Grade 4, Lesson 5 :: Recommended time, 3 hours

Storybook Inventions

Parts Needed	Topics	Cross-Curricular Connections
 Building Brick Extension Set  Sound Record/ Playback Module	Algorithms Self-Expression Engineering Design Process	English Language Arts (CCSS.ELA-LITERACY.W.4.3)

Overview

Students will explore challenges faced by characters in storybooks, then design and build a KIBO-based invention to solve one of these challenges. The lesson integrates creative writing as students develop a fictional story about their invention helping the story characters. Students can optionally use the Building Brick Extension Set to incorporate LEGO™-compatible constructions in their invention. This lesson combines robotics and literacy skills.

Learning Goals

Students will...

- Develop solutions to a problem using the engineering design process.
- Develop a program to support their invented solution
- Explore narrative writing to connect their invention to the story.

Preparation and Materials

This is a 3-hour project lesson. Suggested schedule:

- Meeting 1:
  - » 40 mins: Introduction the project including the INSPIRE and CONNECT steps
  - » 15 mins: ENGAGE step, phase 1 (planning)
  - » 5 mins: Closing class discussion to share their invention ideas
- Meeting 2:
  - » 5 mins: Class discussion to remind groups of the project goals
  - » 50 mins: ENGAGE step phase 2 (building and testing)
  - » 5 mins: Closing class discussion to share challenges and successes
- Meeting 3:
  - » 20 mins: ENGAGE step phase 3 (writing)
  - » 40 mins: REFLECT step, to showcase the project and reflect on the process

Provide students a supply of LEGO™ compatible building bricks to create machines or structures atop KIBO's Building Brick Extension Set.

Inspire: Storybook Problems

"In this activity, we will program our KIBOs to re-live a historical journey!"

Start by introducing a storybook excerpt or description of a situation (e.g., Wilbur's dilemma from Charlotte's Web). Lead a discussion:

- "What problems do the characters face in the story?
- "What solutions did the characters try?"
- "How might technology, like a robot, help solve those problems?"

After discussing students' ideas for solving the problem, next engage students in brainstorming KIBO-based robotic inventions based on these ideas. What might a KIBO Invention to do help the characters?

These inventions might be relatively realistic. For example, as Charlotte tries to show the world how wonderful Wilbur is, KIBO's flashing lights and large whiteboard sign could help her convey the message that Wilbur is "Some pig!". Or they might be more fantastical, such as a KIBO helicopter (with rotors made of LEGO bricks attached KIBO's spinning brick platform) to help Wilbur fly away with Charlotte's baby spiders at the end of the story!

"In this project, you will design and build a robotic invention using KIBO to help a storybook character solve a problem. Then, you'll write a story showing how your invention helps the characters! You can use any of KIBO's programming blocks and add-ons to build your solution, including using LEGO bricks to build devices or machines to attach to KIBO."

"We will draw our own maps to represent a journey from history. Our KIBOs will represent the people who took part in this event.

Connect: Our Favorite Stories

Divide students into their groups. Give students access to storybooks, especially ones that they have explored in their ELA curriculum. See the Tips for the Teacher section for some grade-level appropriate book suggestions.

> Tip: This could be a great opportunity to collaborate with a school librarian, who can offer more suggestions to groups. You may even want to conduct this step of the lesson in the library, to give students access to plenty of books.

Ask groups to share among themselves some of their favorite stories. For each story, groups should discuss the challenges the characters faced and ideas for problems they might help solve with a KIBO invention.

You can help guide their brainstorming with open-ended questions:

- "What is the main problem the characters need to solve?"
- "What will the KIBO robot need to do?
- "What could we add to KIBO to help it perform its task?"

Groups should record these ideas in their journals, including:

- Name of the book and author
- The problem the characters faced
- Idea for solving the problem with a KIBO invention

By the end of the Connect step, groups should choose one of their ideas to base their project on. They should also settle on an idea for the solution they will model.

Close with a brief share-out to ensure groups are on track.

ENGAGE: Inventing Our Solutions

"Now it's time to get to work helping our characters!"

