

III. Using Objects to Complete a Circuit

Target Group: 3rd – 5th grade (meets 4th grade NGSS standard)

Prior Knowledge: This lesson can be used as the 3rd day of the circuit lessons: *Lighting a Bulb* and *Exploring Kinds of Circuits* or as a stand-alone lesson. If used independently, students should have an understanding of basic electric circuits. This should include the knowledge that a circuit is a loop through which electrons can flow from an electricity source → receiver and a familiarity with series and parallel circuits.

Learning Objective: We will use our knowledge of circuits to identify common objects that complete a circuit.

- **NGSS Standard 4-PS3-2:** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
- **CDE Physical Science 1.1:** Energy comes in many forms such as light, heat, sound, magnetic, chemical, and electrical; objects can be either conductors or insulators (1.1.b)
- **CCSS.ELA-Literacy.SL.4.1:** Engage effectively in a range of collaborative discussions (1-on-1, in groups, and teacher-led) with diverse partners on *grade 4 topics and texts*, building on others' ideas and expressing their own clearly.

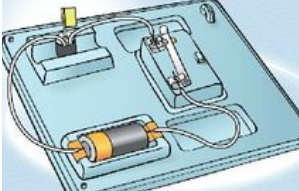
Time: 45 - 60 minutes

Materials:

- Activity Sheet for each student (see below)
- Laptop/computer for each student or pairs
- PhET Sim: [Circuit Construction Kit \(DC Only\)](http://phet.colorado.edu/en/simulation/circuit-construction-kit-dc)
- Materials to create circuits: circuit board, D-cell battery, wires, light bulbs & bulb holders

Time	Procedure	Teaching Tips
5 minutes	<ul style="list-style-type: none"> • <i>Introduction:</i> Review vocabulary and content from prior lessons on circuits. <ul style="list-style-type: none"> ○ A <i>circuit</i> is the pathway that electrons follow to produce electricity. It requires an electricity source (battery) and receiver (bulb). ○ Display a series and parallel circuit and ask students to identify the type and difference between the two. 	<ul style="list-style-type: none"> ✓ In my classroom, our Science Wall displays learned concepts and vocabulary. Students use this as a reference when reviewing previous days' learning.
10 minutes	<ul style="list-style-type: none"> • Have students access the sim: http://phet.colorado.edu/en/simulation/circuit-construction-kit-dc • (#1) <i>Explore:</i> Students will use 5 minutes to make different circuits to light 4 bulbs. • (#2) <i>Turn and Talk:</i> Students will share their 	<ul style="list-style-type: none"> ✓ Keep the exploration to 5 – 10 minutes. Students could continue to work in only this section forever if a time limit is not set! ✓ Monitor student work;

	<p>circuits with the partner, focusing on the following questions:</p> <ul style="list-style-type: none"> ○ What type of circuit did you make? ○ Is there more than one way to design a circuit that will light several bulbs? <ul style="list-style-type: none"> • If time allows, share some circuits as a whole group. Call on different students to create their circuits on the projected laptop. • (#3) <i>Predict</i>: Ask students: What will happen if you split the junction between the 2 wires? Allow them to share predictions. • Use the sim to test student predictions. This can be done by students on their own laptops or on projected laptop for class to see. 	<p>support struggling students if needed by using prompting 'what if' questions such as "What if you tried a parallel circuit?" "What if you added more batteries?"</p> <ul style="list-style-type: none"> ✓ Have chosen students replicate their circuits on the class laptop (projected) during the explore. This will save time, as they can be displayed but will not have to be created during discussion.
15 minutes	<ul style="list-style-type: none"> • <i>Discussion</i>: Introduce today's first inquiry question: "Can common objects be used to complete a circuit?" • Have students <i>turn and talk</i> to discuss ideas and make predictions. • (4) Students will create a simple series circuit, replicating the schematic drawing on their activity sheet. • Once students are successful in lighting the bulb, they will test the common objects in "grab bag" and record their results in the chart. • Tell students to think like scientists and observe each object carefully. 	<ul style="list-style-type: none"> ✓ If a student needs help, encourage him/her to talk with their partner to try to solve the problem before you offer guidance. ✓ Monitor student work and discussion so that you can highlight important findings when you meet to share as a whole group
10 minutes	<ul style="list-style-type: none"> • Students will complete and discuss # 6. Facilitate discussion of similarities/comparisons between successful objects and unsuccessful objects. • Students should determine that the 2 objects made of metal allowed the current to pass through the circuit. Ask students if any other objects in the grab bag should complete the circuit based on this rule. (<i>The pencil lead!</i>) • Students will most likely say that the bulb did not light when using the lead and, therefore, pencil lead does not let electricity flow through it. If possible, project the circuit with the pencil for students to see and ask them to watch the electrons closely. • Students will notice that the electrons are 	<ul style="list-style-type: none"> ✓ For both #6 & 7, you either might give students time (a minute or 2) to write down their own ideas before sharing or have them turn and talk before recording ideas. Whichever works in your classroom, I do think it's important to have students write their responses, as it holds them accountable.

