Camp Fire

Building Blocks
Engineering Our Community

STEM Challenges and Activity Sheets

for Grades 3–5

For your convenience, this document collects all the challenges and activity sheets from the **Building Blocks** program in one downloadable PDF. Use this document to print out the entire grades 3–5 program, complete units, or individual activities and activity sheets. If you want to access the challenges on the tablet, return to www.scholastic.com/sparks2 and click "View" next to the desired challenge.

Contents

Challenge 1: What can STEM do for communities?

Get Prepared

Challenge Goal: Learn about STEM, with a focus on how engineering can help communities

Time Needed: 45 minutes

What You Will Need:

Printouts	Materials
• Activity Sheet A: Engineering in Our Community	• Samsung tablets • scissors • paper • pens or pencils • notebook/folder/binder

Before You Begin:

- Get prepared for the **Building Blocks** program by working with your administrative team to make sure all tablets are connected to your location's Wi-Fi.
- Take the time to locate the apps in the "Apps" section of the tablet so you can direct kids to find them when they need to.
- Because kids will have activity sheets and notes throughout the program, consider giving them notebooks, folders, or binders to use.

Note: Kids may use the activity sheet printouts or they may follow along on their tablets at: www.scholastic.com/sparks2.

Connect With the Home:
Before you begin the **Building Blocks** program, send home the Council-to-Home Communication: Program Overview to explain to parents and guardians what their child will be learning.

After you've begun the first unit, send home the Council-to-Home Communication: Unit 1 Overview so family members will know what types of activities are involved in Unit 1 of the program.

Spark Exploration: STEM Careers 10 mins.

1. Explain that educators use the term STEM to help us think about science, technology, engineering, and math as a group, rather than as separate subjects. Ask: ***Why do you think it would be valuable to learn about these things together, rather than separately?*** (In the world outside of school, these subjects are intertwined, so learning about them together makes it easier to see how they apply to real-life jobs.) Briefly discuss some examples of familiar STEM-related jobs (veterinarian, accountant, architect, etc.) and talk about how STEM subjects are used within them (veterinarians use science and technology, accountants use math and engineering skills, etc.).
2. Share this fun fact: Did you know 20 percent of all jobs in the U.S. are in STEM fields? That's about 26 million jobs!*
3. Have kids use the tablets to open the STEM Career Flip Book and turn to the first page (featuring the food scientist and wildlife biologist). Ask kids what they think food scientists and wildlife biologists do. If necessary, provide background with the following information:
   - Food scientists study food to: make new food and flavors, invent foods for astronauts and soldiers, research ways to package food to keep it from going bad, and test foods for vitamins and minerals, as well as for germs.
   - Wildlife biologists study wild animals and their ecosystems to: find out how they interact with other species and the environment, find out how their health helps the planet and human survival, and to protect wildlife species.

After the discussion, explain that you will continue to discuss careers from the STEM Career Flip Book on future days.

Goal Selection:
What goals would someone in these careers set out to achieve?

*National Math & Science Initiative

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Challenge 1: What can STEM do for communities? (continued)

Setting the Strategy: Engineering in the Community 10 mins.

1. Kick off a group discussion by asking: ***What do you think people with STEM careers can do to help solve problems in or improve communities?*** (Answers may include: STEM careers provide valuable services like health care; or that technology and engineering can make communities safer and improve how they function.)
2. Kids may be familiar with science, technology, and math as part of their daily lives, but less so with engineering. Discuss kids' prior knowledge about this topic by asking:
   - ***What is engineering?*** (Engineering combines science and math to improve the world around us.)
   - ***What do engineers do?*** (There are dozens of types of engineering careers. Some engineers create and construct buildings, bridges, and other structures. Other engineers design planes and cars. Still others clean up oil spills, create new computer technology, or formulate new chemical compounds.)

Shifting Gears: STEM Challenge! 10 mins.

Take the idea of engineering in the community further. Hand out **Activity Sheet A: Engineering in Our Community** and ask kids to work together to identify aspects of their community that have benefitted from engineering. This could include safety matting on playgrounds, community-wide Wi-Fi service, solar-powered buildings, etc.

Use the Tablets! 15 mins.

Wrap-up Session and Reflection Activity:
Ask kids to imagine themselves improving their community with an engineering project. Kids will need to reflect on what they might want to change in their neighborhoods, what they would build, and what the benefit of their engineering projects would be. Then have them use the **FlipaClip—cartoon animation app** to create a short animation that answers the question, "What engineering project can improve my community and how?"

TEAM MEMBERS: _____

Engineering in Our Community

When you walk through your neighborhood, what do you see? Maybe new bike lanes are being built. Buildings might have ramps for people with disabilities. There could be street signs with flashing lights to warn drivers to slow down in school zones. Cool examples of engineering are all around us!

Instructions: As a team, list the types of engineering you've seen in your neighborhood in the middle column of the chart below. Then think of engineering projects that could improve people's lives in your community, and write those in the last column.

Types of Engineering	Our community has...	Our community could use...
Public Buildings (like museums, town halls, post offices, libraries)		
Structures (like bridges, water towers, dams)		
Technology (like lighting and traffic control)		
Utilities (like sewage systems, storm drains, electrical lines)		
Public Facilities (like parks, piers, recreational areas)		
Transportation (like roads, bike paths, sidewalks, buses, trains)		

Challenge 2: How are neighborhoods engineered?

Get Prepared

Challenge Goal: Draw a local map to scale and identify local engineering marvels

Time Needed: Two 45-minute sessions

Before You Begin:

- Locate your program or school site neighborhood on the Google Maps website using the site's zip code. Print out multiple copies of the neighborhood map on large-size paper for use later in the activity.
- Make four printouts of **Activity Sheet B: Map It** for each team of two in your group.

What You Will Need:

Printouts	Materials
• Activity Sheet B: Map it • Google Maps printouts	• Samsung tablets • tape or glue • rulers • Completed **Activity Sheet A: Engineering in My Community** (*from Activity 1*) • graph paper • pens or pencils • poster board

Note: Kids may use the activity sheet printouts or they may follow along on their tablets at: **www.scholastic.com/sparks2**.

SESSION 1

Spark Exploration: STEM Careers 15 mins.

Have kids use their tablets to open the **STEM Career Flip Book**. Point them to the land surveyor in the math section. After kids read the text, ask: ***What skills do you need to work as a surveyor? What do surveyors do?*** (Answers may include: map the environment to determine property borders, help architects plan new construction, map crime scenes, survey land under the ocean to look for oil or find dangers to boats.)

Goal Selection:

- ***What goals might surveyors set?***

Setting the Strategy: Engineering in the Community 15 mins.

1. Discuss the responses kids wrote on **Activity Sheet A: Engineering in My Community** from the previous activity. Call on volunteers and use a whiteboard or chalkboard to list some of their ideas for engineering projects that could help achieve goals in their community.
2. Explain that nothing is built in a community without the input of engineers called *urban planners*. They decide on the best places to build roads and parks. They design improvements to things like outdated sewage systems. Ask: ***What do planners have to think about when they are deciding where to build? (geography, existing buildings, underground water, and sewer lines, etc.)***
3. Explain that urban planners rely on maps to do their job. They need to know the location of existing buildings and streets. They even have maps that show where sewer or electrical cable lines run underground.
4. Give kids a sheet of paper and ask them to draw a map of their community from memory. Maps should include roads, rivers, lakes, buildings, etc.

