Electricity Unit
Lesson 3 of 7

Circuit Basics

Created: 08/2025 by the National FFA Organization

Description of Lesson: This lesson introduces students to electrical circuits and is a supplement to the National FFA Agricultural Technology and Mechanical Systems Career Development Event (CDE). These lessons are designed to be used in order.

Student Learning Objectives:

After completing these activities, students will …

1. Define what a circuit is and distinguish between open and closed circuits.
2. Label the key parts of a circuit: source, path and load.
3. Demonstrate the difference between an open and closed circuit using models or drawings.
4. Explain why a closed circuit allows current to flow and why an open circuit does not.

Suggested Grade Level:

Grades 9 and 10 (This lesson is written so instructors can scale up or down based on class needs.)

Suggested Time:

60 minutes (*Time requirements may vary based upon student understanding and class schedule.)

Resources/References:

1. Website: Making a Paper Circuit, https://www.sciencebuddies.org/stem-activities/paper-circuit?from=Blog

Related Resources:

1. SAE Idea Cards, https://FFA.box.com/s/0j0438zo941eymcncgpqabh5iqzzlrpg

Equipment and Supplies Needed:

1. A copy of the “Go With the Flow!” worksheet for each student
2. Introduction to Electrical Circuits PowerPoint
3. Copper tape
4. Coin cell battery, two per student
5. LED, one per student
6. Scissors
7. Tape
8. Paper

Vocabulary:

1. Circuit
2. Closed Circuit
3. LED
4. Load
5. Open Circuit
6. Path
7. Source

Name: _____

Cross-Curricular Connections:

Science	Math
Create a paper circuit.	Analyze data and troubleshoot issues.

SAE and FFA Connections

1. Agricultural Technology and Mechanical Systems CDE, https://FFA.box.com/s/lm54vln05kzwexi6nx5rzajzrc1d5dxx
2. Agricultural Proficiency Area: Agricultural Mechanics Design and Fabrication, FFA.org/participate/awards/proficiencies/
3. Foundational SAE Connections: Agricultural Literacy

Student Activity Sheets:

Direct access to student activity sheets without lesson plan or answer key for easy upload to a learning management system or printing for classwork.

https://ffa.box.com/s/89ddygmsvvky65zzykfmdqo8jht3go5o (Word)
https://ffa.box.com/s/rw43y4in3k5nsnn637mzx4qhp3u1vsdq (PDF)
https://docs.google.com/document/d/1FhG9bKL-A4P9EtwYEr3EwNiTrcZKiIlXIYr5V0yc7-k/copy (Google)

These Activities Are Aligned to the Following Standards:

AFNR Performance Element

- PST.04. Plan, build and maintain AFNR structures.

FFA Precept

- FFA.PL-A.Action: Assume responsibility and take the necessary steps to achieve the desired results, no matter what the goal or task at hand.
- FFA.PG-J.Mental Growth: Embrace cognitive and intellectual development relative to reasoning, thinking and coping.

Common Career Technical Core

- AG-PST4 Plan, build and maintain AFNR structures.

Common Core – Reading: Informational Text

- CCSS.ELA-Literacy.RI.9-10.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

Common Core – Speaking and Listening

- CCSS.ELA-Literacy.SL.9-10.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups and teacher-led) with diverse partners on grades 9-10 topics, texts and issues, building on others' ideas and expressing their own clearly and persuasively.
- CCSS.ELA-Literacy.SL.9-10.4 Present information, findings and supporting evidence clearly, concisely and logically such that listeners can follow the line of reasoning and the organization, development, substance and style are appropriate to purpose, audience and task.

Common Core – Science & Technical Subjects

- CCSS.ELA-Literacy.RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon or concept; provide an accurate summary of the text.
- CCSS.ELA-Literacy.RST.9-10.4 Determine the meaning of symbols, key terms and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
- CCSS.ELA-Literacy.RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

AFNR Career Ready Practices

- CRP.02. Apply appropriate academic and technical skills. Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive.
- CRP.04. Communicate clearly, effectively and with reason. Career-ready individuals communicate thoughts, ideas and action plans with clarity, whether using written, verbal and/or visual methods.
- CRP.07. Employ valid and reliable research strategies. Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies.
- CRP.08. Utilize critical thinking to make sense of problems and persevere in solving them. Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem and devise

Name: _____

effective plans to solve the problem.

