littleBits education

LITTLEBITS LESSON

INTRODUCING LITTLEBITS

LESSON OVERVIEW

This lesson provides a structured way to introduce littleBits to your students for the first time. They will start by exploring Bit Basics (e.g. color-coding, everything connects with magnets, order is important). Once they've built their understanding of these core ideas they will engage in short rounds of mini-challenges to explore all their Bits, gain confidence, and spark their imagination.

LESSON TAGS

GRADE LEVEL	SUBJECTS	DIFFICULTY	DURATION
elementary, middle	engineering design	beginner	60 minutes

PREREQUISITE KNOWLEDGE

none

SUPPLIES

BITS	ACCESSORIES	OTHER MATERIALS	TOOLS USED
power, button, RGB LED, servo, wire mini challenge: littleBits STEAM Student Set	battery, power cable, purple screwdriver	see list of commonly used materials on pg. 119 of the STEAM Student Set Teacher's Guide	timer

DESCRIPTION

LESSON OBJECTIVES

By the end of the lesson, students will be able to:
- Identify and understand the functional grouping of the four color-coded Bits: powers, inputs, outputs, wires
- Use logic to create basic circuits
- Demonstrate knowledge of how the Bits connect via magnets

• Make connections between Bits and real-world applications

ASSESSMENT STRATEGIES	There are questions embedded throughout the Exploratory and Guided portions of this lesson that can be used to assess students' understanding as they explore the basic principles of 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 "Extension" section at the end of this lesson.

VOCABULARY

input
output
power
signal
circuit
wire
magnetism

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) STEAM Student Set (SSS) Teacher' Guide
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

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.

If the servo hub is not already on the servo Bit, attach it before the lesson (this makes it easier to see how the servo motor spins). See the Invention Guide for instructions on attaching the servo hub.

STEP 2: INTRODUCE

Duration: 5 minutes

Begin by asking students to brainstorm ways in which we use and rely on electronics in our everyday lives. In small groups or as a class, ask students to rank the top five electronic devices they couldn't live without, providing rationale for the ways in which our lives would be significantly different without electronics.

Ask the class if anyone knows how these electronics work. If you have already completed a unit on circuits and electricity, use this opportunity to provide a brief review of relevant vocabulary (e.g. circuit, signal, power, input, output, wire).

After this introduction, explain to students that they are going to begin experimenting and investigating with circuits to better understand how these electronics work. The tool that they'll be using is called littleBits. You may want to show Ayah Bdeir's TED Talk to provide context and get students excited.

STEP 3: CREATE

Duration: 20 minutes

Distribute a single input Bit (button) and an output Bit (RBG LED) to each student and encourage them to explore how the Bits connect. After a few minutes, ask students to share what they have observed and learned about the Bits (for example, they are color-coded, they snap together, there are magnets on the ends). Write responses on the board. Discuss how the magnets will indicate if you have correctly connected the pieces (could you feel the pieces repel if they were aligned the wrong way?).
Helpful tip: Point out the arrows on the top of the Bit; they will always point to the right when currently aligned.

Now it's time to make a functioning circuit. Choose exploratory or guided instructions below, depending on the age and ability of your students. 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.

EXPLORATORY:
Distribute additional parts to each student or group: power Bit, battery, cable, purple screwdriver, servo and wire Bit. Again, provide a few minutes for students to explore their Bits independently. Through experimentation and trial and error, students will naturally learn how to assemble Bits. It is important to provide students with this opportunity and get them comfortable with the Bits. After a few minutes of exploration, ask students to share what they have observed and learned about assembling the Bits. Use guiding questions to promote deeper understanding and engage students in active inquiry.

EXAMPLE GUIDING QUESTIONS:
• How do you know that you are connecting Bits the right way?
• How can you tell the top of the Bit from the bottom?
• Does the order of assembly matter?
• What do the colors mean?
• What happens when a pink Bit comes after a green Bit?
• What role does the blue Bit play in the circuit (and how can you tell that it's powered on)?
• Did you notice that some Bits are adjustable? Who can demonstrate how to use the switch on some Bits, or use the screwdriver to make changes to the functionality of one Bit.

Within this discussion, use and define the following terms in relation to the Bits: circuit, power, input, output, wire, switch.

