

INVENT FOR GOOD



LESSON OVERVIEW

How can students use their invention skills to make a difference in someone else's life? In this lesson, students will combine the littleBits Invention Cycle with an exercise in empathy. First, they will brainstorm ways they could solve common frustrations or improve everyday interactions for someone important to them. Then they will build and test multiple prototypes of their favorite idea, making improvements and measuring each against their criteria for success. At the close of the lesson, students will create advertisements that communicate their invention's power to make a difference.



LESSON TAGS

GRADE LEVEL	SUBJECTS	DIFFICULTY	DURATION
elementary, middle	engineering art/design	intermediate	120 minutes (minimum)

PREREQUISITE KNOWLEDGE

Introducing littleBits
Introducing the Invention Cycle



SUPPLIES

BITS	ACCESSORIES	OTHER MATERIALS	TOOLS USED
any Bits	any accessories	see list of commonly used materials on 119 of the STEAM Student Set Teacher's Guide	see list of commonly used tools on pg. 119



DESCRIPTION

LESSON OBJECTIVES

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

- Brainstorm ideas for meeting the designated challenge
- Create and test a circuit containing a power source, inputs and outputs
- Construct a prototype of an invention using Bits and other materials
- Test their prototypes and make improvements
- Self-assess their work based on the identified success criteria and constraints

- Demonstrate their ability to Create, Play, Remix and Share an invention through the littleBits Invention Cycle by recording their processes in the Invention Log
- Summarize their process and share the results by creating a skit, or a print or video advertisement to explain what they've invented and how it can help make life better for the customer

ASSESSMENT STRATEGIES

The Invention Log checklist (Invention Log pg. 18) can be used to assess your students' understanding of the Invention Cycle, use of the Invention Log and ability to attain the objectives of the lesson. For formative assessment while students work, you can use this checklist to ask questions about their current task and ensure that they are on the right track. The checklist can also be used as a self assessment tool by students as they move from phase to phase. For summative assessment, you can use this checklist to review students' entries into their Invention Log and assess their understanding of the challenge and the invention process as a whole.



STANDARDS

NGSS

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.

To fulfill this standard, students are explicit about the need or want being designed for, and call it such, as well as criteria for success and constraints of materials, time, cost etc. that they're willing to work within.

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

To fulfill this standard, students explicitly compare multiple solutions on the basis of the success and criteria constraints.

3-5-ETS1-3 Engineering Design: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

To fulfill this standard, students test their prototypes and make improvements. Set all but one variable as fixed, and change just one parameter in attempts to maximize the agreed-upon criterion for success. Students may also be allowed to “borrow” the best aspects from one another’s designs during this process.

MS-ETS1-1 Engineering Design: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

To fulfill this standard, students set various criteria for success, as well as constraints for the successful completion of the design problem.

MS-ETS1-2 Engineering Design: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

To fulfill this standard, students create different solutions to the problem and explicitly compare them on the basis of their ability to meet the goal within the constraints.

MS-ETS1-3 Engineering Design: Analyze data

from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into new solutions to better meet the criteria for success.

To fulfill this standard, students test their prototypes and make improvements. Set all but one variable as fixed, and change the amount of just one parameter in attempts to maximize the agreed-upon criterion for success. Students may also be allowed to “borrow” the best aspects from one another’s designs during this process.

To meet these standards, students will need to fill out information in the Remix section of the Invention Log (pg. 11 and 12) every time a variable is changed and tested. Be sure to print additional copies of these pages before the lesson begins.

*For other curricular connections, see the “Extension” section at the end of this lesson.



VOCABULARY

power
input
output
circuits
magnetism
constraints
criteria for success



RESOURCES

ATTACHMENTS [littleBits Invention Log](#)
[STEAM Student Set \(SSS\) Teacher' Guide](#)

HELPFUL LINKS [What is empathy?](#)
[Think it up - Start empathy](#)

TIPS & TRICKS For Open Challenges, we recommend that the teacher create an example invention, which may or may not be shown to students at the beginning of the lesson. Taking the challenge through the Invention Cycle will better equip teachers to successfully conduct the lesson and be more knowledgeable about where the class, or specific students, may need a bit more time or support.

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 Invention Guide, plus one Invention Log and Assessment Checklist per student. 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. Place a variety of construction materials and tools in a central location in the room.



STEP 2: INTRODUCE

Duration: 15-20 minutes

Introduce the lesson objectives and the concept behind the challenge:

What are some inventions that you use everyday that you couldn't live without? What problems do they solve? Make a list on the board to capture student responses.

“Before these products came to life, they were just ideas. People saw problems in the world around them and they created potential solutions first through brainstorming and prototyping their ideas, and then by testing and improving upon their creation to make sure it worked. This is the job of a product designer and you've already been applying this process to make littleBits creations through the Invention Cycle. In this challenge, you're going to take what you've learned so far and think like a product designer to invent something that helps someone else.”