Partnership for 21st Century Skills

- Information Literacy
- Initiative and Self-Direction
- Productivity and Accountability

Lesson Plan:

1. **Bell Ringer:** Have you ever flipped a light switch and the light didn't turn on? What might have gone wrong?

2. **Introduction:** *Have you ever flipped a light switch and just expected it to work? What makes that happen? In this lesson, we're digging into the basics of circuits — those invisible pathways that power everything from your phone charger to a light. You'll learn what makes a circuit "open" or "closed," why one works and the other doesn't and how all the parts need to work together to keep electricity flowing.*

3. **Activity:** Each student needs a copy of the worksheet "Go With the Flow!"
    a. **Part 1:** Present the introduction to electrical circuits notes and instruct students to complete their guided notes as you present them.

    b. **Part 2:** Hand out the paper circuit supplies to students. Direct students to https://www.sciencebuddies.org/stem-activities/paper-circuit?from=Blog and have them watch the video and follow the instructions to create their paper circuits. Instruct students to complete their student activity sheets as they create their paper circuits.

    c. **Part 3:** Students will use what they learned in their Part 1 notes and the paper circuits activity to answer the questions on their student activity sheets.

4. **Follow-up:** Have students find and sketch one real-life example of an open circuit and one of a closed circuit from around their home, school or community. For each, they must label the source, path and load, and explain whether or not the circuit works and why.

5. **Optional – Extended Learning Opportunities (Not factored into time requirement):**
    a. Have students create an additional paper circuit in the form of an art drawing or picture. Refer to Science Buddies for ideas.

6. **Exit Ticket:** List one way an open circuit and a closed circuit are different and one way they're the same.

Aligned to the following standards:
PST.04; PL-A.; PG-J.; CCSS.RI.9-10.1; CCSS.SL.9-10.1; CCSS.SL.9-10.4; CCSS.RST.9-10.2; CCSS.RST.9-10.4; CCSS.RST.9-10.9; CRP.02; CRP.04; CRP.07; CRP.08

Name: _____

Go With the Flow!

Part 1

Directions:

Follow along with the guided notes as your teacher presents them and fill in the activity sheet below.

Fundamentals of Electric Circuits

1. Circuit Terms

   a. _____: A complete circle of current flow. It consists of a source of electricity, one wire to carry the current from the source to where it will be used and another wire to carry it back, plus an object of rated resistance (for example, a lamp) to use the voltage.

   b. _____: Circuits beginning from the service entrance panel and branching out into a variety of places for a variety of purposes

   c. _____: Refers to a break in the circuit circle so that the current cannot flow through it

   d. _____: A current flow around the circuit resistance and back to the source so rapidly that fuses blow, wire insulation burns and batteries drain

   e. _____: The practice of providing an additional connection between a piece of electrical equipment and the earth with a conductor called a ground wire in case the current gets out of the circuit

2. Components of a Simple Two-Wire Circuit

   a. Wires: A simple circuit has a _____ wire and a _____ wire.

   b. The white wire is known as the _____ or _____ wire because it is always connected to an underground water pipe or a ground rod through the service-entrance panel.

      I. It must always run direct to every _____ outlet.
      II. It must always be connected to a _____ terminal (silver-colored).
      III. It never has a fuse or breaker.
      IV. It never has a _____.
      V. It must be electrically continuous.

- The _____ wire is referred to as the "hot" wire.
- One black wire and one white wire must run to every _____.
- Electrical potential always exists between the black wire and the white wire.
- _____: These are boxes made of either metal or plastic, rectangular or octagonal in shape, which have the following functions:

  I. They _____ the cable or conduit so stress cannot be placed on wire connections.
  II. They are nailed, screwed or clamped to the building in order to support outlets, switches or fixtures.
  III. They contain all wire connections made outside of _____.

