

CHANGE THE WORLD ARCADE



LESSON OVERVIEW

How can you use littleBits and the Code Kit or STEAM+ Class Pack to help save the world? Students will use littleBits, programming, internet research and the Invention Cycle to design and prototype a game that will help make life easier for people in their community. At the end, each group will present their prototypes at a Change the World Arcade that will be open to community members.



LESSON TAGS

GRADE LEVEL

middle, high school

SUBJECTS

STEM, computer science, civics

DIFFICULTY

advanced

DURATION

6x 50 min sessions

PREREQUISITE KNOWLEDGE

- Hello World: knows how to use littleBits, code blocks in sequence and upload code to the codeBit



SUPPLIES

BITS

Code Kit or STEAM+ Class Pack (1 kit per group of 2-3 students)

ACCESSORIES

OTHER MATERIALS

laptop with Code Kit App downloaded; USB port required if using the codeBit dongle

note paper
cardboard
markers
poster board
tape or glue

TOOLS USED

internet search engine
scissors



DESCRIPTION

LESSON OUTLINE

INTRO: Review of code concepts. Discussion and research into community issues. Game ideas brainstorm.

Some ideas for inventions that address global issues include:

- Pollution/waste: A game that encourages recycling while also counting the number of bottles & cans that have been recycled.
- Exercise: An activity tracker that can be worn in a shoe and counts the user's steps, celebrating when they reach a certain goal.
- Exercise: A game that motivates players to run a relay.
- Open space: A game that people can play in a small room.
- Nutrition: A hydration counter that counts the glasses of water a person drinks in a day.
- View [#InventForGood](#) inspiration on the littleBits Invention Platform

CREATE: Groups design a game that will address a local community issue. The code for the game should include logic, input/output, variables and loops.

PLAY: Each group tests out each other's game and provides feedback.

REMIX: Students customize and enhance their games based on their experiences during play.

SHARE: Each group presents their remixed game, code, and the research to community members at the Arcade Day. Each group will self-assess their work using their Invention Logs.

LESSON OBJECTIVES

- Research a real-world issue that is impacting the local community.
- Use information and data sources to inform the design of a game that addresses a local issue.
- Design a prototype of a solution to address a local issue, incorporating coding and the littleBits Invention Cycle.
- Make sense of problems and persevere in solving them.
- Construct viable arguments and critique the reasoning of others.
- Use constructive feedback to iterate on a design.
- Present research findings and game prototypes to the community.

ASSESSMENT STRATEGIES

FORMATIVE ASSESSMENT: Use the Invention Log checklist (p. 16) to assess students' understanding of the Invention Cycle, use of the Invention Log, and ability to attain lesson objectives. It can also be used as a self-assessment tool by students as they move from phase to phase in the Invention Cycle.

SUMMATIVE ASSESSMENT: Use the Invention Log checklist to review students' entries into their Invention Log and assess their understanding of the challenge and the invention process as a whole.

Other pieces of evidence that may be valuable for assessment include:

- Comment cards from visitors at the arcade
- Project posters accompanying each invention



STANDARDS

NGSS

MS-ETS1-1: 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.

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

MS-ETS1-3: 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.

HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

CSTA

1B-CS-03: Determine potential solutions to solve simple hardware and software problems using common troubleshooting strategies.

2-CS-03: Systematically identify and fix problems with computing devices and their components.

2-AP-10: Use flowcharts and/or pseudocode to address complex problems as algorithms.

2-AP-15: Seek and incorporate feedback from team members and users to refine a solution that meets user needs.

3A-AP-16: Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue by using events to initiate instructions.

3A-AP-18: Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.

3A-AP-22: Design and develop computational artifacts working in team roles using collaborative tools.

3B-AP-22: Modify an existing program to add additional functionality and discuss intended and unintended implications (e.g., breaking other functionality).



VOCABULARY

Loops

Loops check a condition and then run a code block. The loop will continue to check and run until a specified condition is reached.

Variable

A placeholder for a piece of information that can change.

Logic

Logic lets you add rules to your code.

Input

These Bits add control to the circuit, through information provided by you or the environment, and sends signals to the Bits that follow.

Output

The Bits that “Do Something”. The Bits complete an action or task (for example light, buzz, or move).

Playtesting

The “Play” portion of the Invention Cycle. Playing with what you’ve created is fun, but also an important part of inventing. Playing is like a test run. It’s a chance to see how well your invention works and look for ways you can make it better.

Iteration

The “Remix” portion of the Invention Cycle is your opportunity to iterate and improve your invention. Add new Bits, swap parts with other inventions, or take all the pieces apart and put them together in a different way.



RESOURCES

ATTACHMENTS

[Invention Log](#)
[Lesson slides](#)
[Debugging checklist](#)
[Feedback chart](#)
[Code Kit Curricular Crosswalk](#)

TIPS & TRICKS

Students do not have to start their games from scratch. It might be easier to remix an invention that they’ve already built.