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Challenge 2: How are neighborhoods engineered? (continued)

Use the Tablets! 15 mins.

1. Ask kids to open the **Google Maps app** on their tablets and use the zip code of your local program or school site to locate their neighborhoods. They can orient themselves by finding familiar locations such as their homes, school, or local library.
2. Guide them through the app's features, such as zooming and Satellite View to see an aerial image of their communities. For even more detail, they can also access the **Google Earth app** with Street View (drag and drop the yellow Pegman icon) for a pedestrian's-eye view.

Wrap-up and Reflection Activity:

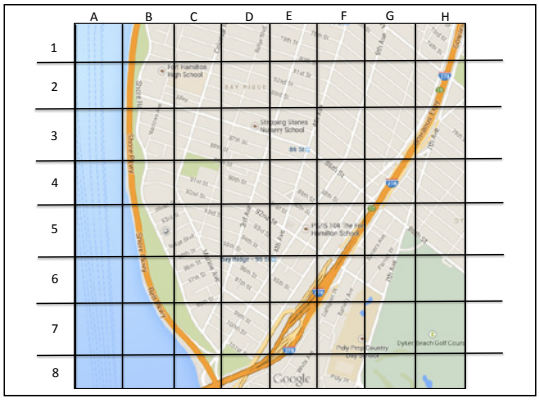
3. Have kids compare the maps they drew from memory with the real maps. What kinds of things did kids draw accurately? What was inaccurate? Ask: ***If an urban or town planner had used your original map to find a spot for a new skateboard park, what might have happened?*** Discuss the importance of accurate, detailed maps.
4. Ask kids to discuss within their teams what they discovered in their neighborhood maps.

SESSION 2

Shifting Gears: STEM Challenge! 45 mins.

To Get Started: Remind kids that they discussed maps and blueprints in the last session. They also used Google Maps on their tablets to locate their own neighborhood. Ask them to discuss what landmarks in their community helped orient them while using Google Maps.

1. Have kids separate into teams of two and provide each team with a printout of a map that shows their community. Note: The map can show their entire community or just a section but be sure it is zoomed in enough to show key local features that will help kids orient themselves. Be sure to include the map scale and coordinate numbers on each printout.
2. Ask kids to use pencils and a ruler to create a grid of one-inch squares on top of their Google Map printouts. Label each horizontal column with numbers and each vertical column with letters as shown in the example below.
3. Using your grids, describe the location of key community locations using the letters and numbers. For example, Fort Hamilton High School is located in the northeast corner of B2.
4. Explain that each group will now attempt to create a more accurate hand-drawn map of your community!



Ask teams to separate their Google map printouts into four equal sections. At the end of this activity, teams will reassemble their sections to create one large map. Ask: ***If you are going to combine each section into one map later, what is the most important thing to keep in mind?*** (Hint: Size!) Remind everyone that an accurate map needs common sizing. This is called

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Challenge 2: How are neighborhoods engineered? (continued)

Shifting Gears: STEM Challenge! 45 mins.

scale. As an example, look at the scale on the Google map printout. Show kids how many feet or miles each 1-inch square of their grid covers.

5. Give each team member a copy of **Activity Sheet B: Map It** and remind kids that their new map drawings will not be the exact same size as the one from **Google Maps** (no tracing allowed!). To make sure the objects they place on the map are all drawn to the same scale, ask them to use the following: 1 inch on the **Google Map** printout = 10 squares on the worksheet (or graph paper). This is a 1:10 ratio. Explain that the ratios show how one thing compares to another. Their new maps will be 10 times larger than the **Google Maps** printout.

6. Have each team member draw a 10x10 grid (labeled) on his or her worksheet.

Photo: © 2014 Google.

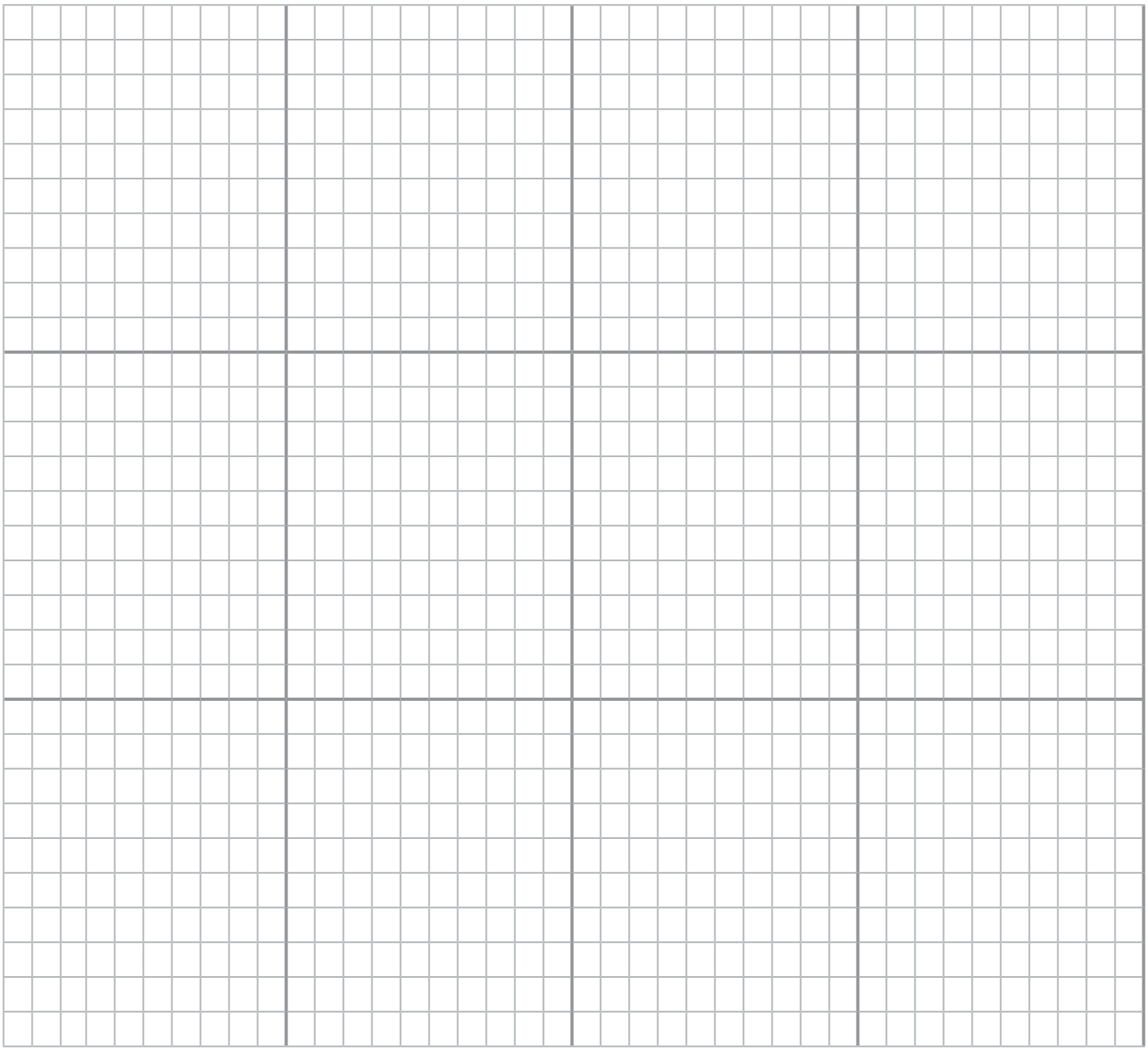
NAME: _____

Map It

You may know your neighborhood like the back of your hand, but this activity will give you an urban planner's–eye view of your community.