GUIDED:
Some students or classes may need a bit more support and focus through this first circuit-building exercise. An alternative pathway is detailed below (note the order in which the Bits and other tools are distributed). Each step in this introduction has accompanying questions you can use to assess students' understanding of the material:

Identify Bit anatomy as a class. Pick up the button or RGB LED from the table. Take time to make sure each student can recognize the top, bottom, and feet of the Bit.
Q: How can I tell the top of the Bit from the bottom of the Bit?
A: The top has the name of the Bit written on the white circuit board. The bottom of the Bit has four feet or legs (like a table).

Hand out the blue power Bit, battery and cable. Have students connect the cable and battery to the power Bit. Use the little black switch to turn the power Bit on (it will shine red).
Q: How can I tell if the power Bit is on?
A: A red light on the Bit will shine.

Instruct students to connect the power Bit to the RGB LED. Identify green Bits as outputs: these are the "doers" of the circuit.
Q: What happens when you connect power to an output?
A: The power Bit gives power to the LED, so it turns on.

Pick up the pink button and add it in between the blue and the green Bits. Identify pink Bits as inputs: these are the controllers of the circuit.
Q: What happens when the button is pushed?
A: The light turns on.

Point out that the order your Bits are in affects how they function.
Q: What happens when you move the pink button to a position after the green LED Bit?
A: The button can no longer control the LED - inputs only control Bits that come after them.

Hand out the servo motor and attach it to the end of this circuit (power > RBG > button > servo). Let students explore how the motor functions. Ask the class about any observations they've made. For example, they may notice that the motor turns back and forth.

Point out the switch on the servo Bit. Have students flip the switch to SWING mode and press the button. Then have them flip the switch to TURN and press the button. They should notice that in SWING mode, the servo continually moves by itself when the button is pressed; but in TURN mode, the servo moves 90* when the button is pressed, and moves back to its original position when the button is released.
Q: What does adjusting the switch do to the Bit?
A: It changes how the servo motor moves.

Finally, to practice adjusting the Bits, have the students change the RGB settings with the small purple screwdriver (hand this out).
Q: What happens when you adjust the dials on the Bit?
A: The light changes color.

Point out that there are other Bits in the STEAM Student Set with switches and dials for making adjustments. They can explore how those switches work when they try those Bits later.

Hand out an orange wire Bit and see how that affects the circuit.
Q: What does the wire do?
A: It connects Bits together and lets you place Bits farther apart or turn corners.

STEP 4: PLAY

Duration: 10 minutes

Hand out a piece of paper, pencil/pen and the rest of the STEAM Student Set materials to each student or group, and instruct students 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. Each page also contains a mini- challenge to help familiarize students with the Bit, and spark their imagination for building with the Bits. These pages will be an important resource as your students learn and grow with littleBits.

Assign one Bit/mini-challenge to each student or group. Give students no more than 5 minutes: 1–2 minutes to read through the instructions/try out a basic circuit and 2–3 minutes to tackle the challenge. Set a timer. At the end of the time, have each student draw or describe their circuit for an additional 2–3 minutes. What did they learn about their Bit? How did they meet the challenge?

Assign another round of Bits and continue the exercise. Walk around the room and troubleshoot any common problems being encountered, and share successful building strategies discovered by groups.

STEP 5: REMIX

Duration: 10 minutes

If time allows, continue the exercise, allowing students to choose which Bits they want to tackle. You can ask students to make more than one solution to each prompt, or ask them to think of some real-world analogies for what they're making. Be sure to set separate timers for play and recording to keep students moving through the challenges.

STEP 6: SHARE

Duration: 10-15 minutes

Wrap up the lesson by reviewing what students have learned about how Bits work; have students refer to their notes from the mini-challenge activity. Read off the names of different Bits and have groups raise their hands if they used the Bits in their circuit. Ask students what they learned about the focal Bit and discuss struggles and successes encountered while addressing the challenges. How do the circuits students 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 one (or more) of the following extensions 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.

MS-PS2-5 MOTION AND STABILITY: Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

To fulfill the above standards, design a careful experiment with the magnets that couple the Bits together.

4-PS3-2 ENERGY: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electrical currents.

To fulfill this standard, explore how the Bits connect and tell a story about how energy moves from place to place in the circuit; what form it might be in at different times. E.g. LEDs and motors convert electricity to light and motion, respectively. Sensors convert light, motion, or heat to an electrical signal.