AHS Capstone Archives
Introduction to Engineering for Seventh Graders

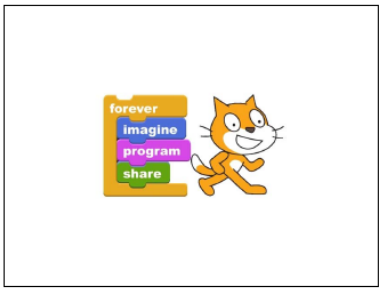
Unit One: Scratch Programming

Class One: Introduction
Length: 45 minutes
Materials: Chromebooks, paper, writing devices
Source: I gained inspiration for the Step by Step activity from the Programmed to Dance activity in the Creative Computing document from Harvard. I changed it to suit a 7th grade audience. http://scratched.gse.harvard.edu/guide/files/CreativeComputing20140806.pdf

Introduction and overview – 5 minutes

Task: Introduce yourself and the four units for the class

The first unit will be Scratch Programming – learning computer programming using colorful blocks. The second unit will use MaKey MaKeys – connecting your computer to the real world, i.e. making game controllers using a banana. The third unit will be a cardboard build – you can design tools for yourself using materials that are easily accessible. The final unit will be a design exercise – we'll have a visitor who hiked the Appalachian Trail talk about his experiences, then design tools for hikers.

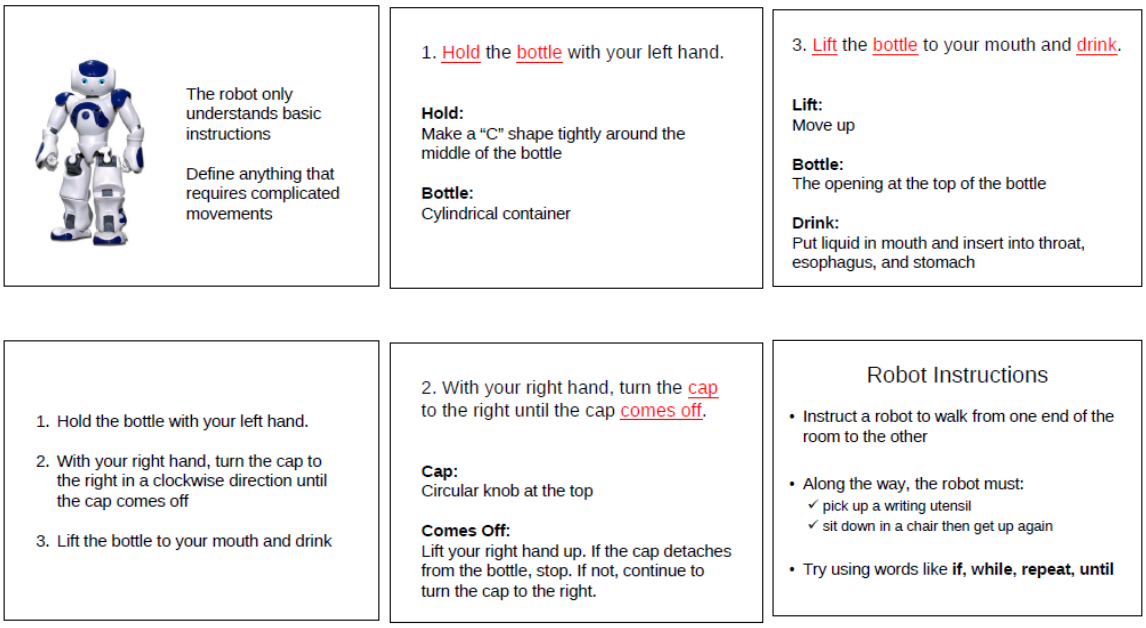


Step by step activity – 20 minutes

Task: The robot only understands basic instructions, so you need to define anything that requires more complicated movements than placing one foot in front of the

other. Walk through example of instructing a robot to open a water bottle and take a drink.

In pairs, write detailed instructions for the robot. Instruct a robot to walk from one end of the room to the other. Along the way, the robot must pick up a writing utensil and sit down in a chair then get up again.



Scratch Tutorial – 20 minutes

Task: Create a Scratch Account (or log in to an existing account if available). Create a new project and do the Dancing Cat tutorial found under "Getting Started with Scratch" in the help menu (question mark in upper right corner).