Instructions: Draw your sections of the Google Map on this worksheet and label streets, buildings, rivers, lakes, and other significant features of your community. Allow them to use the zoom feature on Google Maps to better understand the detail, if desired.

When done, each team should piece together its grid squares and attach them to a poster board to make a completed neighborhood map!



Challenge 3: How do we create an engineering model?

Get Prepared

Challenge Goal: Learn about the concept of an engineering model and then build a scale model of their community

Time Needed: Four 45-minute sessions (as needed to complete the 3D models)

What You Will Need:

Printouts	Materials	
• Activity Sheet C: 3D City • Letter to the Editor Template (*optional*)	• Samsung tablets • construction paper • pencils and markers • glue gun • craft materials (yarn, pipe cleaners, glitter, etc.)	• grid paper • cardboard • rulers • scissors • glue or tape • Popsicle sticks and toothpicks

Connect With the Community *(optional)*:

After kids have completed Unit 1, and the engineering in our community worksheet, they will have identified important needs in their community. Now you can give them a chance to have their voices heard! Wrap up the unit by helping them write letters to the editor of their local newspaper about their community's needs. After they've researched the address of their favorite local newspaper, download the **Letter to the Editor Template** to help them figure out what to say.

Note: Kids may use the activity sheet printouts or they may follow along on their tablets at: **www.scholastic.com/sparks2**.

SESSION 1

Spark Exploration: STEM Careers 10 mins.

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?*** Ask them to reflect on what goals people in the careers would set and reflect on what is important about the work these engineers do. Provide background and some fun insights with the following information:

   - **The oldest example of civil engineering is one of the Seven Wonders of the World.** The Great Pyramid at Giza is at least 5,000 years old. It was the tallest man-made structure in the world for nearly 4,000 years, which is even more impressive when you consider that it is said that it was built as a tomb.

2. 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?***

After the discussion, explain that you will continue to discuss careers from the **STEM Career Flip Book** on future days.

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Challenge 3: How do we create an engineering model? (continued)

Setting the Strategy: Engineering in the Community 10 mins.

Show kids an image of an architectural model on your tablet, using the following link: **http://architecturalmodels.tumblr.com/**. Explain that a model is a 3D representation of an object or structure. Together, use the examples to identify key characteristics of an engineering model such as:

- Built to scale
- Detailed
- Includes models of the surrounding environment
- Often includes models of people

Then help kids develop a definition of the term *3D engineering model* that answers the following questions:

- ***Why do you think models are important to engineers?*** (They help them show others how an engineering project will look, and function in the communities where the projects will be built. A model is also a visual representation of the strategies an engineer implements to achieve goals.)
- ***What do engineers have to consider before building a model?*** (How large the real-life structure will be and how the real-life structure compares to the size of the model; in determining the size of the model, engineers will consider the area of the space where the real-life structure will be built, the scale they will use to build the model, the structures and terrain that will surround the structure, the materials that will be used to build the structure, as well as the goals the structure will need to achieve.)

Use the Tablets! 25 mins.

1. Have kids break off into their teams.
2. Each team will now have a chance to build a 3D model of a part of your community!
3. Ask each team to start by selecting what they want to build. Ask teams to use their tablets to view their community on **Google Maps**.They should select an area that's no more than one block in an urban or town environment and ¼-mile of a rural space. For example, a local train station, farm, or skating rink.
4. Teams should view their selection using **Street View**, **Google Earth**, and **Photos** and bookmark the pages for reference later.
5. Distribute a copy of **Activity Sheet C: 3D City** to each team and ask them to get ready to build by completing the following tasks:
   - Print out a map of their location (using **Google Maps**) and draw a 1-inch by 1-inch grid on top as a scale reference (as they did in Activity 2).
   - Sketch the *footprint* of their models on **Activity Sheet C: 3D City**. They should use a scale of 1:3 so that 1 grid square from **Google Maps** equals 3 grid squares on their worksheets. This footprint should show how much area each element of the model will cover. Show and label everything you intend to build including houses, trees, parks, etc.
   - Sketch the front, back, side and top of their location to show what the outside of it will look like.

Wrap-up and Reflection Activity:

6. Have students consider what they want their models to show overall. Are they showing large buildings, highways, or residences? Have they included community spaces, such as a park? Why did they choose the specific segment for their models?

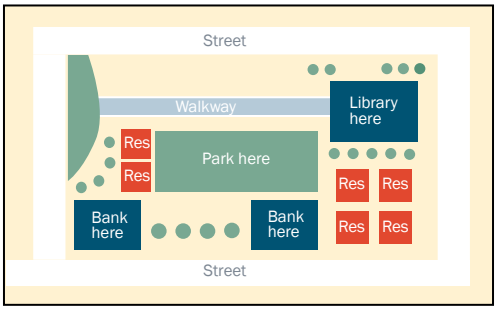
Challenge 3: What is innovative engineering? (continued)

SESSION 2

Shifting Gears: STEM Challenge! 45 mins.

To Get Started: Remind kids that they discussed engineering models in the previous session. Ask students to name a few reasons why models are so important to engineers.

1. Now that kids have used the first session to plan out their models, they are ready to build! Pass out large pieces of cardboard for kids to use as the bases for their models. Glue **Activity Sheet C: 3D City** to the cardboard base.
2. Instruct kids to fill in the street names, buildings, and other structures they will include in their models. This will be a flat plan where they will place all the structures and elements that will be included in their models. A good way to describe this would be to liken the foundation to a place mat with shapes and designations as to where a plate, fork, or cup would go. Please refer to the illustration to the right for a visual example of a foundation.



3. After kids complete this task, they can start making their model structures as described in session 3. If not, they should have sufficient time to cut the foundation and draw in the model elements by the end of session 2.

Wrap-up and Reflection:

4. Ask kids to think about why laying out a foundation prior to building a model is so important. Guide kids to think about spaces and structure sizing. Do they notice anything they may want to include in the 3D model based on their learnings from this activity?

SESSIONS 3 and 4

Shifting Gears: STEM Challenge! 45 min. Sessions

To Get Started: Remind kids that they started building their models in the previous session. Ask them to discuss any challenges they came across during this process.

1. During the final sessions of this activity, kids should use the next sessions to build the buildings, trees, and other structures that will make up their models. Explain that this project will require them to think creatively about how to make the structures in their models. Explain that they can use popsicle sticks and toothpicks to build the structure of houses and other buildings. They can then cover the popsicle sticks with construction paper to serve as walls and roofs. As kids work, encourage them to evaluate whether they are on track and provide feedback on the construction of their models. Remind them to use all the materials they have access to and to use their creativity. Answer any questions teams may have if they become stuck and encourage them to reflect, shift gears, then revise their models as needed.

