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Surprising Science for Kids:

Electricity!

KIT-520

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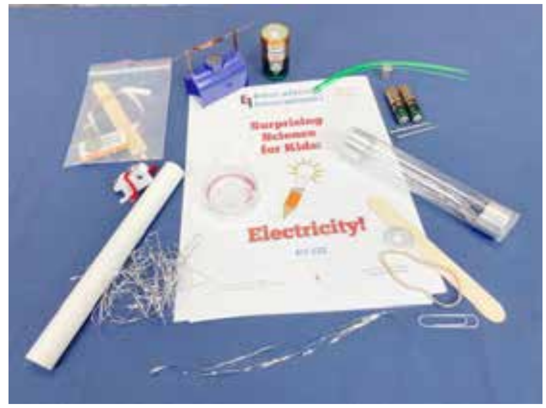
Welcome to
Surprising Science for Kids: Electricity!
Grades 4-8



Your **Surprising Science for Kids: Electricity!** kit includes everything you need to perform hands-on experiments and dynamic demonstrations related to electricity.

We believe the best way to learn about science is to have fun! The activities in this guide will ignite students' curiosity and make them eager to explore on their own.

Included in this kit:

- 1 Static Spheres Container
- Strands of Mylar Tinsel
- 1 PVC Pipe
- 1 Energy Tube
- 1 Washer
- 1 Rubber Band
- 1 Paper Clip
- 1 Wooden Craft Stick
- 1 Plastic Bag
- 1 DIY Light Wand Kit
- 1 World's Simplest Motor Kit
- 1 D-Cell Battery
- 1 ScooterBot Kit
- 1 HomoMotor Kit

You will also need:

- Scissors
- Glass of Water
- Clean Hair
- Tape

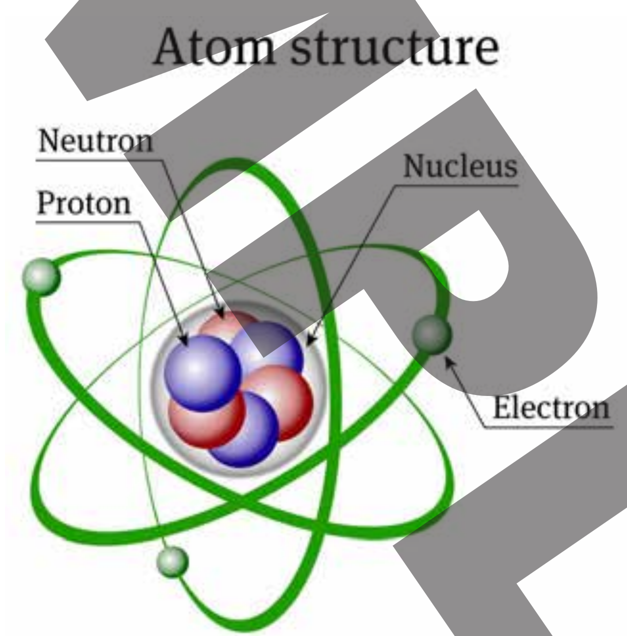
So, what is electricity anyway?

Electricity is a form of energy. It can either flow from one place to another, or it can stay in place. When it gathers in one place and doesn't move, it's called **static electricity**. Static means unmoving. The electricity that flows from one place to another is called **current electricity**.

Tell me more...

Atoms make up everything in the universe: the chair you're sitting on, the paper you're holding, and even you and your parents! Atoms are SUPER small, so you can't see them, but we know they are there, and we know how they behave.

The basic parts of an atom are protons, which have a positive charge, neutrons, which have no charge, and electrons, which have a negative charge. The protons and neutrons are in the nucleus or the center of an atom, and the electrons orbit around the nucleus. The negative electrons stay in orbit around the nucleus because they are attracted to the protons' positive charge. Just like with magnets, opposite charges attract one another.

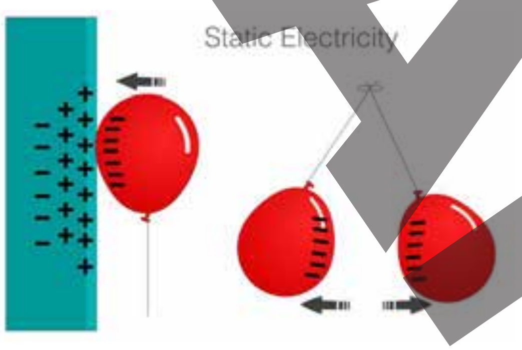


When the number of electrons in an atom have the same number as the protons, the atom is stable and has no electrical charge, but if any electrons are pulled away from an atom, or if an atom gains extra electrons, then an electrical charge exists.

