Electricity Unit
Lesson 5 of 7

Insulators vs. Conductors

Created: 12/2025 by the National FFA Organization

Description of Lesson: This lesson introduces students to insulators and conductors 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 the terms *conductor* and *insulator* in the context of electrical circuits.
2. Predict whether common classroom materials will conduct electricity.
3. Test and classify materials as conductors or insulators using a simple circuit.
4. Explain why certain materials are used in real-world electrical applications based on their conductive or insulative properties.

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: https://www.teachengineering.org/activities/view/cub_electricity_lesson04_activity1

Related Resources:

1. SAE Idea Cards, https://FFA.box.com/s/0j0438zo941eymcncgpqabh5iqzzlrpq

Equipment and Supplies Needed:

1. A copy of the “Will It Conduct?” worksheet for each student
   Each group needs:
2. Four wide rubber bands
3. Two or three D-cell batteries
4. One #40 light bulb (available at most hardware stores)
5. One #40 light bulb holder (available at most hardware stores)
6. 2.5 ft (76 cm) insulated wire (gauge AWG 22) (available at most hardware stores)
7. Two in (5 cm) wide strip of aluminum foil (the foil box width should be long enough)
   For the entire class to share:
8. An assortment of solid test objects: Nails or screws (of various metals), glass stirring rod, wooden dowel, cardboard, rubber eraser, rubber shoe sole, plastic utensil, old metal utensil, brass key, cork, copper wire, chalk, aluminum foil, graphite (from a mechanical pencil), plastic pen, feathers, Styrofoam, etc.
9. An assortment of test solutions including: Tap water, Salt water (using distilled water), Sugar water (using distilled water), Baking soda and water (using distilled water), citric acid, vinegar, Gatorade or sports drink
10. Masking tape
11. Distilled water
12. Tap water
13. Marking pen (for labeling the solutions)
14. Wire strippers or sandpaper (to remove insulation at wire ends)

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Vocabulary:

1. Circuit
2. Conductor
3. Current
4. Insulator

Cross-Curricular Connections:

Science
Test and classify materials based on their conductivity.

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/al6gbyhxm4kx51ygabm7xc4jckp7w3wq (Word)
https://ffa.box.com/s/xb50suaw9j6xhgdgr9vzpyhmnc6dr5jn (PDF)
https://docs.google.com/document/d/1XRfTpuIjqgm6b79rwl2qdDT3IiC2IqZEFzLa98EpshI/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

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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 effective plans to solve the problem.

Partnership for 21st Century Skills

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

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Lesson Plan:

1. **Bell Ringer:** List three materials you use every day. Which ones do you think electricity can pass through? Why or why not?

2. **Introduction:** *Electricity doesn't flow through everything. Some materials help it move while others block it. In this lesson, you'll become a materials tester and determine which everyday items are conductors (allow electricity to flow) and which are insulators (stop the flow).*

3. **Activity:** Each student needs a copy of the worksheet "Will It Conduct?"
    a. **Part 1:** Have students watch the video about conductors and insulators found at https://www.youtube.com/watch?v=qZjDMQbn3a0**.** Instruct them to answer the questions on their student activity sheets as they watch.
    b. **Part 2:** Have students follow the procedures below to create their conductivity tester. Visual directions can be found in this video https://youtu.be/HsgiZCAwyh8.