Class Two: Starter Projects
Length: 45 minutes
Materials: Chromebooks

Introduce Activity – 5 minutes

Task: Sign in to Scratch, then go to scratch.mit.edu/starter_projects. Look through the projects and pick one that you like best. Click "See Inside" and then "Remix" to make it your own project, and rename it.

Starter Projects – 40 minutes

Task: Change the blocks, the sprites, the backdrops, and the costumes to add your own creativity to the project. Try some of the suggestions provided by the Scratch community.

Unit Two: MaKey MaKeys

Class One: Introduction
Length: 45 minutes
Materials: Chromebooks, MaKey MaKeys, Play-Doh, other conductive materials
Source: In order to find simple instructions for starting up the MaKey MaKey and starter projects, I used this site: http://makeymakey.com/howto.php

MaKey MaKey How-To – 10 minutes

> **Task:** MaKey MaKeys allow you to connect your computers to objects in the real world. In order to do this, you need three things: ground, power, and a conductive object to complete the circuit.
>
> Demonstrate how to connect to power (your computer) by using a micro USB cable, and how to connect to ground by placing alligator clips in the ground holes at the bottom of the MaKey MaKey and then holding on to the other end.
>
> Show them the holes for the four arrows, space, and click on the front side of the MaKey MaKey and explain that you can connect to those keys by placing alligator clips in the holes.
>
> Have every group or pair get a MaKey MaKey and a cable, enough alligator clips and wires to connect to ground and all the keys in the front, and a tub of playdoh.

Bongos – 10 minutes

> **Task:** Have the students connect the left arrow and the spacebar to two playdoh pieces. They can then go to http://makeymakey.com/bongos/ to play the bongos using the playdoh. Remind them that it's important to connect to ground, and that in order to complete the circuit the same person that is playing the bongos must be connected to ground.

Pacman – 10 minutes

> **Task:** Have the students connect the rest of the arrows and the click button. Play Pacman at http://scratch.mit.edu/projects/2345919.

Bloons – 15 minutes

> **Task:** Explain that they can flip the board over and directly attach wires to the holes that are related to the mouse (up, down, left, right) and keyboard letters. Have them connect the controls they need to play Bloons at http://ninjakiwi.com/Games/Bloons-Games/Bloons.html

Class Two: Water Play
Length: 45 minutes
Chromebooks, MaKey MaKeys, Play-Doh, other conductive materials, water buckets, a tarp, source of water, longer wires than provided in the MaKey MaKey kit
Source: I took instructions from this website to know that water DDR was possible, and to learn what traps to avoid: http://makezine.com/projects/dance-dip-revolution/

Setup – 10 minutes

> **Task:** Explain that we are going to be using water buckets to play DDR. Determine who is interested in getting wet, and set up a tarp in the classroom depending on interest. Tell everyone else that they can continue to experiment with playdoh or with cups of water. Have each group or pair get a MaKey MaKey and the corresponding wires.

Further MaKey MaKey Projects – 25 minutes

> **Task:** Students not playing water bucket DDR can choose other conductive materials and continue experimenting with interactive music (http://www.patatap.com), Tetris (www.freetetris.org/game.php), or DDR (http://www.flashflashrevolution.com/FFR_the_Game.php).
>
> Students who want to play water bucket DDR will work together to connect longer wires from the MaKey MaKey to buckets filled with water (one for each arrow). They should be instructed not to get the MaKey MaKey or the computer wet. After everything has been hooked up and tested, they can take turns playing DDR (http://www.flashflashrevolution.com/FFR_the_Game.php).

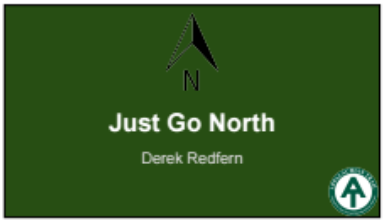
Clean Up – 10 minutes

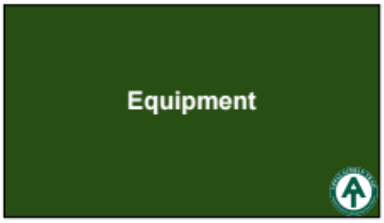
Unit Three: Designing for People

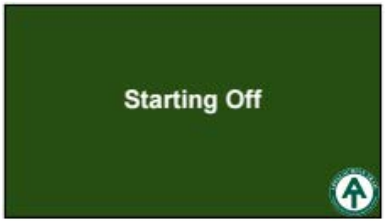
Class One: Visitor and design activity
Length: 45 minutes
Materials: A visitor, prototyping materials such as scissors, paper, felt, string, tape, paper plates, paper clips, CDs, cups, pipe cleaners, coffee filters, etc.
Source: I modeled this activity off of eDiscovery's design for disability workshop, but instead of bringing in guests with disabilities, I used someone who had hiked the AT.