Phase 1: Planning the Invention

Each group should plan how they will construct their KIBO Invention. Working from the rough idea in their journals, groups should:

- Create a sketch of their invention
- List the materials they need
- Create a draft of the program their KIBO will run

> Tip: Allow students to "plan with their hands": in other words, as part of the planning process, let students try out programs with their KIBO robots and experiment freely with the materials. Freely iterating between planning and creating is a common twist on the Engineering Design Process!

Encourage groups to make use of KIBO add-ons to expand their range of invention options. Add-ons that are particularly useful in this lesson include:

- Building Brick Extension Set: integrating LEGO bricks gives children the option to build expressive decorations as well as modeling functional parts, like hinged lifting arms or grasping pincers.
- Sound Record/Playback Module: groups can record lines of dialog that their helper robot or story characters might say as part of solving the dilemma ("Some pig!"), or sound effects of their machine in action.

Close this phase with a brief share-out, where each group briefly shares their story choice and invention idea. Encourage groups to share challenges they may be stuck on and ask for feedback from their peers.

Phase 2: Building and Testing

Working from the plans they recorded earlier, groups should create their initial KIBO inventions and scan their planned programs. Allow plenty of time for groups to test and refine their programs, and to ensure that their inventions are sturdy.

Remind students of the steps of the engineering design process, and that they are now in the important cycle of creating, testing, and improving. Engineers don't expect things to work right the first time. When something doesn't work as expected, that is an opportunity to learn more!

Circulate and ask questions to keep groups focused: "What features of your design help solve the problem your characters are experiencing?"

Periodically, ask all groups to pause and share one thing that they're troubleshooting or having difficulty with, and invite other groups to suggest solutions. Engineers rely on each other for support all the time!

Near the end of this phase, encourage students to test their programs and inventions end-to-end, with the entire program running, sensors attached, and invention in place. Before moving on, ask groups to record their final programs and notes on their final designs in their journals, so they will be ready for the final showcase.

Gather students for a closing share-out, focused on the challenges and difficulties they overcame during their own testing process.

Phase 3: Writing

"Now that we've built our KIBO Inventions to help our characters, it's time to imagine what the story would be like with KIBO's help!"

Provide the groups with a writing prompt: "Write a story about how your invention helped the characters." Groups should incorporate the characters from their chosen problem and a description of how their KIBO invention helped. They could work KIBO into an existing scene from the book, or imagine an entirely new scene.

Tip: You can ask students to write as long or short a story as seems appropriate for your class.

Encourage descriptive writing techniques with prompts like:

- "How did the character feel before and after using your invention?"
- "What details can you include to make your story vivid?"

REFLECT: Gallery of Storybook Inventions

Close the lesson with a showcase where each group demonstrates their Storybook Invention, in turn.

Tip: Before the showcase begins, give groups time to set up their robots, reattach their inventions, and re-scan their programs if needed. They can work from the plans recorded in their design journals.

On their turn to present their storybook invention, each group should:

- State their book title and author.
- Describe the challenge faced by the characters in the book.
- Read the brief story that they wrote about their invention.
- Demonstrate their KIBO invention by running their program.

Tips for the teacher

Book Suggestions

In this lesson, children will choose a book, identify a problem faced by the characters, and invent a solution to the problem. Choosing from books they have read in the ELA curriculum emphasizes the cross-curricular nature of this lesson. But here are some age-appropriate suggestions for books students might choose from:

1. ***Charlotte's Web*** by E.B. White: Charlotte needs help bringing attention to Wilbur.
2. ***The Wild Robot*** by Peter Brown: Roz faces challenges adapting to her environment.
3. ***The Tale of Despereaux*** by Kate DiCamillo: Despereaux needs help getting through the castle's dungeons
4. ***Frindle*** by Andrew Clements: Nick must promote his new word idea.
5. ***Island of the Blue Dolphins*** by Scott O'Dell: Karana needs tools for survival.

Engineering Design Process

Longer integration projects like this one allow student groups more time to engage in the engineering design process: imagining solutions, planning and building their creations, testing to identify problems, and revising to solve these problems. Consciously engaging in these process steps helps children build a "growth mindset" – and meets important NGSS science and engineering process standards for this age group. In particular:

- Check in with student groups frequently, and ask them to describe what they are currently doing.
- Encourage students to design and test prototypes of their project elements before building final creations.
- Consider tradeoffs between different designs, using terms like materials, build time, complexity, and reliability.