        1. As students move through this activity, be sure to stress safety procedures.
        2. Using wire strippers or sandpaper, strip a 1/2 inch (1.3 cm) of insulation from the ends of each piece of wire to ensure a good connection.
        3. Tape one end of a short piece of wire to the positive terminal of a D-cell battery using masking tape. Connect the other end of the short wire to one terminal of the light bulb holder. To make a good connection, wrap the wire around the screw on the bulb holder terminal in a U-shape. Connect a long piece of wire to the negative terminal of the D-cell battery using masking tape. Connect a second long piece of wire to the open terminal of the bulb holder.
        4. Test your circuit by touching the free ends of wire together. What happens? If the bulb does not light, check all connections and try again. Now, leave the circuit open. We will use this circuit as a conductivity tester.
        5. Use the circuit as a conductivity tester for solid objects. Get materials from your teacher to test. Predict whether each item will conduct electricity. Then, touch the two wire ends to a test object to see if the circuit is completed. How will you know if an item is a conductor or an insulator?
        6. Predict which objects you think will conduct electricity. Record your predictions on your student activity sheet.
        7. Use the circuit tester to determine whether each object is a conductor or an insulator. Record your test results on your student activity sheet.
        8. Make a conductivity tester for liquids: Modify the conductivity tester by adding one or two more batteries in series. Use short pieces of wire to connect the batteries in series.
        9. Carefully wrap aluminum foil around the end of the two open-ended wires to make an electrode. Make each electrode one-inch (2.5 cm) long by 1/4-inch (6 mm) wide.
        10. Test your circuit. Touch the pieces of a foil together to close the circuit. What happens?
        11. Predict which liquids will conduct electricity, recording your predictions on the worksheet. How will you know whether a liquid conducts electricity?
        12. Use the circuit as a conductivity tester for liquids. Test each liquid by submerging the electrodes in the solution and holding the electrodes close *without touching each other*. Be careful to only hold the wire where it is insulated. *Put on new aluminum foil electrode strips for each test.*
        13. Record your test results on the worksheet. How were your results different from your predictions?

4. **Follow-up:** Have students look around the classroom or at home and identify two items that are designed with conductors and two that use insulators. They write a sentence for each explaining why that material was chosen.

5. **Optional – Extended Learning Opportunities (Not factored into time requirement):**

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a. Research one real-world product and describe how it uses conductors and insulators for safety and function. Create a mini-poster or slide summarizing your findings with labeled materials.

6. **Exit Ticket:** Which material you tested today surprised you the most and why?

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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: _____

Will It Conduct?

Part 1

Directions:

Watch the video about conductors and insulators found at https://www.youtube.com/watch?v=qZjDMQbn3a0. Answer the questions below as you watch.

1. Materials can generally be classified into two main groups: _____ and _____.

2. What is a conductor?

3. What are some examples of good conductors?

4. What materials are most electrical wires made of?

5. What is an insulator?

6. What are some examples of insulators?

7. The inner part of an electrical cord is made of _____ while the outer part is made of _____.

8. Why is understanding the difference between conductors and insulators important? Give a specific example of when this would be important and why.

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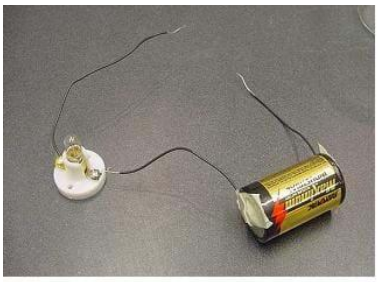
Part 2

Directions:

Follow the procedures below to create your conductivity tester. Visual directions can be found in this video: https://youtu.be/HsgiZCAwyh8.

1. Using wire strippers or sandpaper, strip a 1/2 inch (1.3 cm) of insulation from the ends of each piece of wire to ensure a good connection.
2. Tape one end of a short piece of wire to the positive terminal of a D-cell battery using masking tape. Connect the other end of the short wire to one terminal of the light bulb holder. To make a good connection, wrap the wire around the screw on the bulb holder terminal in a U-shape. Connect a long piece of wire to the negative terminal of the D-cell battery using masking tape. Connect a second long piece of wire to the open terminal of the bulb holder.
3. Test your circuit by touching the free ends of wire together. What happens? If the bulb does not light, check all connections and try again. Now, leave the circuit open. We will use this circuit as a conductivity tester.
4. Use the circuit as a conductivity tester for solid objects. Get materials from your teacher to test. Predict whether each item will conduct electricity. Then, touch the two wire ends to a test object to see if the circuit is completed. How will you know if an item is a conductor or an insulator?



