Activity 4: What is innovative engineering?

Get Prepared

What kids will do: Explore the idea of innovative engineering and learn about basic engineering structures

Time needed: Three 45-minute sessions

What you will need:

Printouts	Materials	
• Activity Sheet D: Build a Better Bridge	• Samsung tablets	• cardboard
• Activity Sheet E: Name That Career	• books	• pennies
	• paper	• glue and tape
	• pens or pencils	• string
	• index cards	• pipe cleaners

Note: Kids may use the activity sheet printouts or they may follow along on their tablets at: www.scholastic.com/STEM.

Before You Begin:

- To plan for the wrap-up activity at the end of session 3, make enough copies of Activity Sheet E: Name That Career so that each team has one complete set of cards. Cut out the activity cards along the dotted lines and keep each set of cards separate to pass out for the optional wrap-up activity.
- In large letters, write each of the following engineering careers on a separate sheet of paper: automotive engineer, drafter, landscape architect, civil engineer. (You will have four signs when done.)

Connect With the Home:
Download and print out the Club-to-Home Communication: Unit 2 Overview for kids to take home and share with their family members.

Introduce Them to STEM Careers 10 minutes

Session 1

Direct kids to take out their tablets, open the STEM Career Flip Book and read about civil engineers in the Engineering section. Ask: ***What role do you think civil engineers played in the engineering of your neighborhood?*** Wrap up the conversation by asking: ***If you were a civil engineer and could build anything in your neighborhood, what would you build and how would you build it?***

Engineering in the Community 35 minutes

1. Engineers are problem solvers. Part of their job is to come up with creative ways to meet people's needs. This characteristic is called being innovative. Ask:
   - ***What do you think it means to be innovative?***
   - ***Can you think of some examples of innovative engineering?***
2. Use your tablet to show kids three examples of innovative engineering at the following links (each of these structures was designed to fulfill a specific purpose to help people in its community):
   - **SkyCycle (London, England):** This elevated pathway was proposed to help cyclists travel safely through the city: http://bbc.in/1hvQAHq
   - **Water-Generating Billboard (Lima, Peru):** An engineering school created this billboard, which collects water from the air and turns it into clean drinking water: http://bit.ly/OJwM6C
   - **Makoko Floating School (Lagos, Nigeria):** This school was built for children living in a poor area

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Engineering in the Community (continued)

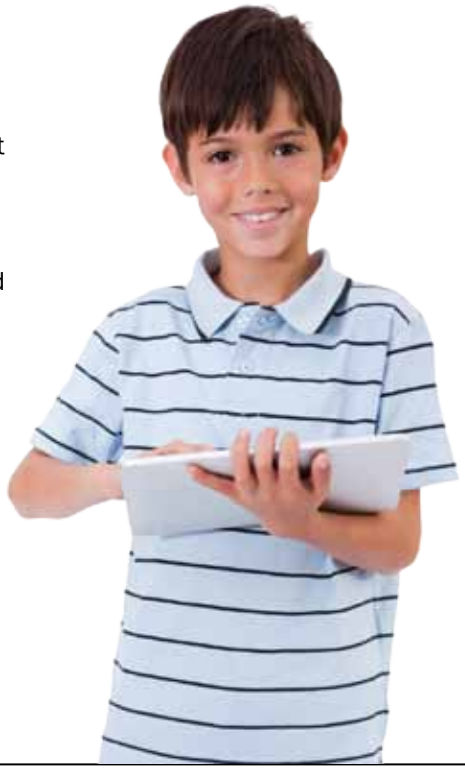
in Africa prone to frequent flooding: http://nyti.ms/1kvwyPi

3. Discuss how these structures meet a community need, what it might have taken to build the structures, and how the kids would change the innovations to benefit their own communities.
4. Wrap up session 1 by having kids choose one of the three innovations that would benefit their neighborhood. Pass out paper and ask teams to adapt the existing design to make it fit their community's needs. If there is time, have teams present their adaptations to the entire group.

Use the Tablets! 45 minutes

Session 2

1. Explain that to create innovative designs, engineers start with some basic building blocks. These simple structures include things like arches to support bridges and domes to cap buildings.
2. Have kids access the building challenges on the Building Big website: http://to.pbs.org/1hDKL4Q. Tell kids to investigate the basic structures used by engineers in their designs. As they discover different building blocks, ask them to find one or two purposes each structure serves and note them on a whiteboard or chalkboard. When finished, discuss why these engineering building blocks are useful.
3. Explain that engineers have many things to consider when building structures. One of the important things engineers have to consider is a structure's *load*. Loads are forces that push, twist, and stretch a structure. Have kids complete the interactive labs on the Building Big website to learn how loads affect a structure's stability. They'll also learn how the right materials and shape can make a structure sturdier: http://to.pbs.org/1hlikxx.