PACING

DAY 1: INTRO
 Prep + setup
 Intro (10 mins)
 Research (30 mins)
 Share + close (10 mins)

DAY 2: CREATE
 Prep + setup
 Warm up (10 mins)
 Brainstorm (10 minutes)
 Create (30 minutes)

DAY 3: CREATE & PLAY
 Prep + setup
 Create (35 minutes)
 Play (15 minutes)

DAY 4: REMIX & PLAY
 Prep + setup
 Remix (25 minutes)
 Play (10 minutes)
 Remix (15 minutes)

DAY 5: REMIX
 Prep + setup
 Remix (15 minutes)
 Share prep (35 minutes)

DAY 6: SHARE- With community!
 Prep + setup

Share (50 minutes)

INSTRUCTIONAL STEPS



STEP 1: SETUP

Duration: 20 minutes

This lesson can be done individually or in small groups (2-3 students).

Each group will need at least one Code Kit or STEAM+ Set, a computer with the Code Kit App installed, plus one Invention Log and assessment checklist per student. Print out a copy of the Debugging Checklist for each group.

Set up a central location in the classroom for assorted materials and tools.

You may want to try going through the challenge yourself so that you have a model to show students, or you can explore the [Invention Platform](#) on the littleBits website for remixes that students have created for this lesson.

Choose a date and space to hold the Arcade Day where community members (including other students, families, school staff, and community leaders) can come view and play with the students' inventions.



STEP 2: INTRODUCE

Duration: 50 minutes

INTRODUCE THE PROJECT (10 minutes)

- Ask students to raise their hands if they've noticed problems in their school or local community.
- Ask students: "What problems or issues do you see in your community?" (community could mean neighborhood, school, block, or even state). Some example ideas include: litter, pollution, exercise, nutrition, open/recreation space. Write down responses on the board.
 - Tip: If students are struggling with ideas, ask them to think about a particular person in their community (e.g. a police officer, their sibling, coach, etc.) and think through what problems they may encounter in their daily life.
- Project brief: Explain that the goal of the next few days is to design games that will help address some of these issues. Review the learning targets.

ONLINE RESEARCH (30 minutes)

- Break students into groups of three or less (if you have a small group, they could also work individually). Ask them to decide as a group which issue from the brainstorm list they'd most like to address.

- Explain that they will use the internet to conduct research on their topic. Stress that it would be ideal to find information about how their chosen issue impacts their local community.
- Review online search methods and tools.
- Walk around the room to help guide student searches and address any roadblocks they encounter. Pass out Invention Logs to each group.

SHARE (10 minutes)

- Ask a couple volunteers to share their findings
- Ask groups to write down in their Invention Logs: 1. What issue they are addressing (p. 1) and, 2. initial ideas they have for addressing the issue in their community (top of p. 2). Ask students to hand in their Logs.

NOTES

- You will use student responses in the Invention Logs as a brainstorming tools in the next session.
- If you'd like to learn more about incorporating game design into your lessons, there are many wonderful resources available on the internet. We recommend the "[Good Play ToolKit](#)" and "[Institute of Play's Design Pack](#)" as a place to get started. Elements of game design from the "Good Play Toolkit" are described in the Create phase below.



STEP 3: CREATE

Duration: 80 minutes

WARM-UP: CODE REVIEW (5 minutes)

- Review the following coding concepts as a group:
 - Inputs/Outputs
 - Loops
 - Logic
 - Variables
- If necessary, add in additional time to revisit the code tutorials for concepts that students are struggling with. See the [Curriculum Guide](#) for a list of tutorials and their learning objectives.

PROTOTYPE BRAINSTORM (15 mins)

- Ask students to revisit the ideas they wrote in their Logs at the end of the last session. Ask for a couple volunteers to describe what they wrote and how it addresses their chosen issue.
- Explain to students that in designing games, they should consider the following elements:
 - COMPONENTS: Whether it's the players that make the game, little wooden pawns, or extraterrestrial obstacles, your game needs items.
 - SPACE: Well, it all needs to happens somewhere, right?
 - MECHANICS: The actions that you take in the game. Think of verbs like jumping, negotiating, singing!
 - GOALS: Make your game have multiple goals that allow your players to make interesting choices.
 - STRATEGY: Even if you are making a very simple game, make sure that it

allows for some strategy so that, if played again, the game will not give the same outcomes. Bottom line: If the same person is winning over and over, something is wrong.

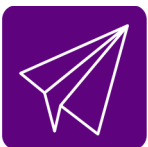
- SURPRISES: You might not be the surprise type, but a game is no fun without some unexpected moments.
- Ask students to fill out p. 4 in their Invention Logs with the game design ideas. If your students seem stuck refer to the suggested ideas in the lesson outline.
- After brainstorming for 6-7 minutes, ask groups to choose one game that they want to work on for this project and share out what they've chosen. They can pick one representative to share out what they wrote in their Logs.
- Make sure to record what each group has chosen. Students will record their decision on p. 2 of the Invention Log under "Which idea seems best?"
- Define the term **constraints** (i.e. restrictions that limit what something or someone can do) and ask students to spend 2-3 minutes making a list of the constraints inherent to their projects. For instance, a game that you need to be able to run with cannot be too heavy. Some games might need to work for people with physical impairments—what kinds of constraints might that imply? Record these notes on p. 3 of the Invention Log.