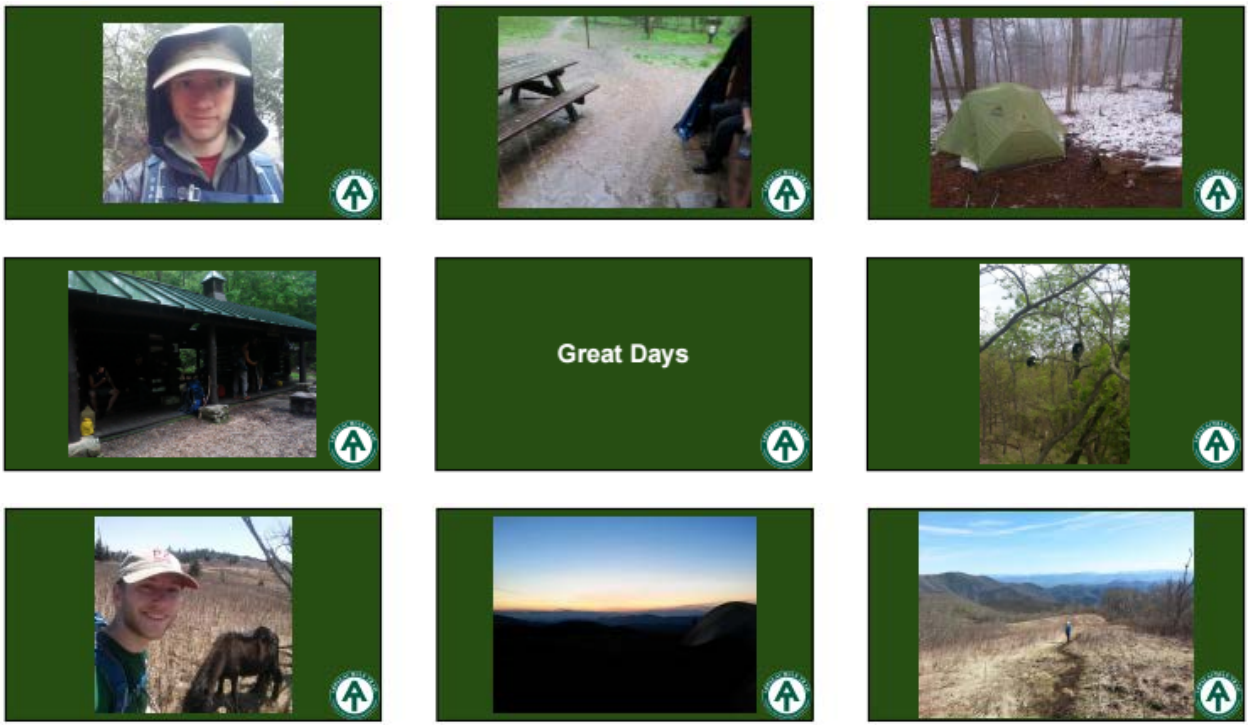
Guest Presentation – 15 minutes

> **Task:** Have guest present their story and present their challenges to the class. Allow students to ask questions.



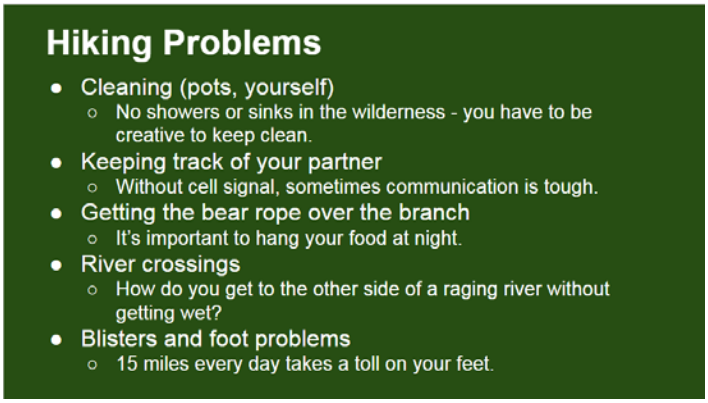






Ideation and Sketches – 10 minutes

Task: Have the students form groups of 3-4 and select a challenge to solve. Encourage them to make sketches and ideate various solutions to the problem. When they have decided one as a team, allow them to get prototyping materials.



