littleBits education

LITTLEBITS LESSON

INTRODUCTION TO LITTLEBITS
Grade 3: Simple Input Circuits

LESSON OVERVIEW

This lesson provides a structured way to introduce littleBits to your students for the first time while they begin to explore fundamental scientific concepts related to polarity, energy transfer, and circuit connectivity. They will start by exploring Bit Basics (e.g. color-coding, magnetic connections, the importance of order) and connect these concepts to basic science about the flow of energy through circuits. Once they've built their understanding of these core ideas, they will engage in short rounds of mini-challenges to explore simple input Bits, gain confidence, and spark their imagination.

LESSON TAGS

GRADE LEVEL

elementary (grade 3)

SUBJECTS

engineering
design
science

DIFFICULTY

beginner

DURATION

60 minutes (minimum)

*For tips on how to break up your lesson over multiple class periods, see STEAM Student Set Teacher's Guide, pg. 117

PREREQUISITE KNOWLEDGE

None (this lesson is designed as a first introduction to littleBits)

SUPPLIES

BITS

ACCESSORIES

OTHER MATERIALS

TOOLS USED

power, button, slide dimmer, pulse, RGB LED (Create, Play sections) littleBits STEAM Student Set (Remix section)	battery, power cable	see list of commonly used materials on pg. 119 of the STEAM Student Set Teacher's Guide	Purple screwdriver (included in the kit)

DESCRIPTION

LESSON OBJECTIVES

By the end of the lesson, students will be able to:

- Build a complete series circuit while demonstrating knowledge of how the Bits connect via magnets;
- identify and understand the functional grouping of the color-coded Bits: powers, inputs, and outputs;
- describe how current changes in a series circuit when a component is added or removed;
- demonstrate knowledge of the directional flow of energy through a circuit;
- understand why the order of Bits is important to establish polarity; and,
- make connections between Bits and real-world applications.

ASSESSMENT STRATEGIES

There are checklists embedded throughout the lesson that can be used to assess students' understanding as they explore the basic principles of circuits and littleBits. Additionally, you can review the circuits students make during the mini-challenges to assess their understanding of building littleBits circuits.

STANDARDS

For curricular connections, refer to the "Extensions" section at the end of this lesson.

VOCABULARY

input	current	wire	switch
output	polarity	magnetism	
power	signal	positive	
series circuit	circuit	negative	

RESOURCES

INSPIRATIONAL LINKS

TED Talk: Building Blocks that Blink and Teach - Ayah Bdeir

HELPFUL LINKS

Bit Basics PDF (This can also be found on pg. 4–5 of the Student Invention Guide.)
littleBits basics (video)
Pulse Bit 101 (video)
Pulse circuits (video)
STEAM Student Set (SSS) Teacher' Guide
STEAM Student Set Invention Guide (the version that matches your Kit can be found within the SSS boxes)

TIPS & TRICKS

Before starting the lesson, establish your classroom set-up and clean-up protocol. Establishing good habits will help ensure Bits are taken care of in the classroom. See pg. 117 of the STEAM Student Set Teacher's Guide for additional classroom management tips.

INSTRUCTIONAL STEPS

STEP 1: SETUP - Prior to Class

This lesson can be done individually or in small groups (2–3 students). Each group will need at least one STEAM Student Set and an Invention Guide.

Take the battery, cable, power, button, slide dimmer, pulse, and RGB LED Bits from each kit. These Bits and accessories will be used in the Create and Play sections. Students will have access to the rest of the Bits in their kit during the Remix section.

STEP 2: INTRODUCE

Duration: 5-10 minutes

Begin the lesson by introducing students to littleBits. Explain that littleBits are electronic building blocks that snap together to turn their ideas into inventions! Tell students that they will get to play with the Bits, learn how they work, and get to know the science behind electronics in our everyday lives.

Ask students to brainstorm ways in which we use and rely on electronics in our everyday lives. For example you might ask students to identify:

- Toys that use batteries;
- gaming systems that have to be plugged in;
- appliances that cook our food or clean our clothes; or
- lights that help them see at night.

Invite students to imagine and discuss the ways in which our lives would be significantly different without electronics. Make a connection by explaining to students that they are going to use littleBits to experiment and investigate with circuits to better understand how electronics work.

If you are completing the grade 3 engineering design unit, explain that after they learn how the Bits work, they will get to invent their own art robot and even build a chain reaction contraption!

You may want to show this one-minute "Welcome to littleBits" video to provide context and get students excited: https://youtu.be/YUUsJSDa7PE

STEP 3: CREATE

Duration: 25-35 minutes

GET TO KNOW THE BITS

Distribute a single power Bit and an output Bit (RGB LED) to each student or group. Encourage them to explore how the Bits connect. After a moment of exploration, ask students to share what they have observed and learned about the Bits. For example, students might notice:

- The Bits are color-coded/different colors;
- they snap together; and,
- there are magnets on the ends.

