mankind explore the cosmos. From John Glenn's first orbit of the Earth, to Neil Armstrong's first steps on the moon, to the 200th spacewalk at the International Space Station, UTAS were involved to help make the missions possible and keep the crew safe. To inspire students to embrace science, technology, engineering and math (STEM) studies, UTC Aerospace Systems support programs that spark students' interest and inspire innovation, including the NC Science Festival!

NC SCIFEST

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NC SCIFEST
PRESENTED BY BIOGEN FOUNDATION

DUKE ENERGY SCIENCE NIGHT

Straw Flutes

Big idea
Explore how sounds are made by building a noisemaker.

You will need
WHAT WE GAVE YOU:
- straws
- masking tape
- Straw Flute instruction sheet

STUFF YOU PROVIDE:
- adult scissors

Fun Options
Have some empty bottles on hand for kids to try blowing across. Different sizes of bottles will make different sounds!

Set it up
Set out the straws, tape, scissors, and Straw Flute instruction sheet on your table. Make a straw flute ahead of time so that students know what the finished product will look like. (Note that when you follow the directions, you will actually make 2 straw flutes at a time. You have enough straws for 200 flutes, so you will need to have students work in pairs or keep the second flute to give to another student.)

It’s showtime!
Ask families if anyone has ever played a musical instrument. Let them know that today they will get the chance to make and play one. Have students (preferably with a partner) select 10 straws and line them up evenly. Wrap masking tape around the straws near each end. Using scissors, cut diagonally through all ten straws. You now have two straw flutes! Demonstrate how to make sounds by blowing across the tops of the straws, not directly into them.

If they love It...
Ask kids if they can play a recognizable song on their straw flute. It may hard for one person to do it, but see what happens if each person plays one of the notes on their straw flute. Kids can work together to play a simple song like “Twinkle, Twinkle, Little Star” if they each have one note to play.

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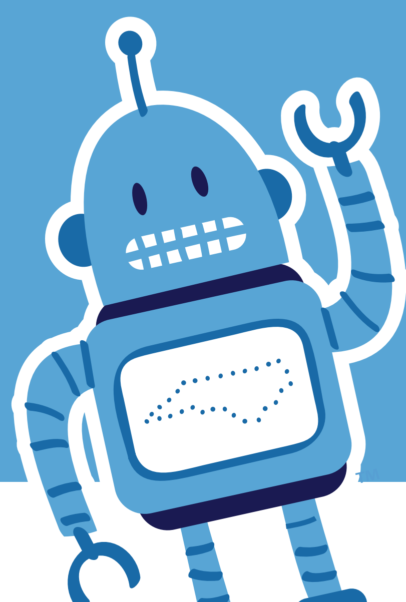

SCIENCE FOR ALL • CIENCIA PARA TODOS •

Straw Flutes

Why is this science?

In order to understand how musical instruments create sound, you need to know a little bit about the physics of sound waves. Sound is the vibration, or back-and-forth movement, of air particles. We hear sound when those vibrations hit our eardrums. All sound is created by vibration, but not all vibrations are made in the same way. You can make vibrations by hitting something (like a drum, or stomping your foot), by plucking something (like a guitar string), or by using your breath to make vibrations in a column of air (like playing the flute or a horn).

In the straw flute, what's vibrating? The air inside each straw. When you blow across the top of your straw flute, you cause the air inside each straw to vibrate as it moves around. That movement of air is what we hear as sound.

Sounds can have different pitches, meaning how high or low it sounds. Blowing over shorter straws makes the pitch higher because there is less air to move so it can quickly vibrate. Blowing over longer straws makes the pitch lower because the greater volume of air vibrates more slowly. Think about big instruments versus small ones: the double bass makes much lower sounds than the violin and the tuba is much deeper than the trumpet. A longer vibration makes a lower sound.

North Carolina connection

The type of flute you just made is called a panpipe or pan flute and it is one of the oldest instruments in the Americas. Panpipes have been found by archaeologists from Canada to South America, with the oldest dating back to 4200 BC. Here in North Carolina, the Cherokee Indians used panpipes, flutes, water drums, whistles, and shakers to play music to accompany traditional songs, dances, and ceremonies. All of the instruments were made of natural materials such as logs, reeds, gourds, animal bones and skin. In the 1700s, Cherokee music began to include new instruments like the fiddle brought by English and Scottish traders. You can still hear these traditional instruments and songs if you visit Cherokee, NC during one of their festivals.