Prototyping – 20 minutes

Task: Have the students build out a prototype of their solution. Throughout the process, have the guest walk around to see what the students are building and give feedback.

Unit Four: Cardboard Construction

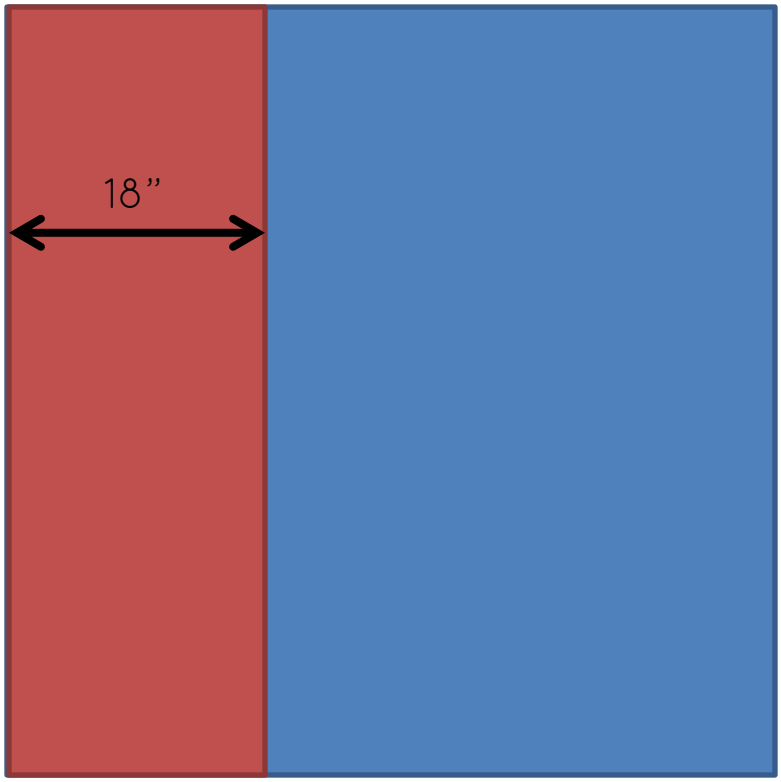
Class One, Two, and Three: Building
Length: 45 minutes (x3)
Materials: Cardboard, instruction packets, exacto knives
Source: I modeled these desks off of Kate Maschan's standing desk, but scaled down and simplified to fit the class

Building – 45 minutes

> **Task:** Have students follow instructions to build their own cardboard desks. Provide assistance with measurements and cutting.

Step One:
Take your 48" x 48" cardboard piece and hold it so the lines are running horizontally, from left to right.

Step Two:
Measure 18" from the left side and draw a line from top to bottom, dividing your cardboard piece like this:



Step Three:
Cut along the line to get two pieces of cardboard, one small piece and one large piece.

Step Four:
Write your name on each of the pieces so they don't get mixed up.
Step Five:
Let's do some math. Fill in the following numbers.

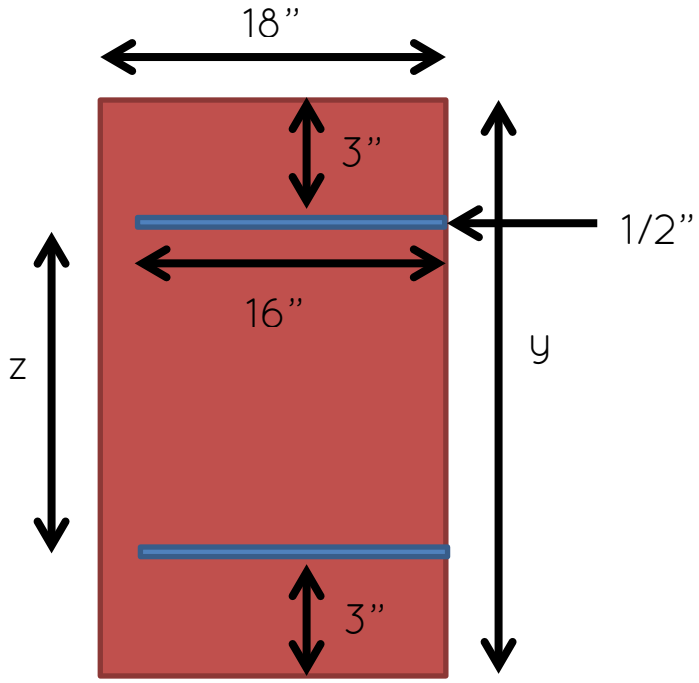
What height do you want your desk to be? x = _____
Height of the sides of your desk: y = x + 3 = _____
Middle part: z = x – 4 = _____
Height of the middle piece of your desk: a = 32 + z = _____
Height of both sides: b = 2*y = _____