Name: _____

- _____: The most common outlet is the duplex receptacle wired so that both of its outlets are on the same circuit.
- Outlets are wired across the black wire and the white wire.
- The current enters the outlet on the black wire, flows from one screw through a metal strap to the other screw and continues on to the next _____.
- One outlet in a duplex receptacle may be switched by breaking the metal strap between the two screws, but they must be on the same _____.
- _____: They are bases or housings for light bulbs, fan motors and other such electrical devices.
- _____: They are electrical devices which provide a means to open a circuit to stop electron flow to outlets or lights and to close it again to allow current flow.
- The wire is usually black except in a _____.
- Their _____ and voltage ratings must match those of the circuit.
- Their number of poles indicates how many _____ wires feed through the switch.
- Their number of throws indicates from how many locations a switch can be operated.
- _____: Fuses and breakers are always wired to the black (hot) wire.
- _____: It is a switch placed ahead of the fuse in the hot wire where electricity enters the building.

3. Colors of Wires and Terminals in Structural Wiring

   a. Colors of Wires

      I. _____ (sometimes natural gray) colored wire must be used only for the ground wire.
      II. Additional grounding conductors may be _____, green with one or more yellow stripes or a bare wire.
      III. Wiring for the "hot" wires may be any other color, but it is most frequently _____.
      IV. The color schemes most often used for structural wiring are:

         a) _____-wire circuit: white and black
         b) Three-wire circuit: _____, _____, _____
         c) _____-wire circuit: white, black, red and blue
         d) Five-wire circuit: _____, _____, _____, _____, _____

   b. Colors of Terminals on Electrical Equipment

      I. Natural copper or _____ terminals are for "hot" wires only.
      II. Terminals of a whitish color (such as nickel, tin or zinc-plated) are for _____ wires only.
      III. Terminals of a _____ color are for grounding wires only.

- Grounding wires are those connected to the surface or shell of an appliance or tool to supply a continuous low-resistance path to ground should the surface of the tool or appliance accidentally become energized.

Name: _____

Part 2

Directions:

Watch the video and follow the instructions available at https://www.sciencebuddies.org/stem-activities/paper-circuit?from=Blog to create your paper circuit. Then, complete the questions below.

1. Lay down two smooth strips of copper tape, about a 1/2 inch apart.

   What will these strips do in your circuit?

2. Attach your LED so the long leg (positive) is on the outer strip and the short leg (negative) is on the inner strip.

   Why is leg direction important?

3. Tape down the LED legs securely to the copper strips.

   How do you know the connection is solid?

4. Place the battery with the '+' side facing up on the inner tape strip.

   What happens when you press the outer tape to the battery top?

5. Secure with a binder clip or paper clip to hold the connection in place.

   Does your LED light up? What might you need to adjust?

Name: _____

6. Draw your final paper circuit below. Label the following parts clearly:

   - Battery (Source)

   - Copper Tape (Path)

   - LED (Load)

   - Open/Closed Switch (if included)

Reflection Questions

1. What made your circuit successful or unsuccessful?

2. Describe the role of the battery, copper tape and LED in your circuit.

3. What would you change if you built another paper circuit?

Name: _____

Part 3

Directions:

Using your notes from Part 1 and the paper circuits activity, complete the questions below.

1. Which three parts are required to complete a simple circuit?

    a. Source, path and plug
    b. Source, path and load
    c. Battery, LED and glue
    d. Wire, tape and multimeter

2. What is the purpose of the source in a circuit?

    a. To stop current from flowing
    b. To physically connect wires
    c. To provide electrical energy
    d. To protect the circuit from overload

3. Which of the following would most likely be considered a load in a simple circuit?

    a. A wire
    b. A switch
    c. A copper strip
    d. A light bulb

4. What is the role of the path in an electrical circuit?

    a. To generate power
    b. To prevent short circuits
    c. To carry electricity from source to load
    d. To support the battery

5. What does a closed circuit allow that an open circuit does not?

    a. Voltage to increase
    b. Heat to escape
    c. Electricity to flow
    d. Battery life to extend

6. What happens when a circuit is open?

    a. The light shines brighter.
    b. Current flows more quickly.
    c. No current flows through the circuit.
    d. The battery explodes.