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DUKE ENERGY SCIENCE NIGHT

Zip Lines

Big idea

Engineer a zip line car that will carry a ping-pong ball to the target!

You will need

WHAT WE GAVE YOU:

- fishing line
- chipboard
- masking tape
- ping-pong balls
- paperclips
- washers
- Zip Lines instructions

STUFF YOU PROVIDE:

- chairs
- coffee cans or other containers to catch ping-pong balls
- stopwatch (optional)

Fun Options

AHEAD OF TIME:

Have extra recycled materials on-hand to inspire creative car designs. This can include any sort of bottle, cup, tube, or paper – the sky is the limit and there is no "wrong" design!

Set it up

Ahead of time, build your zip lines according to the included instructions. Attach a 4-foot segment of fishing line to both the wall as the starting point and a chair as the finish. Place a coffee can or other container on the chair to catch the ping-pong balls.

Depending on your available space, you can also create additional zip lines with longer or shorter lengths, or that have different angles of descent. Or, set up identical lines next to each other for participants to race their cars.

It is a good idea to build a sample car. This way the students can see one example of a 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 cars.

It's showtime!

Invite families to build a car using the materials and instructions provided. Their challenge is to engineer a car that will travel down the pre-built zip line and drop a ping-pong ball into the container at the end of the line. You can show off your finished example or let families get to brainstorming. Allow them time to build, test, and rebuild their cars.

If they love It...

Now that they have a successful design, challenge families to a race! Can their car deliver the ping-pong ball in five seconds or less? Encourage families to adapt their car to fit the challenge. Have a stopwatch on hand, or ask families to track with their smartphones.

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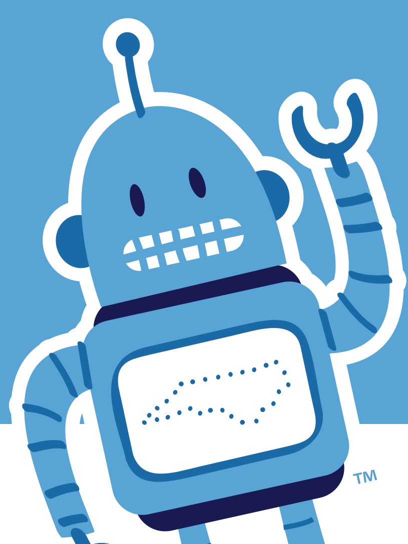

SCIENCE FOR ALL • CIENCIA PARA TODOS •

DUKE ENERGY SCIENCE NIGHT

Zip Lines

Why is this science?

Science is all about trying things out. Specifically, families are working with iterative design, which is an important process in engineering. They design their car, test it, observe how well it works, and then make changes based on their observations.

This activity is also a great introduction to energy and Newton's Laws of Motion. There are two types of energy: potential energy (stored energy) and kinetic energy (the energy of motion). When the car is held at the top of the track before it is released, it has potential energy. Once the car is released, gravity pulls on the car and it slides down the track. The potential energy is changed into kinetic energy because the car is in motion. Once it hits the end, the car quickly stops, but not before it drops the ping-pong ball into the target. This is a great illustration of Newton's first law of motion, which says that an object in motion (in this case, the car) stays in motion unless an external force is applied to it. In the zip line example, the external force is the chair, which stops the car in its tracks!

North Carolina connection

Newton's First Law states that "a body continues to be in its state of rest or of uniform motion in a straight line unless it is compelled to change that state by an external force impressed on it." In the case of our zip line, the chair stopped the car. Here are some additional examples (with North Carolina connections) to help you understand Newton's First Law:

If a Carolina Hurricanes player slides a hockey puck on the ice, there is only a little bit of friction to slow it down, so it keeps going until it hits something like a player's stick or the back of the net for a GOOAAALLL!

If a Carolina Panthers punter kicks a football in space, it will keep going forever because there is no gravity, friction, or air resistance going against it. But here on Earth, the force of gravity pulls the ball back to the ground.

If a NASCAR driver is racing at high speed and crashes into a wall, the car will come to an instant stop but the driver will keep moving forward. This is why NASCAR has developed important safety features like SAFER barriers and the Car of Tomorrow to protect the drivers. These safer, more advanced cars were tested right here in North Carolina at Caraway Speedway and Rockingham Speedway in Asheboro and Rockingham, respectively.

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