Wrap-up and Reflection:

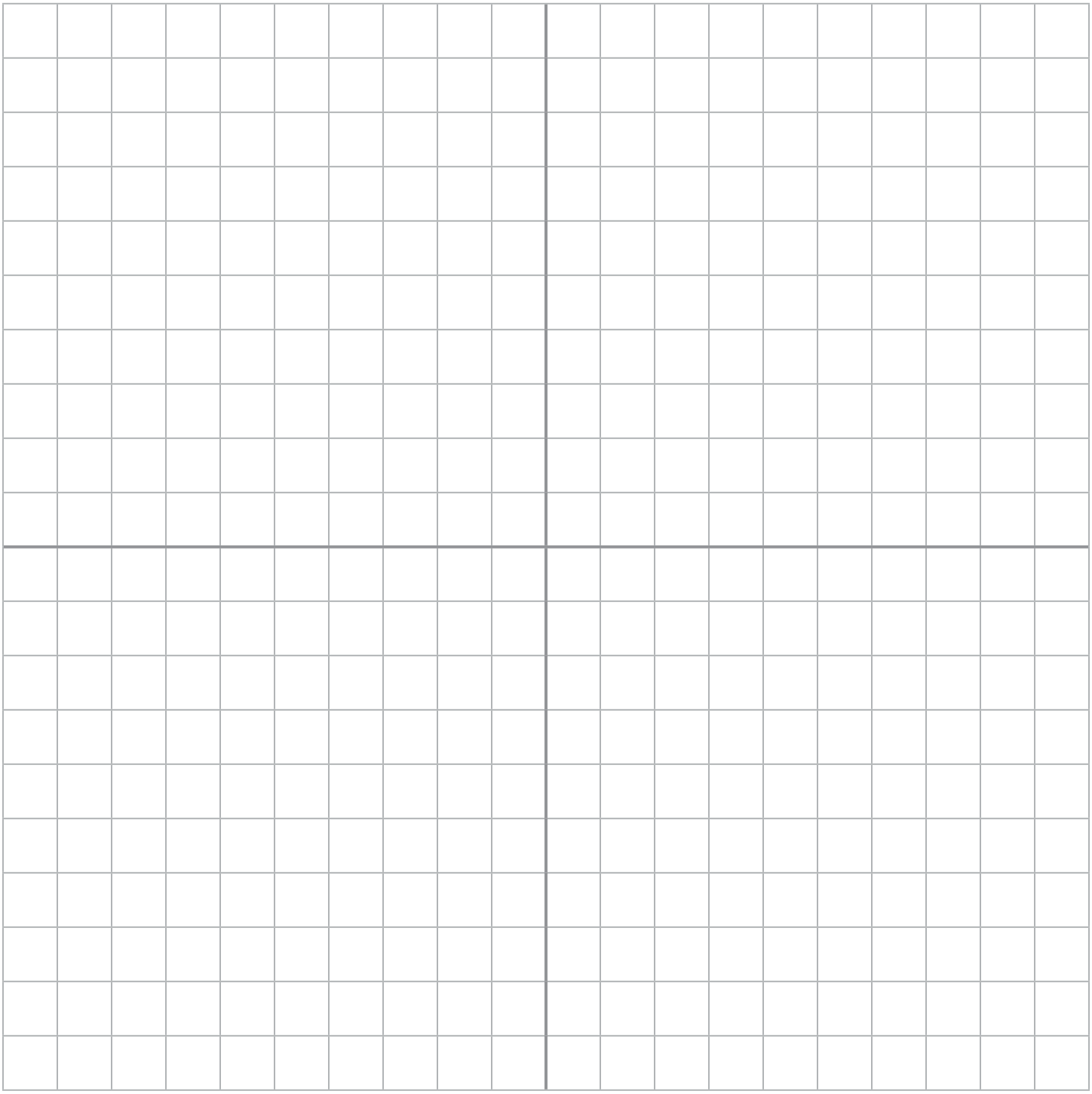
2. Depending on how quickly kids finished session 2, they may only need one session (session 3) to complete their models. If you find your kids need an additional day to put the finishing touches on their models, provide them with more time to wrap up so that they will have models they can be proud of.

TEAM NAME: _____

3D City

Maps are very useful, but the view they show of the world can fall, well, flat. Engineers draw their ideas, then build 3D models of their sketches. Use this page to build a model of one part of your community!

The scale of this model is 1:3.



Challenge 4: What is innovative engineering?

Get Prepared

Challenge Goal: Understand the idea of innovative engineering

Time Needed: Three 45-minute sessions

What You Will Need:

Printouts	Materials	
• Activity Sheet D: Name That Career	• Samsung tablets	• cardboard
• Activity Sheet E: Build a Better Bridge	• 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/sparks2.

Before You Begin:

- Make sure the following website is visible to kids: http//to.pbs.org/1hDKL4Q. They will be referring to this link in the tablet activity on the following page.
- Make enough copies of Activity Sheet D: 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 Council-to-Home Communication: Unit 2 Overview for kids to take home and share with their family members.

SESSION 1

Spark Exploration: STEM Careers 10 mins.

Start this lesson with the following interactive challenge that gets kids thinking about the role engineering plays in communities.

1. Have kids separate into their teams and give each team a set of the activity cards you cut out from **Activity Sheet D: 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.
2. 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*

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Challenge 4: What is innovative engineering? (continued)

Spark Exploration: STEM Careers 10 mins.

- **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*

Strategy: Engineering in the Community

1. Engineers are problem solvers. Part of their job is to come up with strategic and often new ways to meet people's needs and their own goals. 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?***
   - ***Is innovation a skill that can grow with effort and practice or simply something you are born with?***

   (Hint: Abilities improve with effort and practice. Engineers constantly grow their skills and challenge themselves throughout their career!)
2. Use your tablet to show kids three examples of innovative engineering. Each of the following structures was designed to meet a specific goal or need. Review the innovations and discuss strategies used to meet the community's needs.
   - **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 in Africa prone to frequent flooding: **http://nyti.ms/1kvwyPi**
3. Discuss how these structures meet a community need. **What materials were used to build these structures? How would you change the innovations to benefit your own community?**

Wrap-up Session and Reflection:

4. Wrap up session 1 by having kids choose one of the three innovations that would most benefit their community. Pass out paper and ask teams to adapt the existing design to make it fit their community's needs. Ask students to think about what needs their improved design will meet and what strategies they will be using to meet those needs. If there is time, have teams present their adaptations to the entire group.

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Challenge 4: What is innovative engineering? (continued)

SESSION 2

Use the Tablets! 45 mins.

To Get Started: Remind kids that they discussed the role engineers played in their communities and innovative engineering in the previous session. Ask them to discuss their favorite engineering innovation and why.

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. Ask each team to use their tablets to access the Bridge Basics page at **www.pbs.org/wgbh/buildingbig/bridge/basics.html** and read through the four different kinds of bridges. Explain that they are now going to do an interactive lab to help a town in serious need of some bridges!
3. Have each team go to the Bridge Challenge at **www.pbs.org/wgbh/buildingbig/bridge/challenge/index.html** and complete the online activity.
4. Explain that engineers have many things to consider when building structures. One of the most important ones is a structure's *load*. Loads are forces that push, twist, and stretch a structure.

Wrap-up Session and Reflection Activity:

5. Encourage kids to use the Building Big website to illustrate what different forces can do to a bridge. For example, what does a bridge that has been warped under a great weight look like? Have kids reflect on why it is so important to test and retest structures.

SESSION 3

Shifting Gears: STEM Challenge! 45 mins.

To Get Started: Remind kids that they discussed engineering structures, materials, and load. Ask them to name and explain two engineering structures as a group.