Okay, let's get down to the experiments!

Activity 1:
Static Spheres

Static electricity is a stationary (nonmoving) electric charge, which is usually produced by friction. **Friction** is the force that holds back movement from objects in contact. If you can imagine walking on ice, there is very little friction between your feet and the ice. This makes it difficult to walk because the ice is slippery. On the other hand, if you are walking on a sidewalk, there is far more friction between your feet and the ground, so walking is easier.



When two objects are in contact and there is a lot of friction, often times the electrons (the particle with a negative charge) will be knocked out of orbit giving that object a positive charge and the object that gained the electrons a negative charge.

As with magnets, when objects have the same charge, they will repel or push away from one another. When they have an opposite charge, they are attracted to each other and will stick to one another.

Everyday examples of when you see static electricity are:

- Socks that stick together in the dryer. When you pull them apart you can hear a crackling sound and see small sparks.
- Rubbing your feet on a nylon carpet will cause a buildup of electrons, and when you touch a metal door knob or another person, you could get a mild shock.
- Rubbing a latex balloon on your head or wool sweater will cause the balloon to be statically charged so that it will stick to a wall.
- Falling rain produces friction with the air and will sometimes create lightning, which is actually a form of static electricity.

Static Spheres are appropriately named, and you will see why in a second.

Materials:

- Static Spheres

Directions:

1. Take a look at the red spheres in the clear container. What can you observe about them?

2. If you tilt the container, what happens to the spheres?

Activity 2:
The Amazing Levitating Orb

Materials:

- Mylar Tinsel
- PVC Pipe
- Scissors

Directions:

1. Arrange six strands of the Mylar tinsel together and tie them in a knot at one end.
2. Tie the other end about 6 inches (15 cm) from the first knot.
3. Cut off the loose Mylar strands just past each knot.
4. Charge the PVC pipe by carefully rubbing it back and forth through your dry, clean hair for 10 seconds. You can use fur or wool if your hair does not create enough static.
5. Hold the Mylar orb (by a knot) above the charged pipe and let it drop. Use the pipe to quickly 'tap' the Mylar and then move it away.
6. Once the orb touches the pipe, it should expand and start floating.
7. To control the orb, continue to hold the pipe below the orb.

Troubleshooting:

a. *If the Mylar orb sticks to the pipe, you will need to move the pipe away more quickly. You are just trying to pass the charge onto the Mylar. It may take a little practice.*
b. *Moisture in the air reduces the amount of static in a location. Use a hair dryer to blow air over the pipe if humidity is an issue.*
c. *Be sure to "recharge" your pipe before each levitation.*

8. Draw a picture of the orb after it touched the PVC pipe.

Activity 3:
The Energy Tube

continued

Materials:

- Energy Tube
- Wooden Craft Stick
- 1 Glass of Water
- Washer
- Paper Clip
- Rubber Band
- Plastic Bag

Conductors vs. Insulators

This is a simple activity you can perform individually or in pairs. You already know how the Energy Tube functions. Using the test materials provided, place a finger on one electrode, and while holding one of the items from the list, touch the other electrode with the item.

If you have two people, place one hand on the Energy Tube's electrode and using the other hand, hold onto the item you're testing. Have your partner touch the opposite electrode with one hand and using a free hand, touch the test item—being careful not to also touch your hand.

Fill in the chart below with your observations.

Object	Observations
Washer	
Rubber Band	
Craft Stick	
Paper Clip	
Plastic Bag	

Activity 4:
Do It Yourself Light Wand

This STEM activity is a wonderful way to learn about electricity, open and closed circuits, and the difference between conductors and insulators.

Key Terms:

Battery – A container in which chemical energy is converted into electricity. A source of electrical power.

Circuit – A path that electricity flows through continuously.

Open Circuit – An electrical circuit that is not complete; therefore electricity is unable to flow.

Closed Circuit – A complete path that allows electricity to travel from one side of the power source to the other.

Electricity – A form of energy that is the result of the flow of electrons.

Conductor – A material that allows electricity to flow through it easily.

Insulator – A material that electricity does not flow through easily.

LED (Light Emitting Diode) – This bulb emits light when electricity flows through it.

Switch – Part of a circuit designed to break the closed path of electrical flow.

Materials:

- 1 Wooden Craft Stick
- Copper Tape
- 1 Binder Clip
- 1 LED Light
- 1 Button Battery
- Tape

Caution:

This experiment includes a 3-volt Lithium battery.

