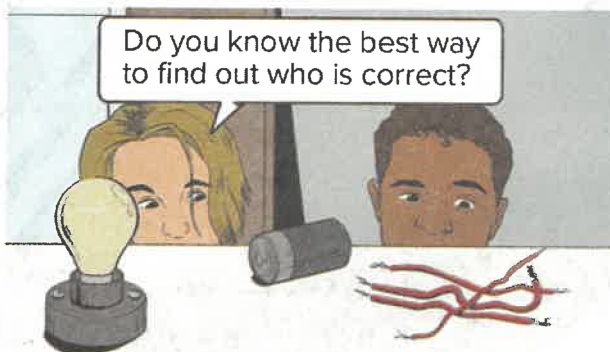
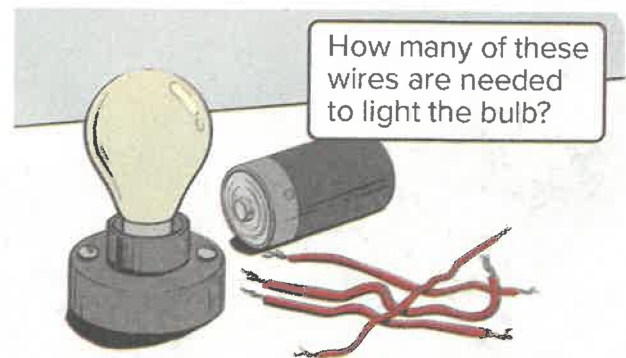




## Crossed Wires



Who do you agree with most? Explain your thinking.

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Essential Question

## What is needed for an electrical circuit to function?



Watch *Calling All Circuits*.



What devices use electrical circuits?



What do you wonder about the parts of electrical circuits?  
Write it down!



hutterstock



## Hands-On Investigation

10 Items or Less

SC.5.N.2.2



Get your notebook and go explore!





battery

complete circuit

electric current

electrical circuit

static electricity

## A Closed Path



### Claim, Evidence, Reasoning



Did you always need wire to light the light bulb? Check your claim. Can you back it up? Keep reading and underline evidence.

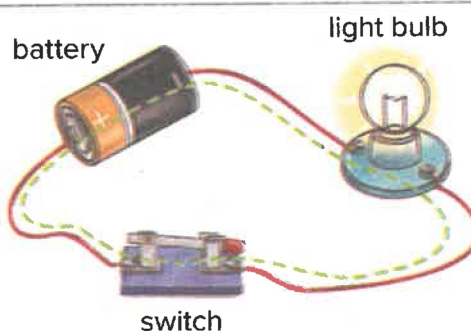
At a light show, lights are always turning on and off. How are the lights controlled? The answer to this question involves the construction of electrical circuits. The flow of electricity through a conductor is called an **electric current**. An **electrical circuit** is a closed path through which an electric current can flow. All electrical circuits have at least three parts: an energy source, an electric appliance or device, and a conductor.

A **battery** is a device that produces an electric current due to the changes to the materials inside it. A battery has two ends, called terminals. The terminals are labeled positive (+) and negative (-). For electric current to flow, the closed path must run through the battery between the two terminals.

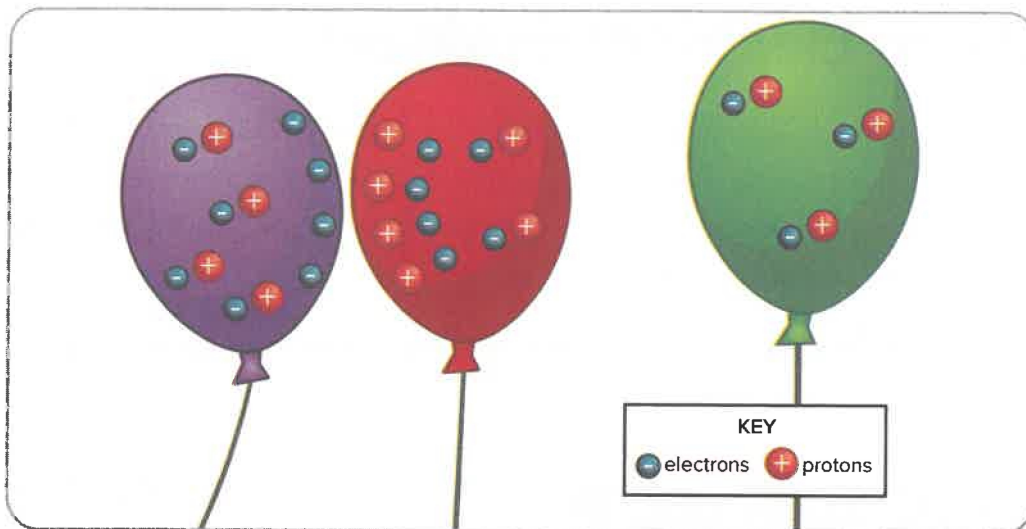
A conductor, such as a wire, carries electricity between the energy source and the device. It is the conductor's job to connect the positive and negative terminals of the battery. This allows electric current to flow out of the positive terminal to the light bulb, back to the negative terminal, and through the battery. The electric current continues to flow until the circuit is broken.

Electrical circuits may also include a device called a switch. A switch is a device that opens or closes a circuit. When the switch is closed, as shown in the diagram, it creates a closed path through which an electrical current flows, called a **complete circuit**. When the switch is open, the circuit is described as an incomplete or open circuit. Electricity cannot flow through an open circuit, so the light bulb is dark.

When the switch is closed, energy flows through the circuit and lights the light bulb. A switch is useful because it can open and close a circuit.







Explore static electricity in *Stuck on You*.

SC.5.N.1.1

## Static Electricity

Batteries aren't the only thing with a positive and negative part. The atoms, or particles, that make up matter also have a positive and negative charges to them. This is what helps them connect and form molecules. Particles with opposite charges are attracted to each other. Particles with the same charge are repelled from each other. When two objects rub against each other, negative charges can swap between them. This imbalance of negative charges can cause **static electricity**, or the buildup of charges in a material.

If you rub a balloon against an object, like carpet or your hair, negative charges will be exchanged between the object and the balloon. As the balloon gains or loses charges, it becomes positively or negatively charged. Since opposite charges attract, the balloon will be attracted to other objects, even those with balanced charges.

The attractive force between negative and positive charges is strong. A buildup of negative charges in one object will cause it to jump through the air toward nearby positive charges in another object. Lightning is a common example of this. After the charges swap back, the two objects have balanced charges. The objects are then neutral.



How are an electrical current and static electricity similar?



Why are switches needed in the electrical circuits at a light show?

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# Be an Electrical Engineer!

An electrical engineer's job is to design electrical circuits and devices that run on electricity. Part of their job is to identify problems that arise in electrical circuits and then fix those problems. Think like an electrical engineer as you study the infographic.

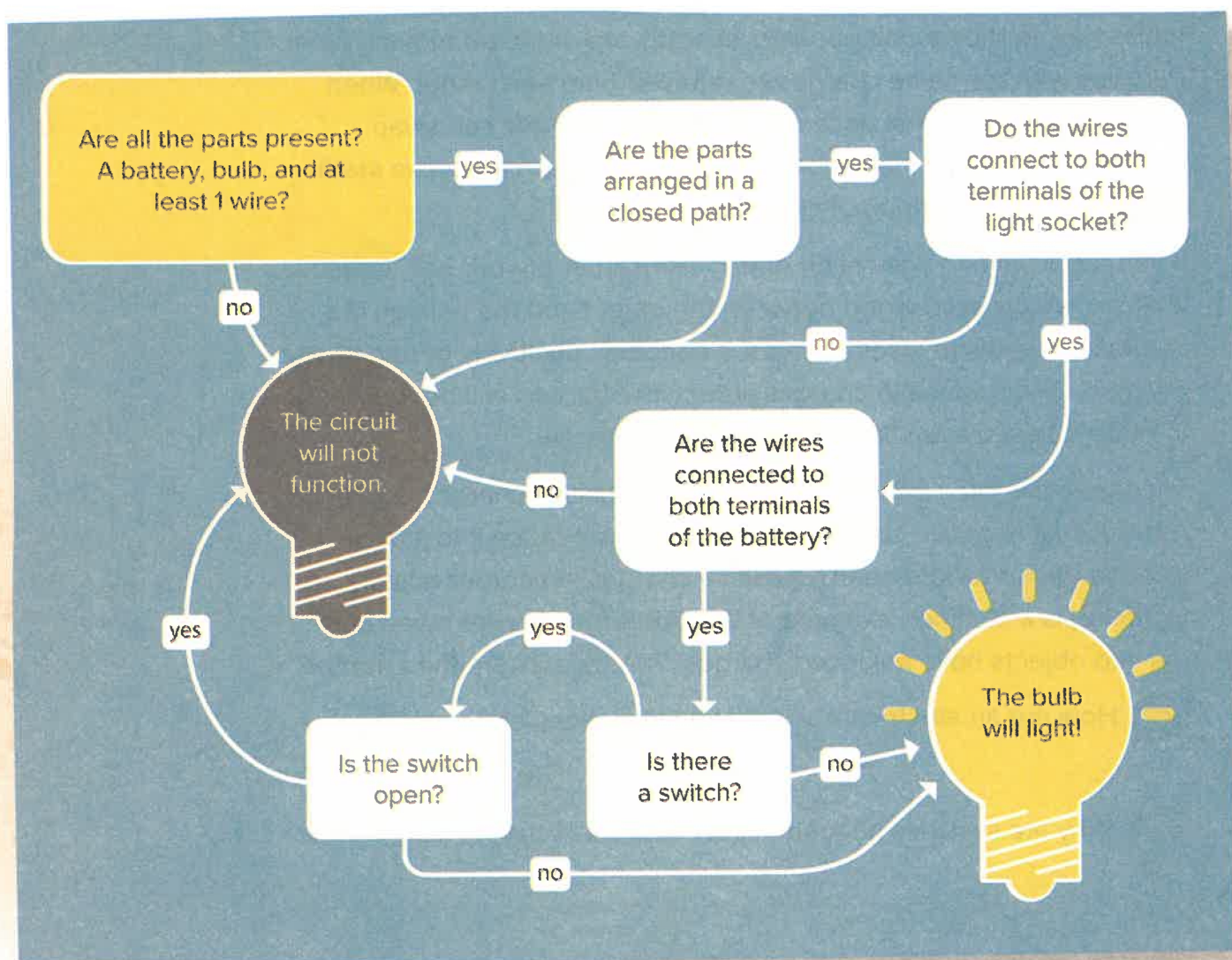
**Read the Infographic** Use the flow chart to identify the steps needed for the light bulb to light up.



## Investigation Connection



Think back to the investigation. Which of the setups did not light the light bulb? Can you now explain why? Identify how the circuit could be repaired.





## Claim, Evidence, Reasoning



Add more evidence to your claim. I think \_\_\_\_\_  
because \_\_\_\_\_.



## WORD LAB

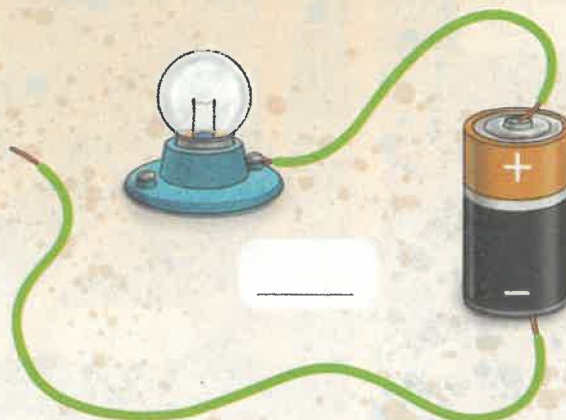
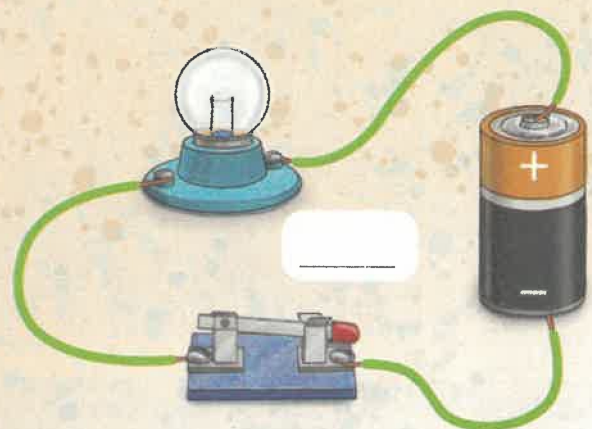
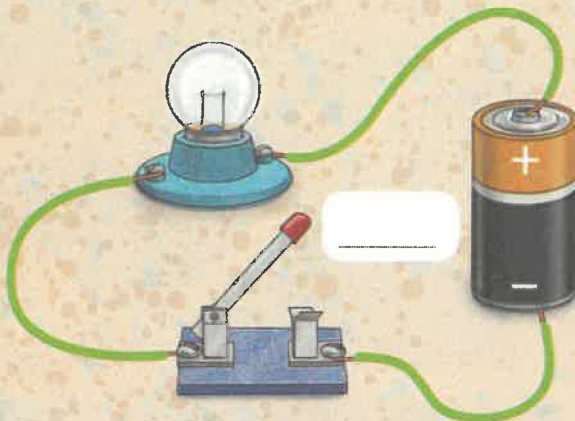
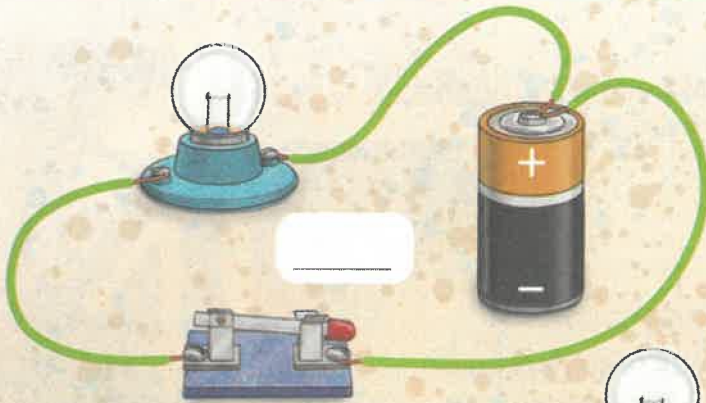
Do you need  
practice?