Hand out **Activity Sheet E: 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. Explain at the outset that many projects fail and that engineers have to shift gears or experience road blocks and revise their designs many times before achieving the goal of the project. Innovation in engineering depends on the idea that structures and things can always be improved. This is true of our own abilities as well.

Name That Career

Teachers: Make five or six copies of this activity sheet and cut up the cards for an interactive game. Each team should receive 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 materials and following safety codes

NAME: _____

Build a Better Bridge

Now it's your turn to build a sturdy structure of your own. Remember to manage your goals instead of simply setting them. Through GPS you will make your goal selection, create your plan, try it, and even "shift gears" to improve your design if you encounter challenges.

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

Loaded Up

All structures experience *loads*, or forces that push, twist, and stretch, the weight of objects pushing down, strong winds, or even vibrations. Over time, these forces can break or bend a structure.

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 things they build won't collapse. Three ways engineers do this are by choosing the right materials and shape and including strong supports for their structures.

For example, bridges can be made out of **materials** like wood, metal, or concrete. They can be **shaped** like a beam to form a straight span across a gap or an arch. 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 at least 3 inches between each stack.
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?

Reflect and Shift Gears:

4. **Adapt your bridge:** Reflect and come up with three adaptations your team can make to better strengthen your bridge. Consider what materials you can add or how you can change the shape of your bridge using engineering structures.

Adaptation 1	Adaptation 2	Adaptation 3

5. **Retest your bridge:** Test all three adaptations to your bridge to see which holds the most weight. Remember to interact with other teams and your leader to share adaptation ideas.

Challenge 5: What is the connection between community needs and innovative design?

Get Prepared

Challenge Goal: Reflect on examples of technological innovations that benefit society

Time Needed: 45 minutes

What You Will Need:

Printouts	Materials
• Activity Sheet F: Talk About It!	• Samsung tablets • pens or pencils

Note: Kids may use the activity sheet printouts or they may follow along on their tablets at: www.scholastic.com/sparks2.

Sparks Exploration: STEM Careers (optional)

If you have time, you can start Challenge 5 by having kids use their tablets to access the **STEM Career Flip Book**. Introduce the software developer and web developer in the technology section. Explain that technology is a growing field with the ability to influence everyday life. Tell them when they use cell phones, apps, and computers, they are benefiting from the work of software developers and web developers.

Goal Selection:
Ask them what needs they think software and web developers consider when they develop projects. Remind them to reference the **STEM Career Flip Book** if they need more information. (Make sure they understand that software developers design computer systems and games, while web developers design websites and web programs.)

Setting the Strategy: Engineering in the Community 10 mins.

1. Remind kids that innovative engineering solves specific problems. When working on a new design, engineers have a particular goal in mind that should solve an issue or meet a need.
2. Explain that community improvement strategies are not just structural. New technology can also solve community problems. Have kids use their tablets to view three examples of helpful technological innovations. As you review, identify the need or want that each innovation was created to serve.

- **Google Self-Driving Cars (California):** To help cut down on traffic accidents, Google created a car that drives itself: http://nyti.ms/1i5NSHt
- **Bluefin-21 Submersible (Maryland):** An underwater robot helps search for a missing Malaysia Airlines plane that disappeared after takeoff in March 2014: http://nyti.ms/1ibMp2I
- **Soccket (New York):** A new soccer ball generates electricity to provide power in underdeveloped areas of the world: http://wapo.st/1hE9OEW

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Challenge 5: What is the connection between community needs and innovative design? (continued)

Shifting Gears: STEM Challenge! 20 mins.

Break kids into their design teams and ask each to choose one of the three innovations you just discussed: Google Self-Driving Cars, Bluefin-21 Submersible, or Soccket. Challenge each team to find a creative way to revise this innovation so it meets a need or want in your community.

Use the Tablets! 15 mins.

Pass out **Activity Sheet F: Talk About It!** for each design team to complete as a group. In this activity, kids will share and write down their opinions about new engineering improvements they would like to see made in their town or community.

Encourage kids to think creatively about the wide variety of innovations they have already learned about. Can ideas be combined? What would improve the lives of the people in your community? For inspiration, following are links to the six innovations discussed in other lessons:

- **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 in Africa prone to frequent flooding: **http://nyti.ms/1kvwyPi**
- **Google Self-Driving Cars (California):** To help cut down on traffic accidents, Google created a car that drives itself: **http://nyti.ms/1i5NSHt**
- **Bluefin-21 Submersible (Maryland):** An underwater robot helps search for a missing Malaysia Airlines plane that disappeared after takeoff in March 2014: **http://nyti.ms/1iVy2et**
- **Soccket (New York):** A new soccer ball generates electricity to provide power in underdeveloped areas of the world: **http://wapo.st/1hE9OEW**

NAME: _____

Talk About It!

Use this sheet to get your creativity flowing! What would make your community happier or more successful? What do kids need? How about the elderly?

Instructions: Read each question and make a short list of three local needs that apply to this question. Then brainstorm a list of solutions for each need!

Ideas for Our Community

1. **Want places to play?** Do we have enough places for physical activity (like public pools, sports centers, basketball courts, soccer fields, playgrounds, and parks) in our town or city? If not, what types of places would you like to have?	**Needs:** 1. _____ 2. _____ 3. _____ Solutions: _____
2. **Want to fix things that are broken?** What things in our town or city need to be fixed or replaced (like boarded-up buildings, old streetlights, or uneven sidewalks)?	**Needs:** 1. _____ 2. _____ 3. _____ Solutions: _____
3. **Want to make dangerous areas safer?** Are there local areas that are dangerous (busy street corners, dark lots, open construction areas)? What could be done to make these areas safer? Could empty buildings or lots be turned into something great for the community?	**Needs:** 1. _____ 2. _____ 3. _____ Solutions: _____
4. **Want to help people?** Are there improvements that could be made that would help people be healthier or more comfortable?	**Needs:** 1. _____ 2. _____ 3. _____ Solutions: _____

Challenge 6: How do engineers create innovative designs?

Get Prepared

Challenge Goal: Reflect on solutions to a community-based engineering problem, then turn ideas into an innovative design

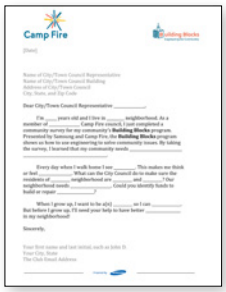
Time Needed: 45 minutes

What You Will Need:

Printouts	Materials
• Activity Sheet G: Brainstorm! • City/Town Council Letter Template (*optional*)	• Samsung tablets • pens or pencils • paper • completed **Activity Sheet F: Talk About It!** (*from Challenge 5*)

Note: Kids may use the activity sheet printouts or they may follow along on their tablets at: www.scholastic.com/sparks2.

Connect With the Community *(optional)*:



Once kids have completed Unit 2, they will have invented an innovative design to meet a need in their community. Wrap up the unit by helping them share their great ideas with their city council representative. Have them research the name and address of their city council representative. Then ask them to use the downloadable City/Town Council Letter Template to write a letter that presents their ideas and asks for support for their communities.

Spark Exploration: Introduce Them to STEM Careers 10 mins.

Have kids open the STEM Career Flip Book on their tablets and flip to the engineering careers to read about a drafter. Explain that engineering projects take a team of STEM professionals. Ask:

- ***When do you think a drafter would be involved in a building project?*** (After an architect or engineer has come up with the idea for the project and before it gets built.)