Name: _____

7. Why is it important to match wire gauge with ampere rating?

    a. To make the circuit look neat
    b. To improve energy storage
    c. To prevent overheating or fires
    d. To save electricity

8. What type of wire is commonly used for grounding?

    a. Black
    b. Red
    c. White
    d. Green

9. To which screw is the black (hot) wire attached on a 110V duplex outlet?

    a. Silver
    b. Brass/Gold
    c. Green
    d. White

10. Which wire carries current back to the panel in a typical household circuit?

    a. Black
    b. Green
    c. White
    d. Bare copper

11. How does understanding the path electricity takes help you troubleshoot real-life electrical problems?

12. Why do you think it is important to have a basic understanding of circuits, even if you're not planning to become an electrician?

Name: _____

KEY: Go With the Flow!

Part 1

Directions:

Follow along with the guided notes as your teacher presents them and fill in the activity sheet below.

Fundamentals of Electric Circuits

1. Circuit Terms

   a. _____Simple Circuit_____: A complete circle of current flow. It consists of a source of electricity, one wire to carry the current from the source to where it will be used and another wire to carry it back, plus an object of rated resistance (for example, a lamp) to use the voltage.

   b. _____Branch Circuit_____: Circuits beginning from the service entrance panel and branching out into a variety of places for a variety of purposes

   c. _____Open Circuit_____: Refers to a break in the circuit circle so that the current cannot flow through it

   d. _____Short Circuit_____: A current flow around the circuit resistance and back to the source so rapidly that fuses blow, wire insulation burns and batteries drain

   e. _____Grounding_____: The practice of providing an additional connection between a piece of electrical equipment and the earth with a conductor called a ground wire in case the current gets out of the circuit

2. Components of a Simple Two-Wire Circuit

   a. Wires: A simple circuit has a ___white_____ wire and a ____black_____ wire.

   b. The white wire is known as the ____neutral_____ or _____grounded_____ wire because it is always connected to an underground water pipe or a ground rod through the service-entrance panel.

      I. It must always run direct to every _120-volt_____ outlet.
      II. It must always be connected to a ___neutral_____ terminal (silver-colored).
      III. It never has a fuse or breaker.
      IV. It never has a ____switch_____.
      V. It must be electrically continuous.

- The ___black_____ wire is referred to as the "hot" wire.
- One black wire and one white wire must run to every ___outlet_____.
- Electrical potential always exists between the black wire and the white wire.
- ____Electrical boxes_____: These are boxes made of either metal or plastic, rectangular or octagonal in shape, which have the following functions:

   I. They ___anchor_____ the cable or conduit so stress cannot be placed on wire connections.
   II. They are nailed, screwed or clamped to the building in order to support outlets, switches or fixtures.
   III. They contain all wire connections made outside of _____fixtures_____.

Name: _____

- ____Outlets_____: The most common outlet is the duplex receptacle wired so that both of its outlets are on the same circuit.
- Outlets are wired across the black wire and the white wire.
- The current enters the outlet on the black wire, flows from one screw through a metal strap to the other screw and continues on to the next _____electrical box_____.
- One outlet in a duplex receptacle may be switched by breaking the metal strap between the two screws, but they must be on the same ____circuit breaker_____.
- ___Fixtures_____: They are bases or housings for light bulbs, fan motors and other such electrical devices.
- ___Switches_____: They are electrical devices which provide a means to open a circuit to stop electron flow to outlets or lights and to close it again to allow current flow.
- The wire is usually black except in a __switch loop_____.
- Their ___amperage_____ and voltage ratings must match those of the circuit.
- Their number of poles indicates how many ___hot_____ wires feed through the switch.
- Their number of throws indicates from how many locations a switch can be operated.
- _____Overcurrent Protection Devices_____: Fuses and breakers are always wired to the black (hot) wire.
- ____Entrance Switch_____: It is a switch placed ahead of the fuse in the hot wire where electricity enters the building.

3. Colors of Wires and Terminals in Structural Wiring

b. Colors of Wires

I. _____White_____ (sometimes natural gray) colored wire must be used only for the ground wire.
II. Additional grounding conductors may be ___green_____, green with one or more yellow stripes or a bare wire.
III. Wiring for the "hot" wires may be any other color, but it is most frequently _____black or red_____.
IV. The color schemes most often used for structural wiring are:

a) __Two _____-wire circuit: white and black
b) Three-wire circuit: white, black and red
c) _Four_____-wire circuit: white, black, red and blue
d) Five-wire circuit: white, black, red, blue and yellow

b. Colors of Terminals on Electrical Equipment

I. Natural copper or ____brass_____ terminals are for "hot" wires only.
II. Terminals of a whitish color (such as nickel, tin or zinc-plated) are for _____grounded_____ wires only.
III. Terminals of a __green_____ color are for grounding wires only.