Step Six:
The smaller piece of cardboard is currently 48" long and 18" wide. It should be **b** inches long. Measure out **b** inches and cut off the remaining cardboard.

Step Seven:
The larger piece of cardboard is currently 48" long and 30" wide. It should be **a** inches long. Measure out **a** inches and cut off the remaining cardboard.

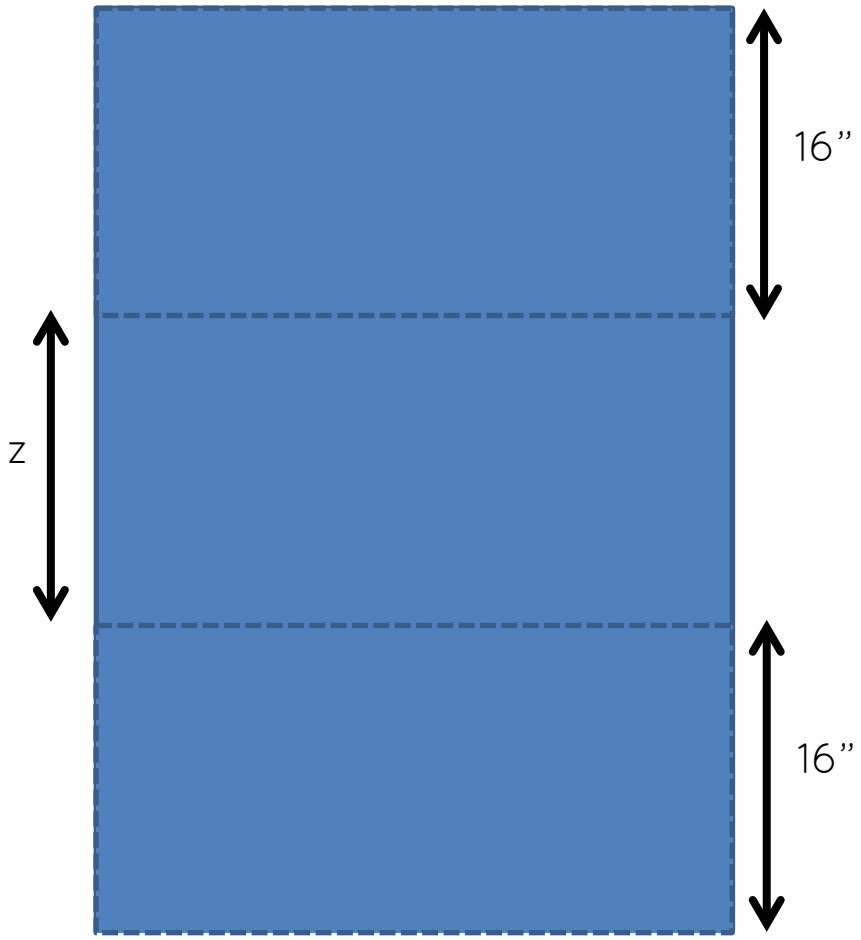
Step Eight:
Take the smaller piece and cut it in half so that you have two pieces that are both 18" wide and **y** inches long.

Step Nine:
Draw lines on your two smaller cardboard pieces to fit the following diagram. There should be two 16" by 1/2" slots that are spaced 3" from either edge and **z** inches away from each other.



Step Ten:
Cut out the slots that you just drew on each of the smaller cardboard pieces.

Step Eleven:
Draw lines on your large cardboard piece to fit the following diagram. There should be three sections – one 16" section, one **z** inch section, and another 16" section.