Goal Selection:

- ***What do you think a drafter's goal is when working with a team?*** (To plan out how an idea will work in real life, identify problems with the design idea, offer alternative solutions, and demonstrate how much space and materials may be needed to build.)

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Challenge 6: How do engineers create innovative designs? (continued)

Setting the Strategy: Engineering the Community 10 mins.

Direct kids to separate into their design teams and **look back over** the responses on **Activity Sheet F: Talk About It!** from the previous activity. Have them debate which community issues are of the greatest importance and why. From the top issues, they'll pick one they'd like to tackle with an innovative engineering project. Encourage teams to clearly define the goals their designs would achieve and what strategies they would integrate to achieve these goals. Explain to kids that a *goal* is the "result or achievement toward which effort is directed."[1] For example, to finish all homework by 6 p.m. is a goal. A *strategy* is a "plan, method, or series of maneuvers for obtaining a specific goal."[2] For example, starting homework as soon as you get home from school and turning off the television while you work are both strategies.

Shifting Gears: STEM Challenge! 25 mins.

Hand out **Activity Sheet G: Brainstorm!** to each kid. Instruct teams to reflect on a possible idea for an innovation that could help address the goals of their chosen community issue. If there is time, instruct kids to start sketching a draft of their design ideas. They may use the **Picasso app** to sketch out their designs on the tablets or they may use separate sheets of paper. If kids do not have time to sketch their ideas, wrap up the activity by having them write detailed notes. Have them save their sketches and notes for the next activity.

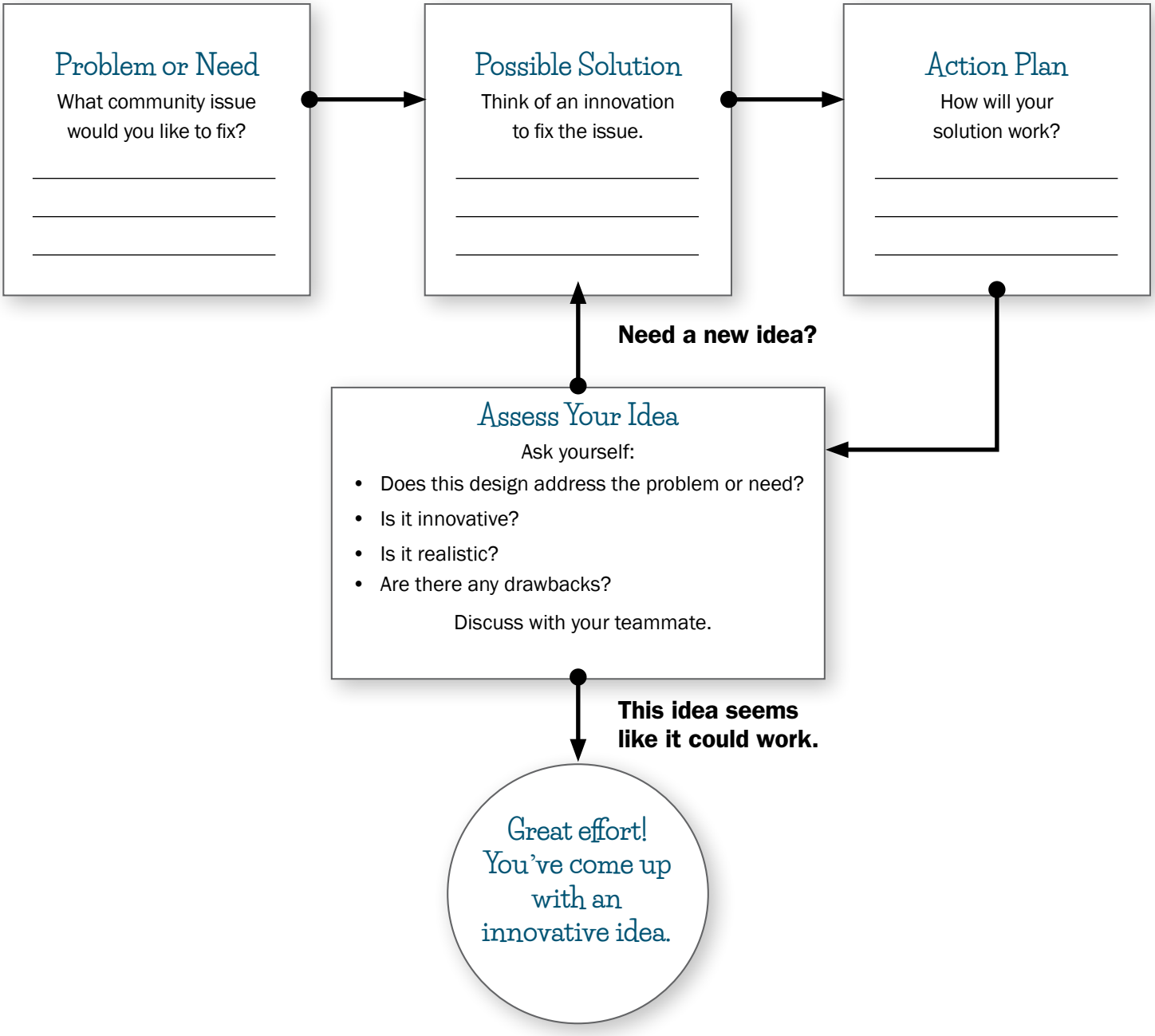
Sources: [1,2] www.dictionary.com.

NAME: _____

Brainstorm!

It's not always easy to come up with solutions to a problem. It helps to brainstorm to create a list of possibilities. Use this activity to spark a flood of ideas!

Instructions: Write the important community issue your team would like to fix in the "Problem or Need" square below. Then come up with an innovation that could be a potential solution. Next, consider what it will take for your innovation to work. The diagram below will help you map out your thoughts so you don't get stuck.



Challenge 7: How can we improve innovative designs?

Get Prepared

Challenge Goal: Learn about the role of revision in the design process

Time Needed: 45 minutes

What You Will Need:

Printouts	Materials
• Activity Sheet H: Troubleshooting	• Samsung tablets • paper • pens or pencils • team notes and sketches on their innovation ideas (*from Activity 6*)

Connect With the Home:

Now that you've begun Unit 3, send home the **Council-to-Home Communication: Unit 3 Overview** so family members can read about the activities for the final unit of **Building Blocks**.

Note: Kids may use the activity sheet printouts or they may follow along on their tablets at: **www.scholastic.com/sparks2**.

Engineering in Action 10 mins.

Goal Selection:

1. Ask two or three teams to share their experiences with creating their own innovations. Ask: ***What community need does your idea meet? What goals did you set for your idea?***

Setting the Strategy:

2. Explain that the idea for an innovation is just the first step in creating a community solution. Finished designs don't get built right after the idea is created. Designs go through many revisions. Engineers create a plan and come up with strategies to achieve set goals. They put their designs through a design development process to make sure their innovations work in the best possible way and offer the best solution to a problem.
3. Ask kids: ***Reflect on how engineers might determine what improvements to make to a design?*** (They look for problems in the design and make sure it meets all the identified community needs; they develop models of their designs and test them; they get feedback from consumers and other engineers.)

Photo: © Daniel Kaesler/Herrera/Thinkstock.

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Challenge 7: How can we improve innovative designs? (continued)

Shifting Gears: STEM Challenge! 25 mins.

1. Tell kids that, like real engineers, they need to evaluate their design ideas before settling on a final design. They'll test and revise their ideas with the help of a role-playing activity.