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Activity 4: What is innovative engineering? (continued)

STEM Challenge! 45 minutes

Session 3

1. Hand out **Activity Sheet D: Build a Better Bridge**. Kids will test what kind of load a simple bridge can hold. Then they'll modify their bridges using a variety of materials, shapes, and supports to see which design aspects allow their bridges to withstand the greatest force.

2. Wrap up session 3 with the following interactive challenge that gets kids thinking about roles engineering plays in communities.
3. Have kids separate into their teams and give each team a set of the activity cards you cut out from **Activity Sheet E: Name That Career**. Ask each team to write their name on the back of their cards so that the teams can be identified.

   Put each of the four signs with the names of engineering careers in a different corner of the room.
4. Tell the teams that they have five minutes to match the cards with the correct sign. This will require them to match the STEM skills on their cards with the appropriate engineering career. They can refer back to the **STEM Career Flip Book** to research the career if necessary. The first team to finish placing the most cards in the correct place wins the game.

Answers

- **Career: Automotive engineer**
- **Cards:** *Protect people from car crashes, protect the environment by designing more efficient cars, make sure cars function properly to prevent car crashes*
- **Career: Drafter**
- **Cards:** *Help architects plan buildings by drawing up the plans, create solutions for problems in building plans and make improvements to building plans, work with teams to draw the plans for new innovations*
- **Career: Landscape architect**
- **Cards:** *Fix damaged areas like wetlands or rivers, design parks for neighborhoods, help the environment by designing gardens that collect storm water or trap air pollution*
- **Career: Civil engineer**
- **Cards:** *Test buildings to make sure they are strong and people are safe inside them, plan where to put new buildings, make sure buildings are using the right building materials and following safety codes*

NAME: _____

Build a Better Bridge

You just learned about the techniques engineers use to build structures that hold up under all sorts of conditions. Now it's your turn to build a sturdy structure of your own.

Instructions: Read the passage below to learn how engineers build superstrong bridges. Then follow the instructions to construct your own bridge that won't buckle under pressure.

Loaded Up

All structures experience *loads*, forces that push, twist, and stretch. Changes in a structure can be caused by the weight of objects pushing down on the structure, strong winds, or even vibrations.

In the case of a bridge, cars and people create a heavy load that pushes down on the bridge. Strong winds and vibrations can cause the bridge to twist or collapse.

Engineers have to account for these forces to make sure the bridges they build won't collapse. Three ways engineers do this are choosing the right materials, shape, and supports for their structures.

Parts of a bridge can be made out of materials like wood, metal, or concrete. It can be shaped like a beam to form a straight span across a gap or an arch. Bridges can be made stronger by reinforcing them. Engineers use supports, such as trusses and suspension cables. These supports reduce the force of a load by spreading it over a larger area.

Build It:

1. **Stack the books:** Make two stacks of books that are the same height with 3 inches between the stacks.
2. **Lay the bridge:** Lay an index card lengthwise across the gap.
3. **Add the load:** Pile pennies in the middle of the card. How many can it hold before collapsing?
4. **Strengthen your bridge:** Try making your index card bridge stronger by changing the structure of the card. You may fold the card in half or in pleats. Or you might want to try taping it into an arch shape. You should also build supports for the bridge with cardboard, pencils, string, pipe cleaners, and/or tape to make the bridge stronger.
5. **Test it out:** Test your new bridge design to see how many pennies it will hold. If your bridge collapses, make more changes to create the strongest structure possible.

Name That Career

Make five or six copies of this activity sheet and cut up the cards for an interactive game. Each team will get a complete set of cards.

Protect people from car crashes	Protect the environment by designing more efficient cars	Make sure cars function properly to prevent crashes
Help architects plan buildings by drawing up the plans	Create solutions for problems in building plans and make improvements to building plans	Work with teams to draw up the plans for new innovations
Fix damaged areas like wetlands or rivers	Design parks for neighborhoods	Help the environment by designing gardens that collect storm water or trap air pollution
Test buildings to make sure they are strong and people are safe inside them	Plan where to put new buildings	Make sure buildings are using the right building materials and following the safety codes