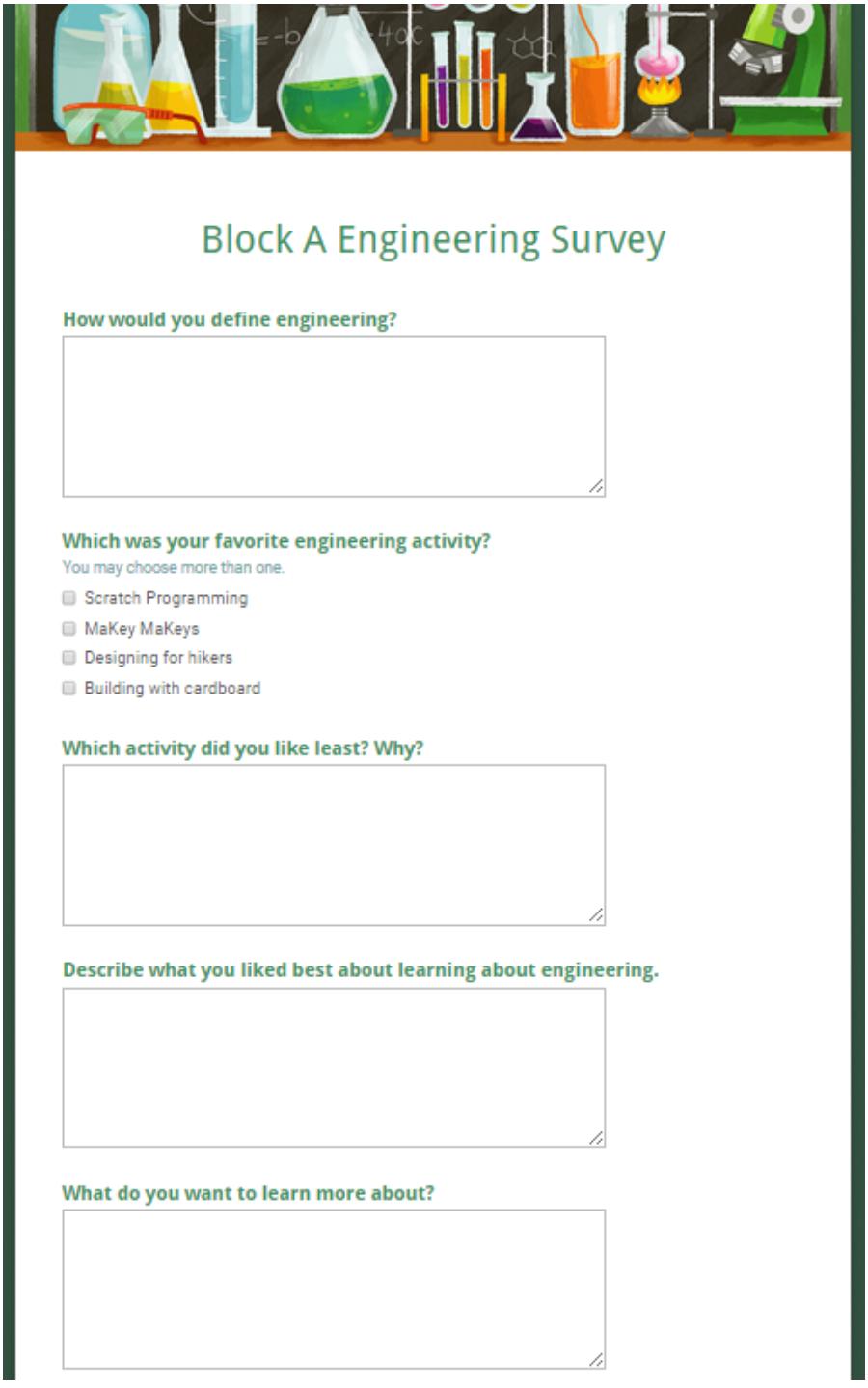
Step Twelve
Cut through only one of the three layers of cardboard along the lines drawn on the larger cardboard piece.

Step Thirteen
Fold back the cardboard at each of the cut lines. You should fold the cardboard in the opposite direction as you cut.

Step Fourteen
Fit the folded larger piece of cardboard into the two small cardboard pieces.

Conclusion

At the end of my weeks of teaching, I created an exit survey for the students to help them think through the activities we did and how they all relate to each other and the broader context of engineering, and also to receive feedback on how I can improve in the future.



Block A Engineering Survey

How would you define engineering?

Which was your favorite engineering activity?

You may choose more than one.

- Scratch Programming
- MaKey MaKeys
- Designing for hikers
- Building with cardboard

Which activity did you like least? Why?

Describe what you liked best about learning about engineering.

What do you want to learn more about?