5. Predict which objects you think will conduct electricity. Record your predictions on your student activity sheet.
6. Use the circuit tester to determine whether each object is a conductor or an insulator. Record your test results on your student activity sheet.
7. Make a conductivity tester for liquids: Modify the conductivity tester by adding one or two more batteries in series. Use short pieces of wire to connect the batteries in series.
8. Carefully wrap aluminum foil around the end of the two open-ended wires to make an electrode. Make each electrode one-inch (2.5 cm) long by 1/4-inch (6 mm) wide.
9. Test your circuit. Touch the pieces of a foil together to close the circuit. What happens?
10. Predict which liquids will conduct electricity, recording your predictions on the worksheet. How will you know whether a liquid conducts electricity?
11. Use the circuit as a conductivity tester for liquids. Test each liquid by submerging the electrodes in the solution and holding the electrodes close *without touching each other*. Be careful to only hold the wire where it is insulated. *Put on new aluminum foil electrode strips for each test.*

12. Record your test results on the worksheet. How were your results different from your predictions?

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1. In the space below, draw a picture of the conductivity tester.

2. What happened when you touched the free ends of the wires of the conductivity tester together?

3. How will you know if an object is a conductor or an insulator?

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Name: _____

- In the table below, list the objects you are testing in the left column. Predict whether each object is a conductor or an insulator by placing an X in the Prediction column for conductor if you think it is a conductor or an X in the Prediction column for insulator if you think it is an insulator.

- Test each object to determine whether it is a conductor of electricity. Once you have determined whether it is a conductor or an insulator, place an X in the correct Test Results column.

Solid Object	**Prediction**		**Test Results**	
	Conductor	**Insulator**	**Conductor**	**Insulator**

1. What types of materials are good conductors?

2. What are three examples of insulators?

3. How will you know whether a liquid conducts electricity?

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Name: _____

- In the table below, list the liquids you are given to test. Predict whether each liquid will conduct electricity or not by placing an X in the Prediction column for conducts if you think the liquid will conduct electricity or an X in the Prediction column for does not conduct if you think it will not conduct electricity.

- Test the liquids given to you to determine if they conduct electricity. Once you have determined whether each liquid conducts electricity, place an X in the correct Test Results column.

Liquid	**Prediction**		**Test Results**	
	Conducts	**Does Not Conduct**	**Conducts**	**Does Not Conduct**

Reflection Question:

1. Why is understanding insulators and conductors important?

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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: _____

KEY: Will It Conduct?

Part 1

Directions:

Watch the video about conductors and insulators found at https://www.youtube.com/watch?v=qZjDMQbn3a0. Answer the questions below as you watch.

1. Materials can generally be classified into two main groups: _____conductors_____ and _____insulators_____.

2. What is a conductor?

   Materials that allow electricity to flow through them easily

3. What are some examples of good conductors?

   Metals like copper, aluminum and gold

4. What materials are most electrical wires made of?

   Copper

5. What is an insulator?

   Materials that resist the flow of electricity

6. What are some examples of insulators?

   Rubber, glass, plastic

7. The inner part of an electrical cord is made of _____copper wires_____ while the outer part is made of _____rubber or plastic _____.

8. Why is understanding the difference between conductors and insulators important?

   For safety; misusing could lead to electrical hazards and injuries

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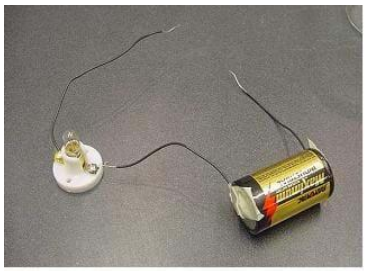
Name: _____

Part 2

Directions:

Follow the procedures below to create your conductivity tester. Visual directions can be found in this video: https://youtu.be/HsgiZCAwyh8.