BUILD A SERIES CIRCUIT

Tell students that they're ready to make a functioning circuit with the Bits. If you or your students need additional support, refer to the littleBits Basics in the Invention Guide. Introducing this "cheat sheet" at the end is also a good way to review and visualize what the students have just learned.

Now, distribute a battery and cable to each student or group. Provide a few minutes for students to explore their Bits independently. IAsk students to build a circuit that will light the RGB LED. Identify the green Bits as outputs: these are the "doers" of the circuit.

When each student/group has created a complete circuit, ask them to explain:

- What role does the blue Bit play in the circuit, and how can you tell that its "ON"?
- Does the order of assembly matter?
- How do you know that the circuit is working?
- How could you stop it from working? (They could disassemble the Bits to break the connection, disconnect the battery/cable from the power Bit, or turn off the switch on the power Bit)

Explain to students that what they just built is called a series circuit. A series circuit is a pathway through which energy can flow in one direction. Tell students that their circuit has three basic components. Ask students to point to the:

- power source (the battery)
- conductive pathway (the battery cable and the blue power Bit)
- output (the "doer" of the circuit that's using the energy, in this case the RGB LED)

MAKE A CONNECTION

Tell students that when the parts of a circuit are connected correctly, this allows energy to flow from one Bit to the next. We see this energy as light on the RGB LED. When you remove one part or change the order of the Bits, you break the flow of energy. If the parts of a circuit are not connected correctly, then the energy doesn't have a pathway and that's when we see the light go out.

To further demonstrate the idea of Connection and Energy Flow in circuits, have students stand in a circle and hold hands. Explain that you represent the battery in a circuit. Start the flow of energy by giving the student on your right-hand side a small squeeze. When the student receives the squeeze, they pass it on to the person on their right. Continue to pass the energy squeeze around the circle several times.

Then, ask two students to stop holding hands. Pass the squeeze again and ask students to describe what happened. Invite them to wonder what happens to the energy when there is a break in the pathway. Ask students for ideas about how they could fix their "circuit" to get the energy flowing again.

Reinforce the idea that circuits require a complete loop through which energy can pass.

Now, ask one student to turn around and face outside of the circle while the rest of the group is facing in. Remind students they can only receive the squeeze with their left hand and pass it on with their right hand.

Start the flow of energy by giving the student on your right-hand side a small squeeze, just as before. Ask students to describe what happens when the energy squeeze reaches the student facing in the wrong direction.

Reinforce the idea that energy flows through a circuit in one direction. Ask students for ideas about how they could fix their "circuit" to get the energy flowing again.

EXPLORING POLARITY

Explain to students that they will use littleBits to explore these ideas in the circuit they've built.

Ask students to look closely at their circuit. Have them "flip" the direction of the output Bit (so either the Bit is upside down or the name of the Bit is upside down

in front of them) and describe what happens (the magnets push back). Remind students that energy can only flow when the pathway is complete, and it can only flow in one direction—just like when they were holding hands in a circle. Ask students to explain:

- What happens when you flip the Bit? (You change the direction of the energy flow.)
- Why do the magnets push back? (The poles no longer match and repel each other. This design by littleBits is meant to show us that our energy pathway is disrupted.)
- How do you know that you are connecting Bits the right way?

Have students locate and describe the (+) and (-) symbols on the top of the battery cable. Explain that the positive (+) and negative (-) poles on the battery control the direction that the energy flows through the circuit. In science, this is called polarity.

Ask students to use their fingers to trace the path and direction of the energy through the circuit: from the (+) pole on the battery, through the wire, through the power Bit, through the LED, and back again into the (-) pole on the battery. Ask students to explain:

- Where does the energy go after it returns to the negative pole on the battery? (It flows back into the positive pole and continues the loop over and over again.)
- How do you know that the energy is continuously flowing? (The LED stays lit.)
- What do you think the arrows found near the top left and right sides on the white part of the Bits mean? (They show the direction that the energy flows into and out of the Bit. This is also a good reminder of which way the Bits will connect in your circuit!)

MINI-CHALLENGE 1

Announce that it's time for their first invention challenge! Using the Bits they've

learned about so far, challenge students to build a white reading light that you can use to secretly read books under the covers at night. How can you quickly turn it on and off so you don't get caught?

Hint: Use the color slider or purple screwdriver (depending on which version of the Bit you have) to adjust the color output of the RGB LED to white.