Do not put it in your mouth!

Activity 5:
World's Simplest Motor

By definition, a motor is:

> **A rotating machine that transforms electrical energy into mechanical energy.**
> (*Merriam-Webster.com*)

A motor is defined as a device that changes a form of energy into mechanical energy to produce motion. In this case, we are using electricity to create an electromagnet. The electromagnet attracts and then repels the attached magnet, causing the armature to spin.

Terms:

Direct Current: Electricity that flows in only one direction; produced by solar cells and batteries.

Magnetic Force: An attraction or repulsion that is exerted by a magnet.

Electrical Current: The flow of electrons along a continuous path.

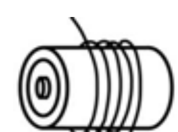
Materials:

- World's Simplest Motor Kit
- 1 D-Cell Battery

Directions:

1. Using the instructions below (also on the back of the motor package), build your motor.
2. Once it's working, draw a diagram of your motor. Use the cards on page 17 to label your diagram.
3. On your diagram, draw arrows to trace the flow of electricity through your motor.

Building Your Motor:



1. Unwrap the wire and straighten out any bends. Leaving about two inches straight (about the length of a D-cell battery), wrap the wire around the battery to form a coil.

2. Unwrap a small amount from the second end so that you now have about two inches of wire sticking out from either side.

3. Wrap the extra wire on each end tightly around the coil twice. This will keep the coil together. The two ends should stick out directly opposite of each other and should be at least one inch long. Excess can be trimmed or wrapped around the coil as additional turns.

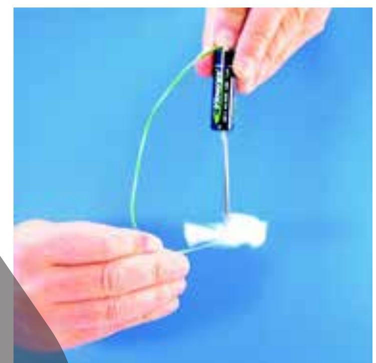
Activity 7:
HomoMotor Kit

This kit will help you in building one of the simplest electric motors, a "homopolar" motor (also referred to as a "monopolar" motor). A homopolar ("one pole") motor does not involve a polarity change as is utilized in more complex motors. The first of these types of motors are credited to Michael Faraday. In 1821, he built and demonstrated motors that used these principles to the Royal Institution in London. Faraday's motor used a movable wire that rotated about a magnet that was sitting in a pool of mercury.

Our motors will use a single battery, a wire and a powerful neodymium magnet. Review all instructions before trying this. Also, don't miss the Important Notes and Suggestions on page 26.

Building the basic motor:

Place the magnet on the head of the nail. This will cause the nail itself to become magnetized.



Hold the battery vertically with the positive (+) end up.

Use the negative (-) end of the battery to pick up the now magnetized nail by the pointed end. The nail should be magnetically suspended from the battery.

Connect one stripped end of your wire to the positive (+) end of the battery. Secure it with a piece of tape, or just hold it firmly with a finger. Caution: The wire may become hot. If holding the wire, only run your motor for brief periods.

Touch the other end of the wire to edge of the magnet.

Optional: You can tape a pinwheel, or other lightweight decoration, to the magnet to make the rotation more easily observed. See page 26 for a pinwheel template.

The nail should begin to rotate. Make note of the direction of rotation. Flip the magnet over, so the opposite pole is in contact with the nail. What change occurs?

Try flipping over the battery, so the nail is contacting the negative (-) end. How does this affect your motor?

Will the motor work if, rather than touching the end of the wire to the edge of the magnet, you touch the wire to the side of the shaft of the nail? Why, or why not?

Activity 7:
HomoMotor Kit

continued

Important Notes and Suggestions:

With all of these motors, don't be surprised if they spin so rapidly that they quickly shake themselves apart. It may take many adjustments to get them to spin freely for long periods. Also, keep in mind that **the wire will get hot**, especially if they run for a long time.

What methods can you develop to control the speed of the motors to make them more stable?

The wires included in this kit are copper-core. How might aluminum or other wires affect performance? For the butterfly motor, how do wide versus narrow "wings" affect the motor?

Do some research on how more practical motors are made. Find the definitions for the motor's components, such as armature, commutator, or brushes. Could the exposed contacts on your homopolar motors be described as brushes? Why or why not?

Can think of a way one of these motors can perform some practical work?

Pinwheel Template: