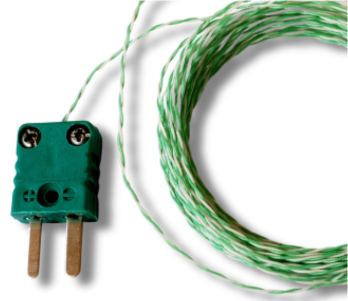
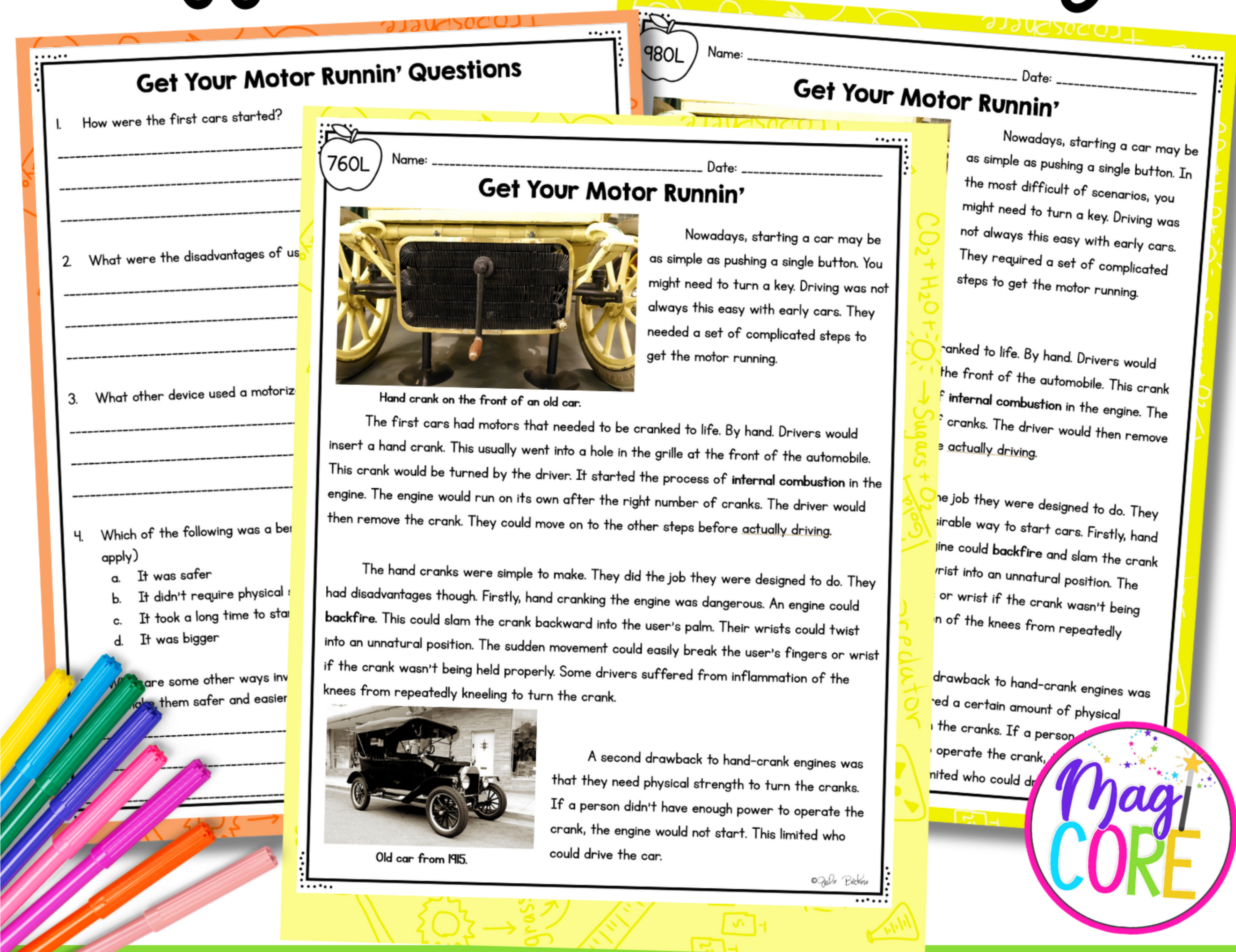
ENERGY CONVERSION



differentiated passages



MagiCORE

4th Grade NGSS 4-PS3-4

ABOUT LEXILE LEVELS

MagiCore is a certified Lexile® Partner. These texts are officially measured and approved by Lexile and MetaMetrics® to ensure appropriate rigor and differentiation for students.

The Lexile Framework® for Reading measures are scientific, quantitative text levels. When the Lexile of a text is measured, specific, measurable attributes of the text are considered, including, but not limited to, word frequency, sentence length, and text cohesion. These are difficult attributes for humans to evaluate, so a computer measures them.

Common Core State Standards uses Lexile level bands as one measure of text complexity. Text complexity ranges ensure students are college and career ready by the end of 12th grade. Lexile measures help educators scaffold and differentiate instruction as well as monitor reading growth.

Grade Band	Lexile® Bands Aligned to Common Core Expectations
K-1	N/A
2-3	420L-820L
4-5	740L-1010L
6-8	925L-1185L

Keep in mind when using any leveled text that many students will need scaffolding and support to reach text at the high end of their grade band. According to Appendix A of the Common Core Standards, "It is important to recognize that scaffolding often is entirely appropriate. The expectation that scaffolding will occur with particularly challenging texts is built into the Standards' grade-by-grade text complexity expectations, for example. The general movement, however, should be toward decreasing scaffolding and increasing independence both within and across the text complexity bands defined in the Standards."

Energy Conversion Device

4th grade

Table of Contents

Each passage set includes two differentiated passages on a fourth-grade level (one at the beginning of the band, one towards the end) and a question set geared towards comprehension and science mastery. The first question is differentiated to include a fill-in-the-blank diagram (lower complexity) or an open-ended diagram (higher complexity).

How to Use This Resource

This resource was created with the NGSS Science Standards in mind. It includes six differentiated passages aligned to the following standard:

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

Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.

Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.

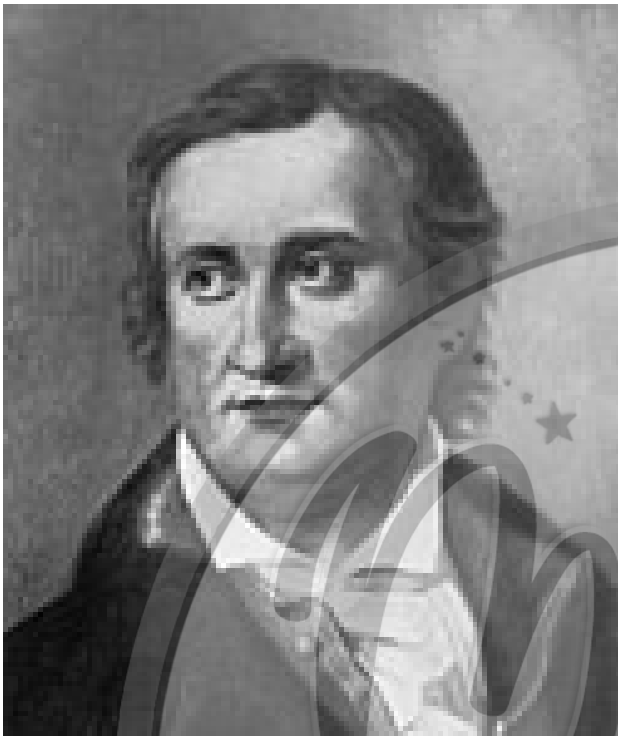
Here are some suggestions for using these passages:

- Use as independent work after you have taught an overview of this standard. Assign the different levels based on the passage students can read and comprehend independently.
- Use as a reading center to reinforce key comprehension and science concepts at the same time!
- Use as a homework or review packet.
- Use as an intervention for students who need to revisit science concepts.

780L

Name: ______________________________ Date: ____________________

Candle-Powered Model Car



Thomas Seebeck

Humans like to find ways to make things move. We have so many inventions that involve moving, so getting around is important to us. All those forms of transportation need energy. Power is needed to get in motion whether it's energy from pedaling, fossil fuels, or another form. Humans are always looking for new energy solutions. This is because the resources we depend on now, such as oil, are nonrenewable. They are also not friendly to the environment.

Changing energy from one form to another has helped humans advance over the years. One such energy conversion is the **Seebeck Effect**. The Seebeck Effect happens when a temperature difference between two electrical **conductors** or **semiconductors** occurs and makes electricity. A German scientist, Thomas Seebeck, discovered this effect in 1821. The Seebeck Effect is used in **thermocouples**. These are sensors for measuring temperature. It is also found in automobiles to increase fuel **efficiency**. **Generators** use it to make electric power.

Thermocouple wire with a plug.

Illustration of a candle powered car.

A very simple display of the Seebeck Effect can be seen when using a candle to power a small model car. The model car gets energy from a single tealight candle. It has a metal dish atop it. That dish gets filled with cold water. The tealight candle is lit. It's placed below this dish. The temperature difference between the cold water and the hot flame of the candle on both sides of a **thermoelectric** generator on the model car makes electricity. This electricity powers a motor on the wheels. The electricity is converted to kinetic energy. This makes the model car roll around on a flat surface. The colder the water that is used, the faster the model car's speed.

We have thermal energy converting to electrical energy converting to kinetic energy in this example. The end result of these energy conversions is the movement of the model car. The **input energy** is heat. The **output energy** is motion. Researchers may one day find more ways to use the Seebeck Effect. It could benefit our world and meet our energy needs.

Candle Powered Model Car Questions

1. Why are humans looking for new energy solutions?

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2. What is the Seebeck Effect?

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3. Where does the energy come from in the candle-powered car experiment?
   a. An electrical outlet
   b. A generator
   c. A tealight candle
   d. A car engine

5. Which of the following would produce the fastest-moving car?
   a. Warm water, a heavy car, a carpeted surface
   b. Warm water, a heavy car, a smooth tile surface
   c. Cool water, a light car, a carpeted surface
   d. Cool water, a light car, a smooth tile surface

4. Fill in the boxes to show the 3 energy conversions that happen with a candle-powered car.

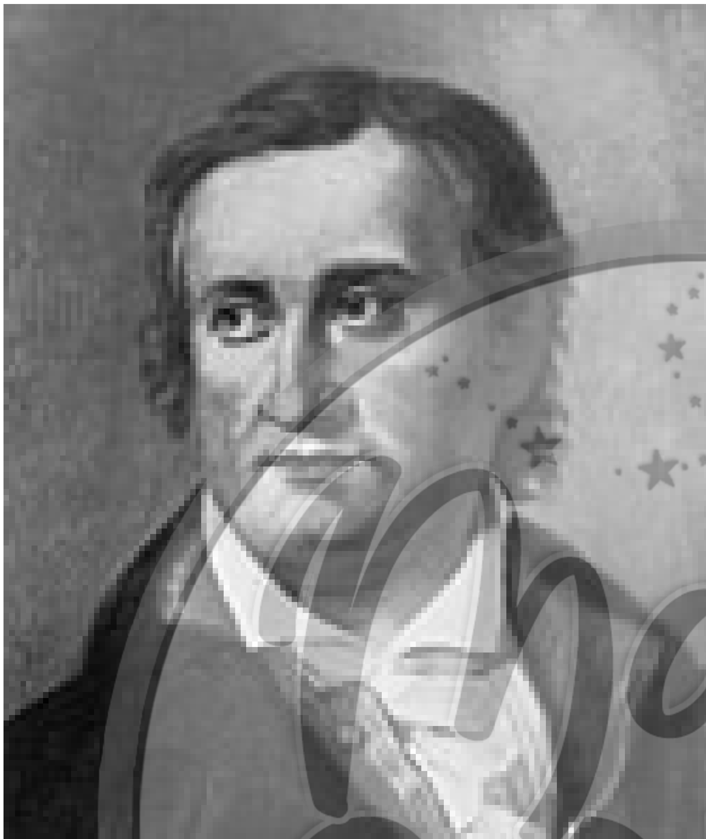
	→	Electrical energy	→	

6. Researchers want to use the Seebeck effect for other uses. Which of the following would be a possible way to utilize it?
   a. To convert thermal energy into sound energy to play a radio.
   b. To convert thermal energy into electrical energy to turn a mixer.
   c. To convert electrical energy into thermal energy to heat a car.
   d. To convert electrical energy into chemical energy to light a flashlight.

990L

Name: ____ Date: _________________________

Candle-Powered Model Car



Thomas Seebeck

Humans like to find ways to make things move. If you think about the inventions we have made that involve just moving ourselves – bikes, cars, airplanes, boats – you can see how important getting around is to us. All those forms of transportation need energy. Whether it's energy from pedaling, fossil fuels, electricity, or another form, power is needed to get in motion. With resources such as oil being nonrenewable and not environmentally friendly, humans are always looking for new energy solutions.

Converting energy from one form to another has helped humans advance over the years. One such energy conversion is the **Seebeck Effect**. The Seebeck Effect is a phenomenon in which a temperature difference between two electrical **conductors** or **semiconductors** makes electricity. A German physicist, Thomas Seebeck, discovered this effect in 1821. The Seebeck Effect is used in **thermocouples**, which are sensors for measuring temperature. It is also found in automobiles to increase fuel **efficiency**. **Generators** use it to make electric power.

Thermocouple wire with a plug.

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In this example, we have thermal energy converting to electrical energy converting to kinetic energy. The end result of these energy conversions is the movement of the model car. The **input energy** is heat, and the **output energy** is motion. Researchers may one day find more ways to use the Seebeck Effect to benefit our world and meet our energy needs.

Candle Powered Model Car Questions

1. Why are humans looking for new energy solutions?

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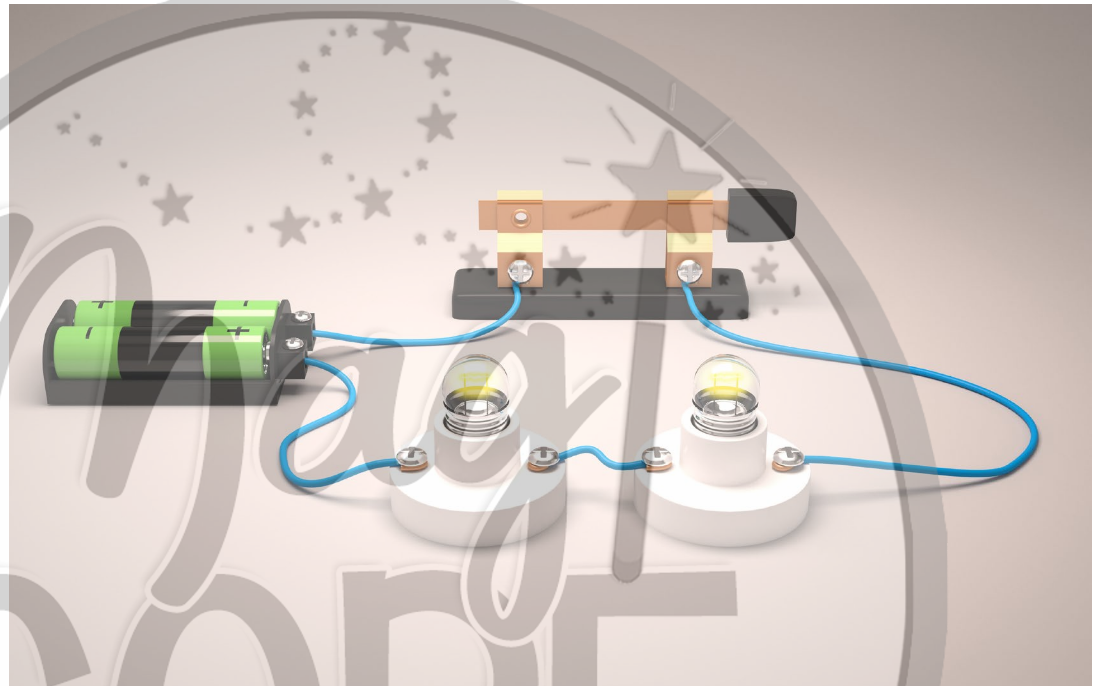
770L

Name: ____ Date: ________________________

Circuits

A **circuit** is a complete path that allows electricity to flow. It provides power to lights and many other **devices**. Circuits also let us send electricity to where we need it. The ability to use circuits has changed our lives in many ways.



Simple circuit with a switch.

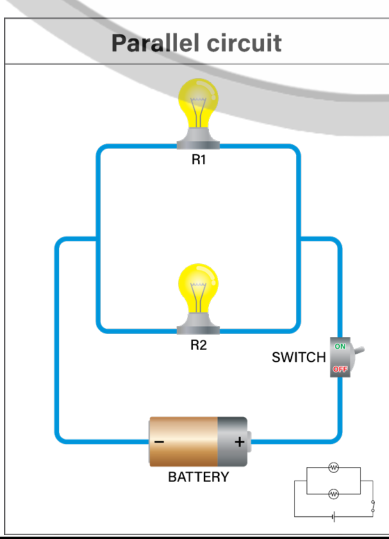
Circuits have several parts. First, they need a power source. This could be a **battery** or electricity from a public power plant. Next, circuits have to have wires. Electricity passes through them. These wires should be made of materials that are **conductors** such as copper. Conductors allow the **electric current** to pass through easily. They are generally covered in plastic for insulation and protection. These wires link the positive and negative ends of a battery. This creates the circuit. The final part needed in a circuit is a device, which could be a lightbulb or an electric motor. A continuous loop is formed when all of these parts are connected. The chemical energy from the battery is converted into electricity and then to light and heat energy for a bulb or kinetic energy for a motor.

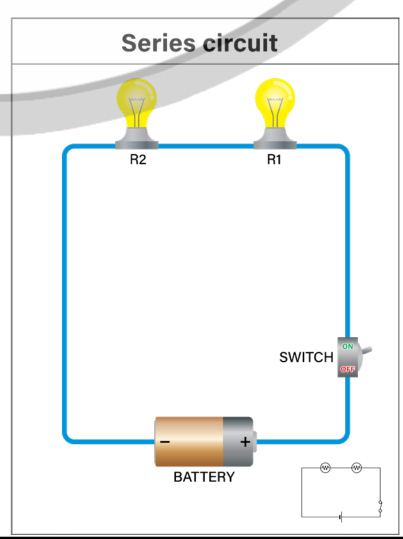
Switches are also included in circuits. This lets people control the flow of electricity. When the switch is in the "on" position, the circuit is complete, and electricity can reach a bulb. Positioning this switch to "off" breaks the connection in the circuit. It stops the flow of electricity and shuts off the bulb.

Circuits can be set up in series or in parallel. In a series circuit, all the parts are connected one after the other. They form a loop. The electricity passes through each piece along the way. If more than one bulb is attached to a series circuit, the lighting will be dimmer. This is because the bulbs are sharing the power of one battery. If one of these bulbs burns out, the entire circuit won't work anymore. The loop has been broken. In a parallel circuit, the electric current is divided among different paths. Each bulb in a parallel circuit receives the full power of the battery, making them equally as bright. These pathways can be switched on and off individually as well. If bulbs are attached to a parallel circuit, some or all of the lights may be lit.

Energy in circuits is usually stored in the chemicals of a battery. **Capacitors** also store energy, but they do so in an electric field. This stored energy in either batteries or capacitors creates electrical potential. This potential drives the flow of electrons, and an electric current is made. This current can then power the devices attached to the circuit. Batteries are good for storage. They can store a great deal of energy in a steady stream. A disadvantage to batteries is they don't always supply the energy as quickly as it is needed. They also can be a problem to throw away. This is because of the chemicals they contain. Capacitors, however, can be recharged. They can be used again. They also don't involve toxic materials. This makes getting rid of them easier.

Without circuits, we couldn't use the devices that we depend on in our lives. Circuits help us light our world, communicate with each other, and power the many machines we use every day.





Circuits Questions

1. Why do circuits need wires?

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2. What parts are needed to form a continuous loop in a circuit?

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3. What could be an advantage to using a parallel circuit over a series circuit?
   a. The bulbs will use less energy
   b. Some bulbs can still work even if others burn out
   c. The bulbs will shine less brightly
   d. None of the bulbs will work if one bulb burns out

4. What is the purpose of a battery or a capacitor in a circuit?

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5. Why is a capacitor a better choice than a battery?