ASSESSMENT CHECK-IN

Move about the room and observe students as they tackle the challenge. Evaluate student understanding with the following questions:

- Do students connect the Bits correctly to create an energy pathway?
- Can students name the basic components of their circuit?
- Can students adjust the Bit settings to create a white light output?
- Can they provide a simple solution for turning on and off the circuit?

SWITCH IT UP

Distribute a pink button Bit to each student or group. Ask students to connect the button Bit between the blue power Bit and the green LED. Have students turn the power on and describe what happens.

Identify pink Bits as inputs: these are the controllers of the circuit. They control how the energy flows through the circuit pathway. Explain to students that this "switch" controls the flow of energy.
Give students a few minutes to explore their new circuit. Ask them to explain:

- What happens when you press the button?
- What is happening to the flow of energy when the button is pressed?

- What happens when you release the button?
- You've created a complete circuit, so why doesn't the LED stay lit?
- What happens when you move the pink button to a position after the green LED Bit?

Provide rationale for why everyday electronics would require switches to control the flow of energy (light dimmers, fans, ovens, etc). Reinforce that when a circuit switch is "on" the energy is allowed to flow through the complete pathway.

STEP 4: PLAY

Duration: 10 minutes

Provide the following mini-challenge and allow students time to build upon their reading light circuit. Students have access to the previous Bits plus the remaining simple input Bits from the kit (slide dimmer and pulse).

MINI-CHALLENGE 2

Improve your reading light circuit from Mini-Challenge 1. How could you change the brightness and use it as a dim nightlight when it's time to go to sleep?

Hint: Use the slide dimmer to control the brightness of the LED.

ASSESSMENT CHECK-IN

Move about the room and observe students as they tackle the challenge. Evaluate student understanding with the following questions:

- Do students correctly identify and connect the slide dimmer Bit?
- Do students arrange the Bits in the correct order?

- Can students explain why they connected the Bits in that order?
- Can students explain the function of the input Bit in controlling the flow of energy through the circuit?

STEP 5: REMIX

Duration: 10 minutes

As students wrap up the challenge, explain that they will continue to build on their inventions by adding additional Bits into the mix!

Hand out the rest of the STEAM Student Set materials to each student or group, and instruct them to open their Invention Guides to the Bit Index. The Bit Index lists each Bit, describes what it does, how it works, and provides some real world analogies.

Students can use the Bit Index to spark their imagination for building with the Bits. These pages will be an important resource as your students learn and grow with littleBits.

MINI-CHALLENGE 3

Let's change it up! How could you remix your circuit to build a game show buzzer that makes a noise and lights up when you know the answer? How could each contestant light up a different color?

Hint: Think about how each input Bit controls the flow of energy. Which input

would work best for a game show buzzer?

ASSESSMENT CHECK-IN

Move about the room and observe students as they tackle the challenge. Evaluate student understanding with the following questions:

- Do students remix their circuit with the button and buzzer Bits?
- Can students adjust the Bit settings to create different colors?
- Can students explain why the order of the BIts is important?

Troubleshoot any common problems being encountered, and share successful building strategies discovered by groups.

STEP 6: SHARE

Duration: 5-10 minutes

Wrap up the lesson by reviewing what students have learned about how Bits work. Strategies include:

- Have students refer to their notes from the mini-challenge activity and say a "Today I learned…" statement;
- crowd-source a list of vocabulary terms they remember as you write them on the board;
- raise their hands if they used a given Bit in their circuit as you read a list; and/or,
- discuss struggles and successes encountered while addressing the challenges.

Conclude the discussion by asking students how the circuits they made compare to circuits they've seen in the real world.

STEP 7: CLOSE

Duration: 5 minutes

At the end of the lesson, students should put away the Bits according to the diagram on the back of the Invention Guide, clean up their materials and hand in their papers.

STEP 8: EXTENSIONS

Incorporate the following extension in the Remix section of this challenge to bolster your lesson's NGSS applications:

> 3-PS2-4 MOTION AND STABILITY: Define a simple design problem that can be solved by applying scientific ideas about magnets.

To fulfill this standard, support students in using the Bits to develop a model of how magnetic forces between a pair of objects do not require that the objects be in contact. Have students determine the forces between the Bits at different distances apart, and with different orientations relative to each other.

Students can also describe how magnets are used in the littleBits design to show that the energy pathway is disrupted. Support students as they define the problem and explain how the problem is solved through the development of magnets on the Bits.

LOOKING AHEAD

In the next lesson, students apply what they've learned about littleBits and circuits to approach new invention challenges with creative confidence. They are introduced to the littleBits Invention Cycle, a process that can help guide them through the invention and engineering design process in a more formalized way.