littleBits education

LITTLEBITS LESSON

INTRODUCING THE LITTLEBITS INVENTION CYCLE

LESSON OVERVIEW

This lesson will introduce students to the littleBits Invention Cycle, a process that can help guide students through the invention and engineering design process. Students will start the lesson with a 15-minute challenge using littleBits. The class will then reflect on their process and learn how their experience connects to the littleBits Invention Cycle.

LESSON TAGS

GRADE LEVEL	SUBJECTS	DIFFICULTY	DURATION
elementary, middle	engineering art/design	beginner	1 hour

PREREQUISITE KNOWLEDGE

Introducing littleBits

SUPPLIES

BITS	ACCESSORIES	OTHER MATERIALS	TOOLS USED
STEAM Student Set	STEAM Student Set	notebook or copier paper for making paper balls (or a collection of similar small objects) see list of commonly used materials on pg. 119 of the STEAM Student Set Teacher's Guide	Phillips-head screwdriver timer masking tape

DESCRIPTION

LESSON OBJECTIVES

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

- Create a circuit containing a power source, inputs, outputs and wires

• Identify and explain the value of each phase of the Invention Cycle

ASSESSMENT STRATEGIES

During the final one minute of the challenge, students will be able to demonstrate their ability to create a functional circuit using littleBits.

There are questions embedded throughout the Share and Close steps of this lesson that can be used to assess students' understanding of the core concepts of the Invention Cycle.

STANDARDS

3-5-ETS1-1 Engineering Design
Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
Performance Expectation

3-5-ETS1-2 Engineering Design
Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

VOCABULARY

invention
prototype
engineer
designer
remix
power
input
output
wire
circuits
magnetism

RESOURCES

ATTACHMENTS

STEAM Student Set (SSS) Teacher's Guide

TIPS & TRICKS

We suggest removing the buzzers and environmental sensors (light, temperature sensors) from the STEAM Student Sets for this activity; they aren't essential tools to run the challenge and may be distracting.

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

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 Invention Guide. We suggest handing out the Bits in the Create phase to keep students focused on initial instructions and review activities.

For more experienced users, you may want to provide access to additional Bits in the Play and Remix phases to provide a greater diversity of circuit combinations.

Set up a central location in the classroom for assorted materials and tools that students will use to build their inventions.

For each group, use masking or painter's tape to create two 1 ft. by 1 ft. squares on the floor. The squares should be about 3 ft. apart (with no obstructions between). You will also need to create a collection of roughly equal-sized crumpled paper balls. Students will be using their Bits and the construction materials to invent ways of moving the paper balls from their starting square to their goal square.

STEP 2: INTRODUCE

Duration: 10 minutes

Introduce the lesson objectives and the concept behind the challenge:

You can begin the lesson with some of the following questions to frame the activity:
- How do they make sure their projects work?
- What do engineers and designers do?
- How do they figure out what to make?

- What happens if the project doesn't work?
- How do they get better at the work they do?

Explain to the students that they are going to use Bits to complete a short engineering design challenge so they can experience how engineers and designers work.

Introduce the challenge to the students:

Using Bits and the provided craft materials, groups will need to move as many paper balls from one square (starting square) to the other (goal square). Each team will be given 15 minutes of work time to create and test their inventions. The final test will happen after this period. Each group will have one minute to move as many balls as they can from their starting square into their goal square.

Teams must agree on the following rules/constraints:

• They can only use their Bits and the construction materials provided.
• Balls can only be sent to the goal square if a littleBits circuit is causing them to move. Students cannot touch the balls on their way to the goal (e.g. students can use the Bits to push, throw, or carry balls to the goal, but can't throw or carry the balls themselves)
• At any point, students can add more balls to their starting circle.
• Balls must be in the goal square at the end of the one minute in order to be counted.

STEP 3: CREATE

Duration: 15-20 minutes

Now the students will begin the challenge. Once each group is familiar with the rules, pass out the Bits and materials, start a timer with 15 minutes on the clock (you can adjust the time to 20 minutes for younger students), and announce that teams may begin building. Either place the timer in a prominent place, or announce the time every five minutes so teams can try to pace themselves appropriately.

Walk around the room and observe how the groups work. These observations will be helpful during the next step when the class discusses their process. Here are some things to keep your eyes open for:
• How do the groups start working? Some may begin by planning, while others will dive in and start with hands-on experimentation.
• Do the groups try to execute one single plan or do they experiment with several different approaches to determine what works best?
• How do groups decide what to build or what changes to make?
• How often are their experiments unsuccessful? Do they get discouraged?
• How often are their experiments successful and kept as part of the project?