1. Using wire strippers or sandpaper, strip 1/2 inch (1.3 cm) of insulation from the ends of each piece of wire to ensure a good connection.
2. Tape one end of a short piece of wire to the positive terminal of a D-cell battery using masking tape. Connect the other end of the short wire to one terminal of the light bulb holder. To make a good connection, wrap the wire around the screw on the bulb holder terminal in a U-shape. Connect a long piece of wire to the negative terminal of the D-cell battery using masking tape. Connect a second long piece of wire to the open terminal of the bulb holder.
3. Test your circuit by touching the free ends of wire together. What happens? If the bulb does not light, check all connections and try again. Now, leave the circuit open. We will use this circuit as a conductivity tester.
4. Use the circuit as a conductivity tester for solid objects. Get materials from your teacher to test. Predict whether each item will conduct electricity. Then, touch the two wire ends to a test object to see if the circuit is completed. How will you know if an item is a conductor or an insulator?



5. Predict which objects you think will conduct electricity. Record your predictions on your student activity sheet.
6. Use the circuit tester to determine whether each object is a conductor or an insulator. Record your test results on your student activity sheet.
7. Make a conductivity tester for liquids: Modify the conductivity tester by adding one or two more batteries in series. Use short pieces of wire to connect the batteries in series.
8. Carefully wrap aluminum foil around the end of the two open-ended wires to make an electrode. Make each electrode one-inch (2.5 cm) long by 1/4-inch (6 mm) wide.
9. Test your circuit. Touch the pieces of a foil together to close the circuit. What happens?
10. Predict which liquids will conduct electricity, recording your predictions on the worksheet. How will you know whether a liquid conducts electricity?
11. Use the circuit as a conductivity tester for liquids. Test each liquid by submerging the electrodes in the solution and holding the electrodes close *without touching each other*. Be careful to only hold the wire where it is insulated. *Put on new aluminum foil electrode strips for each test.*

12. Record your test results on the worksheet. How were your results different from your predictions?

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Name: _____

1. In the space below, draw a picture of the conductivity tester.

   Answers will vary.

2. What happened when you touched the free ends of the wires of the conductivity tester together?

   The circuit is complete and the bulb lights.

3. How will you know if an object is a conductor or an insulator?

   If an object is a conductor, the bulb will light. If an object is an insulator, the bulb will not light.

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Name: ___________________________________

- In the table below, list the objects you are testing in the left column. Predict whether each object is a conductor or an insulator by placing an X in the Prediction column for conductor if you think it is a conductor or an X in the Prediction column for insulator if you think it is an insulator.

- Test each object to determine whether it is a conductor of electricity. Once you have determined whether it is a conductor or an insulator, place an X in the correct Test Results column.

Solid Object	**Prediction**		**Test Results**	
	Conductor	**Insulator**	**Conductor**	**Insulator**
Answers will vary.	Answers will vary.	Answers will vary.	Answers will vary.	Answers will vary.
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Answers will vary.	Answers will vary.	Answers will vary.	Answers will vary.	Answers will vary.
Answers will vary.	Answers will vary.	Answers will vary.	Answers will vary.	Answers will vary.

1. What types of materials are good conductors?

   Answers will vary.

2. What are three examples of insulators?

   Answers will vary.

3. How will you know whether a liquid conducts electricity?

   The bulb will light.

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Name: _____

- In the table below, list the liquids you are given to test. Predict whether each liquid will conduct electricity or not by placing an X in the Prediction column for conducts if you think the liquid will conduct electricity or an X in the Prediction column for does not conduct if you think it will not conduct electricity.

- Test the liquids given to you to determine if they conduct electricity. Once you have determined whether each liquid conducts electricity, place an X in the correct Test Results column.

Liquid	Prediction		Test Results	
	Conducts	Does Not Conduct	Conducts	Does Not Conduct
Answers will vary.	Answers will vary.	Answers will vary.	Answers will vary.	Answers will vary.
Answers will vary.	Answers will vary.	Answers will vary.	Answers will vary.	Answers will vary.
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Answers will vary.	Answers will vary.	Answers will vary.	Answers will vary.	Answers will vary.

Reflection Question:

1. Why is understanding insulators and conductors important?

Answers will vary.

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