- Grounding wires are those connected to the surface or shell of an appliance or tool to supply a continuous low-resistance path to ground should the surface of the tool or appliance accidentally become energized.

Name: _____

Part 2

Directions:

Watch the video and follow the instructions available at https://www.sciencebuddies.org/stem-activities/paper-circuit?from=Blog to create your paper circuit. Then, complete the questions below.

1. Lay down two smooth strips of copper tape, about a 1/2 inch apart.

   What will these strips do in your circuit?

   These copper tape strips act as the path for electricity to flow through the circuit. One strip connects the positive side of the battery to the positive leg of the LED, and the other connects the negative side to the negative leg of the LED.

2. Attach your LED so the long leg (positive) is on the outer strip and the short leg (negative) is on the inner strip.

   Why is leg direction important?

   LED lights only allow current to flow in one direction. If the legs are reversed, the circuit won't work because the LED blocks the current. The long leg must connect to the positive side and the short leg to the negative.

3. Tape down the LED legs securely to the copper strips.

   How do you know the connection is solid?

   There should be no gaps.

4. Place the battery with the '+' side facing up on the inner tape strip.

   What happens when you press the outer tape to the battery top?

   This completes the circuit, creating a closed loop for electricity to flow. The LED should light up if everything is connected correctly. If not, you may need to check polarity or tighten the tape.

5. Secure with a binder clip or paper clip to hold the connection in place.

   Does your LED light up? What might you need to adjust?

   Answers will vary.

Name: _____

6. Draw your final paper circuit below. Label the following parts clearly:

   - Battery (Source)

   - Copper Tape (Path)

   - LED (Load)

   - Open/Closed Switch (if included)

   Answers will vary.

Reflection Questions

1. What made your circuit successful or unsuccessful?

   Answers will vary.

2. Describe the role of the battery, copper tape and LED in your circuit.

   Answers will vary.

3. What would you change if you built another paper circuit?

   Answers will vary.

Name: _____

Part 3

Directions:

Using your notes from Part 1 and the paper circuits activity, complete the questions below.

1. Which three parts are required to complete a simple circuit?

    a. Source, path and plug
    b. Source, path and load
    c. Battery, LED and glue
    d. Wire, tape and multimeter

2. What is the purpose of the source in a circuit?

    a. To stop current from flowing
    b. To physically connect wires
    c. To provide electrical energy
    d. To protect the circuit from overload

3. Which of the following would most likely be considered a load in a simple circuit?

    a. A wire
    b. A switch
    c. A copper strip
    d. A light bulb

4. What is the role of the path in an electrical circuit?

    a. To generate power
    b. To prevent short circuits
    c. To carry electricity from source to load
    d. To support the battery

5. What does a closed circuit allow that an open circuit does not?

    a. Voltage to increase
    b. Heat to escape
    c. Electricity to flow
    d. Battery life to extend

6. What happens when a circuit is open?

    a. The light shines brighter.
    b. Current flows more quickly.
    c. No current flows through the circuit.
    d. The battery explodes.

Name: _____

7. Why is it important to match wire gauge with ampere rating?

   a. To make the circuit look neat
   b. To improve energy storage
   c. To prevent overheating or fires
   d. To save electricity

8. What type of wire is commonly used for grounding?

   a. Black
   b. Red
   c. White
   d. Green

9. To which screw is the black (hot) wire attached on a 110V duplex outlet?

   a. Silver
   b. Brass/Gold
   c. Green
   d. White

10. Which wire carries current back to the panel in a typical household circuit?

    a. Black
    b. Green
    c. White
    d. Bare copper

11. How does understanding the path electricity takes help you troubleshoot real-life electrical problems?

    Answers will vary.

12. Why do you think it is important to have a basic understanding of circuits, even if you're not planning to become an electrician?

    Answers will vary.