	<p>moving very slowly, but the lightbulb does not light. Ask students how they could increase the speed of the electrons. (<i>Add batteries!</i>) Test with students.</p> <ul style="list-style-type: none"> • Have students complete #11, generating a list of other objects that would allow electricity to flow and complete the circuit. 	
5 minutes	<ul style="list-style-type: none"> • Once students have demonstrated an understanding of this concept, introduce the terms <i>conductors</i> and <i>insulators</i> and add to science wall. <ul style="list-style-type: none"> ◦ Conductors are objects that conduct electricity by allowing electrons to flow through them. Objects that do not allow electricity to flow through them are called insulators. 	<p>In my classroom, we have a Science Wall to anchor student learning. Each time new vocabulary or concepts are introduced, the word, definition, and an illustration/picture (often depicted by a student) are added to the wall. Students use the Science Wall as a reference throughout units.</p>
15 minutes	<ul style="list-style-type: none"> • Optional activity: In our classroom, which objects are conductors and which are insulators? Can you design a circuit that can be used to test your predictions? • Show students possible materials: circuit boards, D-cell batteries, wires, and light bulbs. Tell students they may use whichever materials need to create a real life circuit to test classroom objects. • Once students have designed a circuit that can test, allow them to build it and explore the classroom, searching for conductors. 	<ul style="list-style-type: none"> ✓ Show students the materials that they can use. If accessible, a circuit base like this one makes it much easier for students to walk around testing objects.  ✓ Some pairs or teams may develop a design before others. If a team is struggling to design or make a working conductor tester, have another group support them OR ask prompting questions to guide their thinking.

Using Objects to Complete a Circuit

Objective: We will use our knowledge of electric circuits to identify common objects that complete a circuit.

1. **Explore:** Take 5 minutes to explore the sim. Make several different circuits that light 4 light bulbs. Draw one working circuit below.



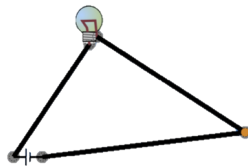
2. **Turn and Talk:** Share your working circuit with your partner.
- What type of circuit did you make?
 - Is there more than one way to design a circuit that will light several bulbs?



3. **Predict:** What will happen if you split the junction between 2 wires in a working circuit?

Inquiry Question: Can common objects be used to complete a circuit?

4. **Let's test it!** Using 3 wires, a battery, and a bulb, create the following series circuit:



5. Open your circuit by disconnecting two of the components. Click on "Grab Bag." Try to close the circuit using each item and complete the table below.

Grab Bag Item	Did the bulb light?	
Dollar	Yes	No
Paper Clip	Yes	No
Penny	Yes	No
Eraser	Yes	No
Dog	Yes	No
Hand	Yes	No
Pencil Lead	Yes	No

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Comment [1]: Keep this time limited. It is not the focus of the lesson and students could work on this part for hours! Some kids may make 1 circuit, others may make several.

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Comment [2]: Have students come up to create their working circuits on the class laptop while others continue to explore. This will save time when sharing.

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Comment [3]: Discuss predictions - in partners, small groups, or whole class. Then test predictions on the circuits already projected on board.

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Comment [4]: Have students talk about their ideas and predictions here.

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Comment [5]: Students should Reset All here. Prompt if needed.

6. What do the materials that were able to light the bulb have in common?



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Comment [6]: Once students come to the conclusion that both of the metal objects allowed electricity to flow, ask if any other objects in the grab bag should complete the circuit based on this rule. Draw students' attention to the pencil lead. Did anyone observe anything happening in the circuit? Project the circuit with the pencil, if possible. If not, have all students test the lead again. They should notice that the electrons move very slowly, but the lightbulb does not light.

7. What other objects would complete the circuit?



These objects are called **conductors** because they conduct electricity by allowing it to flow through them. Objects that do not allow electricity to flow through them are called **insulators**.

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Comment [7]: Ask students what they could do to increase the speed of the electrons to light the bulb more brightly. (Add batteries!) Test this (and other suggestions) with class.

*8. Look around our classroom. What objects do you see that you are **conductors**?

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Comment [8]: Optional extension; Dependent upon time and materials.

9. Using our classroom circuit materials, design a circuit that would allow you to test these classroom objects. (Think about how you tested the grab bag objects!)

My Design:

10. Build the circuit and test the classroom **objects** that you predicted!

Conductors:

Insulators:

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Comment [9]: If time allows (or the following day), talk about classroom conductors and insulators. Some classroom objects – staplers, mounted white boards, wall joints – might surprise students!