Before jumping into the challenge, provide a quick review of the Invention Cycle framework and the format of the Invention Log (SSS Teacher's Guide, pg. 11). Ask students to share lessons learned about Bits, the invention process and things they enjoyed or struggled with from previous challenges.



STEP 3: CREATE

Duration: 45-55 minutes

A. CREATE IDEAS

For each of the prompt sections below, students will record their process and reflections in their respective Invention Logs.

What ideas do you have?

Prompt students to create a list (either as a class, or in groups) of ideas for a product. Start by thinking of an

intended user (parent, neighbor, teacher, friend) and reflect on what their frustrations or difficulties are. For example, a neighbor that is hard of hearing might need a way to know if someone is knocking at their door. For additional brainstorming ideas, refer to pg. 13 in the Invention Advisor section (particularly the sections on Empathy and Experience Mapping).

Which idea seems best?

After making a list of 3–5 ideas, have students choose the issue that they want to work on. It could be the idea that sounds the most fun to solve, or makes the biggest difference in someone else’s life.

Students should frame their thinking in the following framework: I will invent a _____ that _____ because _____.

What’s the “before” story?

What is life like now, before the proposed invention exists? Ask students to draw or describe the series of events before, during and after to show cause-and-effect scenarios. Be sure to consider the characters involved and the setting that the “story” takes place in.

What are the constraints?

Constraints are the limits and requirements that need to be considered in the invention process. Examples include time, materials, weight. Have students detail any constraints that they may need to keep in mind as they work. For younger students, you may choose to run this exercise as a class and have students record shared ideas.

What are the criteria for success?

How will students know if their invention works? Describe the number-one goal for the invention. What qualities are important for the invention to have?

B. CREATE PROTOTYPE

For each of the prompts below, students will record their process and reflections in their respective Invention Logs.

How could Bits help you solve your problem?

Instruct students to look through their available Bits and materials to see how they could (or couldn’t) help solve their problem. If students get stuck, try snapping a Bit into a circuit or read through the Bit Index (pg. 7–27 in their Invention Guide). If students’ initial ideas don’t directly translate to the function of the available Bits, check out helpful suggestions in the prototypes section on pg. 15 of the SSS Teacher’s Guide.

What does your first prototype look like?

Students create a drawing(s) of their first prototype, labeling Bits and any important features. A description of how the prototype is supposed to work should also be included. This is a time for students to dig into the Bits and materials and start to bring their ideas to life.



STEP 4: PLAY

Duration: 10-15 minutes

How did your testing go?

Once the prototypes have been constructed, students should test the inventions themselves to make sure they work. Have students pretend that they are the customer who just purchased the invention. How well did the invention do its job? Keep in mind that the inventions might not work the first time; failure is part of the process. Students should take note of successes and things that still need to be improved in their

Invention Logs.



STEP 5: REMIX

Duration: 25-30 minutes

To meet the outlined NGSS standards, instruct students to fill out a new Remix section in their Invention Logs (pg. 11 and 12) every time a variable is changed and tested. If you do not plan to adhere to the NGSS standards, allow students more flexibility and exploratory pathways during this phase of the design process.

PROTOTYPE # 2 (AND MORE...)

This is the opportunity to experiment with fixes and improvements. As students make changes to their inventions, make sure they are documenting in their Invention Logs how their prototypes are changing and the results (good and bad).

Getting feedback during the iteration process will help students make even better versions of their prototype. Pair up students so they each have someone else to test their prototype on (or ideally have the intended user try it out, if possible). Test the invention after a few improvements have been made. Have students ask the person what their favorite features are and what suggestions they have to make it better.

Continue the Remix phase (and remind students to play with their updated inventions) until the prototype is able to meet the criteria for success, or until the allotted time runs out. If you need more advice on how to conduct and provide prompts in the Remix phase, read through the Invention Advisor section (SSS Teacher's Guide, pg. 13).



STEP 6: SHARE

Duration: 30-35 minutes

Wrap up the challenge by reflecting and tying together the story of the invention. Create a skit, or a print or video advertisement to explain what they've invented and how it can help make life better for the customer. Share it with the classroom (or with the world!).

You may also encourage students to take their inventions further and recruit a product design team. Have students show their invention to friends or peers. How could a group of students, with different ideas and perspectives, work together to create an even better product?



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 Invention Logs.



STEP 8: EXTENSION

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

MS-ETS1-4 Engineering Design: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Students define and iteratively collect data to explore the explicit connection between the invention and a physical or environmental interaction that may impact the design. For example, modeling the impact of friction on the ability of a wheeled invention to climb a slope, or the impact of an invention on human behavior. The storyboard in the Invention Log should be used and updated throughout the lesson for each iteration tested.