When the timer goes off, have each group collect the paper balls and prepare for their one-minute challenge.

STEP 4: PLAY

Duration: 5 minutes

Run the one-minute challenges. You can use half of the students as timers and counters, while the other half try to move balls to the goal squares, and then flip the groups. Alternatively, you can have each group go one at a time so all students get to watch each invention perform. Record each team's times on the board.

STEP 5: SHARE (+ REMIX)

Duration: 20 minutes

Once all the one-minute challenges are complete, gather the students together to reflect on their process. The goal of this discussion is to have the students reflect on each group's design and engineering process so you can draw connections between their methods of working and the littleBits Invention Cycle.

Create four empty columns on a whiteboard (or use four large sheets of paper). Each column will help explain a step of the Invention Cycle, but don't label the columns yet.

In the first column, you will put responses relating to the Create phase. To get students thinking about how they got started, you could ask:

• How did you come up with ideas for what to build?
• How did you decide what to do first?
• Were everyone's designs the same?
• Was your project complete after putting it together the first time? Why not?

In the second column, you will put responses relating to the Play phase. To get students to think about how they used and tested their prototypes, you could ask:
• When was the first time you used what you were working on? Did you ever give it a test? How did it go?
• Why is it important to test what you are working on?
• What could you do with what you learn from testing?
• What did you learn from playing with it?
• Did anyone's invention not work the way they hoped when they played with it?
• Was your invention complete after using it the first time? Why not?

In the third column, you will put responses relating to the Remix phase. To get students thinking about how they experimented with and improved their inventions, you could ask:
• Did anyone make changes or improvements to their inventions after they played with them?
• Did anyone try more than one approach/method?
• What was the weirdest idea you tried? What did you learn from it?
• How many different ideas do you think you tried?
• How did you decide which method was the best?
• Why might you want to try more than one way of doing something?

In the fourth column, you will put responses relating to the Share phase. To get students thinking about how to share and why it is important, you could ask:
• After seeing what others have done, do you think you could do it even better now?
• Were there ideas others had you would like to try?
• Did anyone have something to say to you about your invention, maybe some praise or a suggestion?
• Why might you want to share the work you've done with others?
• Why might you want to listen to others share what they've done?

REMIX

Allow students an additional 10 minutes to remix/improve their inventions and run the trial again. Record the second trial scores for each team on the board. Subtract the second trial from the first trial to get each team's "growth score" (how well they improved between each trial).

STEP 6: CLOSE

Duration: 10 minutes

Now you will summarize and connect the lesson to the Invention Cycle. Once all the columns are filled, verbally summarize the main ideas in each and draw attention to what they went through as a process. For example:

In the first phase they created a bunch of ideas, picked one of them, explored the Bits to see how they could help, and created a prototype of their idea. After summarizing, write Create at the top of the first column to highlight these ideas.

Next, they tested their idea by playing with it. They learned which parts of their ideas were on the right track and which parts still needed work. Some of the inventions might not have worked at all, but these "failures" weren't actually bad. They helped the students understand their inventions in a better way. After summarizing, write Play at the top of the second column to highlight these ideas.

After playing with and learning about their invention, they made changes and tested those out. Sometimes these changes were small improvements. Others might have pushed aside their old model and tried a totally different approach to the problem. Each time they tried new combinations of Bits and materials, the groups got smarter about the invention, and the inventions got a little better. After summarizing, write REMIX at the top of the third column to highlight this.

The term "Remix" is common in the popular music industry, but kids may not be familiar with it. To clarify, you could explain that "-mix" means to put things together (like mixing ingredients in a cake batter) and "re-" means again (like renewing a library book). So remix means to put things together again.

When the challenge time is up, give students a chance to walk around and see what others have done. They could see the strategies others used, ask questions, and offer comments or suggestions. Sharing helps students feel proud of their work and provides a source of fresh new ideas and inspiration. Some may even want to take these new ideas and keep working. After summarizing, write Share at the top of the fourth column to highlight this.

Explain to students that they just went through the littleBits Invention Cycle. They created a first prototype, played with it to see how it worked, then remixed it with adjustments, improvements, and perhaps tried a few totally different approaches. After a lot of experimentation and comparison, they got to share their results with others, collecting feedback and inspiration.

Lots of designers and engineers have a process they go through when inventing. This is the process the team at littleBits uses when they create new Bits and Kits. The students will also be using it when they complete their littleBits challenges.

To check students' understanding of the Invention Cycle, you could ask them if there are other times in their life when they have done all or part of this process. For example, have they ever made a recipe, but decided to change some of the ingredients? Or perhaps they were building with LEGOs and continued to build and experiment even after following the printed instructions.

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