2. Have teams partner with one other team to complete **Activity Sheet H: Troubleshooting**. The testing groups will take turns putting on a short skit to act out how each team's innovations will work.

3. Hand out **Activity Sheet H: Troubleshooting**. Give teams ten minutes to choose characters based on the roles described on the chart on the activity sheet then plan a skit to answer the questions listed below. Ask them to think carefully about their innovation ideas. Their role-playing should demonstrate:

   - What their innovations will do
   - What goals their innovations will meet
   - Who will use their innovations
   - Who will operate their innovations
   - Where their innovations will be located in the community
   - Who will be impacted by their innovations

4. Now that teams have developed their ideas, explain that it's time to role-play. Make sure that each of the four group members has a specific role to play. Group members will play the following roles:

   - **Role #1:** The person who will ***use*** and ***benefit*** from the innovation
   - **Role #2:** The person who will ***operate*** the innovation
   - **Role #3:** The person who will be ***affected*** by the innovation's location and/or presence in their community
   - **Role #4:** The person who will be ***critical*** of the innovation

5. Give groups five minutes to act out a short scene involving the first team's innovation. After five minutes, have the kids stop and take notes on what worked and what didn't. Then have the groups start a new role-play to test out the other team's innovation so that both teams get feedback on their design ideas.

Use the Tablets! 10 mins.

Have kids separate into their teams and review the issues they discovered during the role-play activity. Tell them to use this information to revise their innovation's design in the **Picasso app** on their tablets. Teams may also choose to draw their solutions on paper.

Photo: © Wavebreak Media/Thinkstock.

NAME: _____

Troubleshooting

Will your innovation work as expected? You won't know until you test it in a real-life scenario. Use this role-play activity to look for possible problems with your design.

Get Ready

Describe the characters in your role-play activity. These should represent specific people who will interact with your innovation.

Role	Character Description
Role #1: The User **Who will use the innovation? Who will the innovation help?** Choose a character who will use the innovation and be helped by it.	
Role #2: The Operator **Who will operate the innovation?** Choose a character who will make the innovation work.	
Role #3: The Neighbor **What size will the innovation be and where will it be located?** Is the innovation large or small? Will the size and location of the innovation impact someone in the community? Choose a character who has to get used to the innovation in the community.	
Role #4: The Critic **Will someone in the community dislike the innovation?** Think of a character who might not like the innovation and might complain about it. This character's criticisms can help you come up with design solutions!	

Act It Out

Now that you have your characters, act out a short scene involving your innovation. All team members should be involved and pretend to interact with the innovation. As you're acting it out, notice what works the way you think it will and what doesn't.

Reflect and Shift Gears

On the back of this sheet, write down any issues that arose during the role-playing activity. Then brainstorm solutions to address these issues so your innovation better meets your community's needs.

Challenge 8: How can we show how innovative design works?

Get Prepared

Challenge Goal: Create flowcharts to show how innovations will work and how the community will use them

Time Needed: 45 minutes, plus one additional 45-minute session (*optional*)

What You Will Need:

Printouts	Materials
• Activity Sheet I: Set the Scene	• paper • pencils • markers or colored pencils (*optional*) • glue or tape (*optional*) • poster board (*optional*)

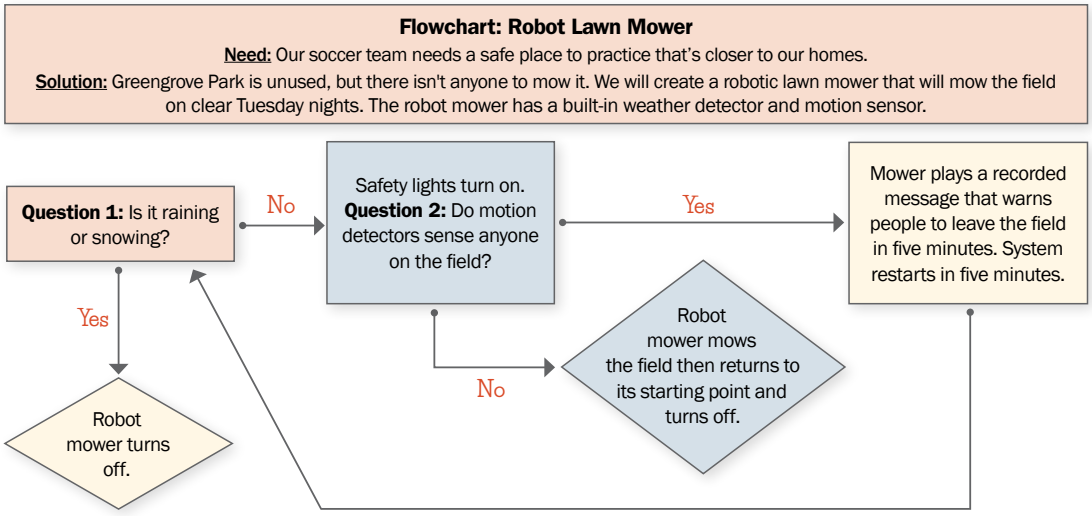
SESSION 1

Engineering in Action 5 mins.

Once engineers have identified their goals, they then have to identify strategies to make them work. Teams have already set their goals for Unit 3, now they will focus on setting strategies.

1. Explain that engineers have many tools to help come up with strategies on exactly how innovation will function. Ask kids: ***What are some ways that engineers could show the community how an innovation will work?*** (Answers might include: creating models, graphs, charts, computer simulations, drawings, and diagrams.)

2. Explain that a flowchart is one tool engineers use to show how something functions. A flowchart is a diagram that uses boxes and arrows to show the steps involved in a process, the order in which they occur, and the possible outcomes of each one.



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Challenge 8: How can we show how innovative designs work? (continued)

Use the Tablets! 40 mins.

1. Have kids access the **Draw Express Diagram Lite app** on their tablets. Explain that they will use it to create flowcharts for their innovations. Tell them that this chart will detail how their innovations will function and how residents in their community would use them.
2. Discuss the importance of if/then statements when devising a flowchart. An if/then statement states: If _____ step happens, then it causes _____ step to happen next. If/then statements allow people to plan out exactly how an innovation will work and react to the person using it. Tell kids that these statements will help them keep track of all the steps in a process. These steps will also help them see setbacks to their ideas that would need rethinking/revising.

Wrap-up Session and Reflection:

3. Instruct kids to use the **Draw Express Diagram Lite app** to create if/then statements for their innovations. As they record each interaction from the innovations on their flowcharts, they will reflect more deeply on what happens during each step of their innovations in action.

SESSION 2

Shifting Gears: STEM Challenge! 45 mins. (optional)

To Get Started: Remind kids that they discussed engineering tools in the previous session, focusing on flowcharts. Ask them to discuss why a flowchart is so helpful in showing how an innovative design works.

1. If you would like to add a session, prepare your kids to do more! Let them know that a flowchart may reveal how an innovation will function, but it has a downside: It's so technical that it doesn't give a good overall picture of the innovation at work. A more visual way to show an innovation in action is with a storyboard. A storyboard is a type of graphic organizer that shows a sequence of illustrations depicting a scene, sometimes with explanatory text or dialogue.
2. Use your tablet to share this article about storyboards with kids at: **www.scholastic.com/teachers/article/what-are-storyboards**. Ask kids what they notice about how the storyboards are organized.