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980L

Name: ____ Date: ________________________

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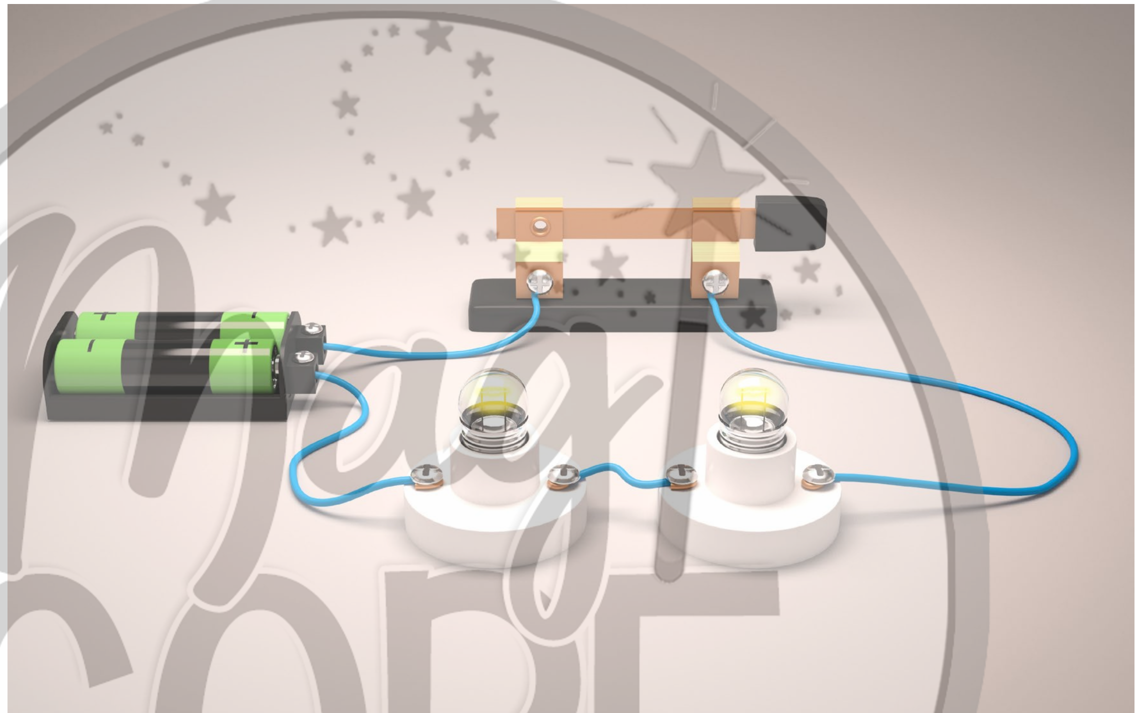

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Switches are also included in circuits so people can control the flow of electricity. When a switch is flipped to the “on” position for a light, for example, the circuit is complete, and electricity can reach the bulb. Positioning this switch to “off” breaks the connection in the circuit. It stops the flow of electricity and shuts off the bulb.

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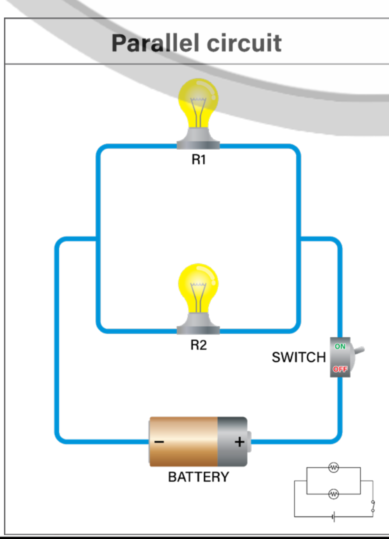

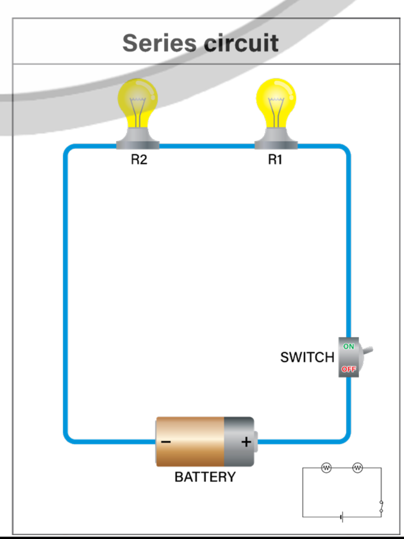

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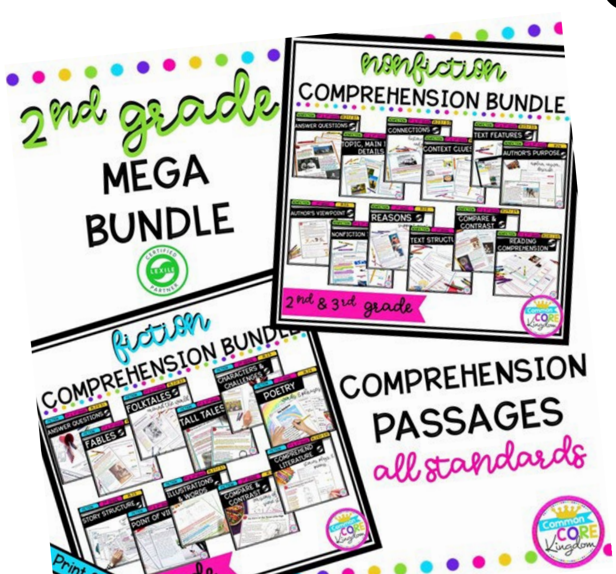

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