CREATE (60 minutes)

- Some guiding questions for them to consider while exploring:
 - What kinds of components and code might we need for our game?
 - Is there a littleBits invention I have previously made that has similar construction or code to the game we'd like to make? If so, how can we use it in our game?
 - Where are some areas where we might run into trouble? What will we do if that happens?
- Be sure to make time to record their first prototype on p. 6-7 of the Invention Log.
- Ask students to refer to the Debugging checklist if they get stuck.

NOTES

- If your students seem to have a firm grasp of all the coding concepts, feel free to spend less time on the review and more time on brainstorming and tinkering.
- If breaking between Step 3 and 4, walk through the process with students of how you would like them to save their code and store physical prototypes. This will allow them to easily pick up where they left off when they come back to the next session.



STEP 4: PLAY

Duration: 50 minutes

PLAYTESTING & FEEDBACK (15 minutes)

- Each group chooses another group to playtest their game. Use the "Glow, Grow, Question, Idea" feedback chart to frame these discussions.
- One person in the inventor group should record in the Invention Log (p. 8) all of the feedback and observations that come up. Switch testing roles so the second group now gives/receives

feedback.

- When there are five minutes left, stop the playtesting and have each group choose 3 pieces of feedback as priorities to work on at the next session. Circle these notes in the Invention Log.

NOTES

- If breaking between Step 4 and 5, remind students of the saving and storing process that you would like them to follow. Have students pass in their Invention Logs so you can review them and add any suggestions before the next class.



STEP 5: REMIX

Duration: 65 minutes

ITERATING ON PROTOTYPES BASED ON PEER FEEDBACK (25 minutes)

- Pass out the Invention Logs to the respective groups. Explain that they will be making new **iterations** or remixes of their games based on the feedback they recorded in the last session. An iteration is a new version of something that features improvements based on user feedback.
- To meet the outlined NGSS standards, instruct students to fill out a new Remix section in their Invention Logs (p. 9-11) every time a design element 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.

PLAYTESTING & FEEDBACK (10 minutes)

- Once again each group chooses another person (or group of people) to playtest their game, with one person recording observations and feedback in their Invention Logs (p.12).

MORE ITERATING (15 minutes)

- Students return to their projects, feedback in hand, and iterate on their games some more.
- Continue the Remix phase (and remind students to Play with their updated games) until the prototype is able to meet the criteria for success, or until the allotted time runs out.

FINISHING TOUCHES (15 minutes)

- Students put the finishing touches on their games, ensuring they are ready to display at the Arcade Day. Be sure to save the final code so they have it for their presentations. Fill out p. 13 of the Invention Log to document their final prototypes.

NOTES

- If breaking between Step 5 and 6, remind students of the saving and storing process that you would like them to follow.



STEP 7: SHARE

Duration: 95 minutes

CREATE POSTER BOARDS (35 minutes)

- Students use the poster boards, markers, glue and craft supplies to create a poster to explain their project. If the Arcade is happening on a separate day, remind students of what they will need to bring to the actual showcase including the items they need to turn in for assessment purposes (Invention Logs, feedback charts). You may want to assign the reflection questions on p. 14-15 of

the Invention Log to each student for homework.

ARCADE

SETUP FOR THE ARCADE (10 minutes):

- Set up games and posters so that visitors can walk around the room and see each one.
- Be sure each group is set up with a computer open to the group's code set up in the app. Students will need to import their code to a blank canvas.

CHANGE THE WORLD ARCADE: COMMUNITY REVEAL! (50 minutes)

- Welcome visitors and give a brief summary of the work the students have been doing.
- Allow visitors to walk around to each group's display and test the games.
- At the end, present students with certificates of completion; [certificates can be customized here](#).

NOTES

- Collect all project materials that you will need for assessment (posters, Invention Logs, feedback charts). Groups will need to fill out the self-assessment checklist at the back of their Invention Logs (p.16) before passing them in.
- If time allows, you may encourage your students to post their remixed inventions on the [littleBits Invention Page](#). Often teachers will create a central account on the littleBits site to publicly showcase their class or school's work.



STEP 8: EXTENSIONS

Incorporate one (or more!) of the following extensions into this challenge to bolster your lesson's NGSS applications:

MS-ETS1-2: Engineering, Technology, and Applications of Science: 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, have multiple project groups brainstorm, design and build separate machines that all address the same issue. Then have groups use rubrics to compare each other's games to evaluate how well they each addressed the problem.

MS-ESS3-3: Earth & Space Sciences: Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.

or

HS-ESS3-4: Earth & Space Sciences: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

- To fulfill either of these standards, focus all student projects on environmental issues. Ensure learners can use their research to explain the science behind why their projects will reduce human impact on the planet's climate.

HS-ETS1-3: Engineering, Technology, and Applications of Science: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

- To fulfill this standard, ask students to envision how larger versions of their prototypes would work in the real world. Ask them to design an imaginary, large-scale version of their games while

keeping within a budget, fulfilling basic safety requirements, and keeping the social/cultural values of their community in mind.