Wrap-up Session and Reflection Activity:

3. Hand out **Activity Sheet I: Set the Scene**. It will guide kids through the steps necessary to plan and draw storyboards of their own. Have kids reflect on the best sequence of illustrations to represent community residents using their innovations. Encourage kids to discuss why community residents would use their innovations. This will provide them with great insight while they complete this activity.

NAME: _____

Set the Scene

A flowchart may reveal how an innovation will work, but it doesn't give the whole picture. To really show your innovation in action, you're going to create a storyboard by following the steps below. It will show, in a series of images, how people in your community will use your innovation.

1. **Plan Your Panels:** Jot down some ideas for a series of illustrations that will show residents of your community using your innovation. You will use six sheets of paper as your six storyboard panels. The panels should tell a visual story like a scene in a movie. Make sure the scene unfolds panel-by-panel in a logical order so that anyone who views it will understand the steps of how your innovation works.

2. **Ready, Set, Draw:** Begin drawing rough pencil illustrations for each panel in the storyboard template below. Work together as a team to reflect on whether the sketches are effective. Make revisions to be sure you're presenting your innovation in the best way possible. When done, add final details, outlines, and color to the panels.

3. **Mount Your Storyboard:** Arrange the panels in order in two rows of three on a piece of poster board. Give your storyboard a title and add text or dialogue underneath each panel to help explain what's happening in each. Make sure you make any text on the poster large enough for an audience to read.

Challenge 9: How do we create a model of our innovative design?

Get Prepared

Challenge Goal: Kids will build models of their innovations

Time Needed: 45 minutes (with an additional 45-minute session if more time is needed to complete the models)

What You Will Need:

Printouts	Materials
• Activity Sheet J: Model Construction • Activity Sheet K: Presentation Guide (*optional*) • Letter to the Mayor Template (*optional*)	• Samsung tablets • Building materials, such as: · cardboard · clean, disposable plastic containers · egg cartons · straws · pipe cleaners · caps · tinfoil · markers · paint · scissors · glue · tape

Note: Kids may use the activity sheet printouts or they may follow along on their tablets at: www.scholastic.com/sparks2.

Connect With the Community *(optional)*:

Since kids have completed the **Building Blocks** program, have them write a letter to the city's mayor using the provided **Letter to the Mayor Template**. The template will help them find the words to explain their innovations and invite the mayor to come take a look at their hard work.

Engineering in Action 15 mins.

1. Now that kids have their goals and have planned their models, it's finally time for them to build. So dive right in! Ask kids if they can recall why models are important to engineers. (Remind them that they learned about this in Challenge 3 when building their model 3D cities.) Models help engineers show others how an engineering project will look, function, and interact with the real world.
2. Explain that engineers call a model of a design a prototype. Ask:
   - ***Why is it important to build a prototype before producing the actual design?***
   - ***Why do designs need to be tested?***
   - ***What happens if a design fails?***
3. Explain that building a prototype is one part of the design development process. Ask kids to identify other design stages they have learned so far. Make sure they include the following stages: define the problem; set goals; brainstorm solutions; choose the best solution; come up with strategies; draft your design; test and troubleshoot your design; improve your design. (If you'd like to test their sequencing skills, you can write these steps randomly on your whiteboard or chalkboard and have kids put them in the correct order.)

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Challenge 9: How do we create a model of our innovative designs? (continued)

Shifting Gears: STEM Challenge! 30 mins.

1. Hand out **Activity Sheet J: Model Construction**. It will walk teams through the steps to plan how to build a model of their innovations. Before they begin, have them look over the building materials provided so they can determine what is available and will work best for their models. Encourage kids to come up with building plans in advance.
2. Once kids have completed their activity sheets, give them about 30 minutes to work on building their models. Remind them to look back as needed at the design they drew on their tablets, as well as the flowcharts they created in the previous activity.
3. Circulate among the teams as they work on their innovation models. Encourage them to evaluate whether they are on track and provide feedback.

Answer any questions teams may have if they become stuck. Extend this activity to an additional session if kids need additional time to complete the models of their innovations. Remind kids to shift gears and make revisions as necessary.

Final Presentation (optional)

Congratulations! You and your kids have come to the end of your journey of learning about STEM and innovation. Give yourselves a round of applause for your hard work. Now that they've completed this challenge, your kids should have plenty to be proud of. So help them share their hard work with the community!

Prepare for the Presentation

If your council has the time and space, organize an event where kids can present their ideas to peers, families, and community members. You may also invite government officials. Find a place where kids can display their 3D models and the models of their innovations. If you did not complete the optional **Activity Sheet I: Set the Scene** during Challenge 8, consider going back to complete it so teams will have storyboards to accompany their 3D models. As a final component to the presentation, use **Activity Sheet K: Presentation Guide** to help kids prepare a public presentation of their innovations. Public speaking and communication are important educational, job, and life skills. Give your kids a head start in learning how to effectively share their thoughts and ideas. Good luck!

TEAM NAME: _____

Model Construction

You've worked long and hard setting goals and strategies to develop a design idea to benefit your community. Now it's time to show others what your innovation will look like in real life. So just like a real engineer, you're going to build a model of your innovation.

Instructions: Make sure your model building goes smoothly. Before you begin, use the checklist below to outline the building process. Check off each step as you complete it. Remember to make changes to your model as needed.

Construction Checklist

☐ Choose Your Materials

Of the materials provided, which will work best for your model? List them here:

_____

_____

_____

What will each type of material be used for?

_____

_____

_____

☐ Plan Your Building Method

How do you plan to construct your model? List the steps here:

Step 1 _____

_____

Step 2 _____

_____

Step 3 _____

_____

Step 4 _____

_____

☐ Label It!

When you are done building, use strips of paper to label the key parts or features of your model to show how it will function. Write down what you plan to label here:

Part/Feature 1 _____

Part/Feature 2 _____

Part/Feature 3 _____

Part/Feature 4 _____

☐ Building in Real Life

What materials and other resources would you need to create your actual innovation?

_____

_____

What strategies would you use to build your actual innovation in your community?

_____

_____

_____

Presentation Guide

Sharing your ideas in front of a group can sometimes be intimidating. But don't worry! This guide will help you improve your presentation skills.

Instructions: Complete the steps below on a separate sheet of paper to learn what important information to include in your presentation. Make sure you know which team member will present which part of the presentation. Then read the "Helpful Talking Points" section below to assist your team in preparing the presentation speech.

1. Introduce Your Design Team

- Share your team name and the names of its members.
- Give the name of your innovation and a brief overview of what it does.

2. Describe Your Innovation

- Discuss the problem or need in your community that your innovation addresses. Make sure to state the goals that you have set.
- Explain how you think your community will benefit from your innovation.

3. Discuss Your Model or Storyboard

- Use your model or storyboard to explain the details behind how your innovation will work.
- Explain how you came up with the design for your innovation. Describe the strategies and revisions you came up with along the way.

Helpful Talking Points

- **Write It Down:** It can be easy to forget what you are supposed to say when presenting. Beat stage fright by writing down a few helpful notes as a reminder of the key points you want to make.
- **Rehearse:** Don't wing it! Practice what you're going to say before the day of your presentation. This will help you relax and stay focused as you speak.
- **Know Your Stuff:** People may have questions, so come prepared to answer them. It's okay if you can't answer every question, but everyone on your team should be able to explain the main ideas behind your project and how it works.