Interactive

Word

Wall

Remember  
to update  
your graphic  
organizer!





# STEM Connection

## Meet a Crane Mechanic: Ed Carroll

Ed Carroll works as a crane mechanic in Maryland's Port of Baltimore. He works with a crew to diagnose problems and fix these giant machines.

### What does a crane mechanic do?

**A** A crane mechanic repairs, maintains, and upgrades many different systems of the crane. Cranes require regular maintenance, like greasing moving parts, replacing filters, inspecting steel-wire ropes, adjusting brakes, and much more. Crane mechanics spend a lot of time replacing parts of the crane.



**"Trade school taught me how electricity and mechanical systems behave and how to diagnose and repair them."**

Port of Baltimore USA

trolley

boom

hoist and  
spreader

gantry



### What components make the crane work?

**A** The crane has four major components that make it work. The hoist is everything that involves the motion of lifting a load. The trolley is like a car that rides on steel rails over the ship and back over the dock, carrying the load. The trolley works with the hoist ropes and spreader through a series of pulleys. The gantry is the base of the crane, which allows the crane to travel along the side of a ship using 32 wheels over two rails. The boom is the part of the frame that hangs out over the water and the ship and that the trolley rolls on. The boom rests on a hinge and is raised up and lowered down.

### What are some challenges you face?

**A** One of the toughest parts of our job is to diagnose an electrical failure. It could take hours of diagnostics to find a problem as simple as a loose wire connection. Sometimes old, outdated systems on the crane become impossible to maintain, so we upgrade to a modern device. Before the crane operator takes control of the crane and starts working, a crane mechanic spends two hours getting the crane ready and inspecting different parts of the crane to make sure it is ready for operation.



This shore-power cable reel provides 13,200 V of electricity to the crane.



Check out the crane operator's view from the cab! They use computers to move the hoist and spreader over the boat to pick up each shipping container.

Copyright © McGraw Hill (t.c) Ed Carrol, (b)halbergman/Getty Images



Port of Baltimore, MD



# STEM Connection



## Write About It! ELA.K12.EE.1.1

### 1. Choose a writing prompt.

- In the video *Meet a Crane Mechanic*, Ed Carroll discusses the energy transfers that happen within ship-to-shore cranes. Research a different type of crane, and determine what energy transfers take place. Compare your research to the ship-to-shore crane.
- Ed Carroll discusses how electrical energy transfers from the power grid back into the crane. Research cranes that run on diesel engines. How do they operate? Compare your research to the cranes powered by the power grid.

### 2. Organize your information. Draw an Opinion Writing graphic organizer (like this one) in your notebook.

#### Opinion Writing

| Opinion | Supporting Reasons |
|---------|--------------------|
|         |                    |
|         |                    |
|         |                    |

### 3. Write a letter to Ed Carroll telling him which type of crane you think is better. Be sure to include words from the **Interactive Word Wall** in your writing.



How do you fix some of the world's largest cranes? Watch *Meet a Crane Mechanic* to find out.