# Maker Tech Camp 2015
## Learning Journal

Session 2

Student Name: _____

## Maker Tech Camp – Session 2

*Teacher's Guide*

Welcome to the Maker Tech Camp, developed by Teresa Green and FIRST Robotics Competition (FRC) team, Team Neutrino #3928!

This document includes lesson plans for several activities you could include in your tech camp. Feel free to use one lesson, two lessons, or the entire document. Mix and match lessons with what you have at your elementary school. You could also use these worksheets during the school year.

We recommend that you use these lessons for kids going into **grades 4-6**. See session 1 for kids going into grades 2-3.

The "Learning Journal" can be assembled in several ways. We suggest using a report cover, a three-pronged folder, a three-ring binder, or something else that is easy to add to and take from. You'll want to keep the surveys on pages 1 and 12-13.

# Maker Tech Camp Survey

You will take this survey before and after the camp. Please answer each question to the best of your ability. Thanks!

| *Before Camp* | *After Camp* |
|---|---|
| 1. What is 3D modelling? | 1. What is 3D modelling? |
| 2. What can you use 3D printing for? | 2. What can you use 3D printing for? |
| 3. What is a robot? | 3. What is a robot? |
| 4. How does a circuit work? | 4. How does a circuit work? |
| 5. Have you ever programmed LEGOs before? | 5. Have you ever programmed LEGOs before? |
| 6. How much do you like STEM (science, technology, engineering, and math)?<br>1 2 3 4 5=a lot! | 6. How much do you like STEM (science, technology, engineering, and math)?<br>1 2 3 4 5=a lot! |



Use this survey before and after the class in order to get an idea of how effective it was. If you do it on paper in their learning journals, you can slip it right out before they take them home.

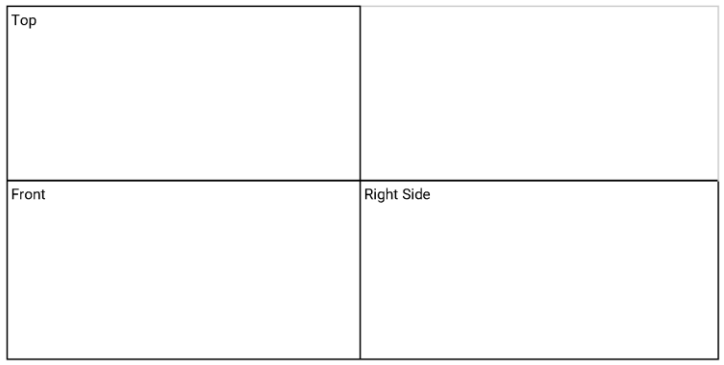
Some students might be wondering if they've ever programmed LEGOs before. If they ask, you could explain that this includes RCX, NXT, EV3, and WeDo. If they've been on a Jr. FLL or FLL team before, they've most likely programmed LEGOs. If you choose to do the LEGO education lesson from session 1, they will all have programmed LEGOs by the end of the class.

## 3D Printing

By making models in 3D, you will get to use your creative and spatial thinking skills! During the presentation, answer the questions below.

1. What is 3D printing?
2. What could *you* use 3D printing to print?
3. How do you think the printer moves the printhead?
4. What are some other applications for 3D printing?

We'll be using Tinkercad to create 3D models. Sketch the front, top, and right side views of your model.






Start this lesson by explaining what 3D printing is and how it's used to solve real-world problems. If you're on an FRC or FTC team, you could bring in examples of 3D printed parts you've used!

Have the students answer the questions either during or after your presentation. Go over them as a class.

Next, have the students create a simple model on a 3D modelling software. We used Tinkercad since it was free and easy to use. Go through the basics of whatever program you decide on, and then give the students time to work.

Tinkercad: https://www.tinkercad.com/

If the students are having trouble coming up with something to model, you could suggest making a keychain with their name on it, a model of a pet, etc.

After they create their designs, have them make sketches of their model from the front, top, and right side, and explain that from these three views, you can find out a lot about a model.

If you have access to a 3D printer, consider printing the students' models as a unique take-home project.

**Lesson length estimate:** 45 minutes

# Brush Bots

Building and playing with Brush Bots will exercise your problem-solving and engineering skills! Answer the questions below.

(During the video) Why do you think that you can't have the two wires from the battery touch?

Project steps:

1. Check the contents of your kit.
2. Cut the toothbrush.
3. Cut the tape.
4. Trim the battery wires.
5. Test-fit the battery.
6. Attach the battery.
7. Attach the vibrating motor.
8. Twist the wires and go!
9. Use the pipe cleaners, etc. to modify.

What did you do to your Brush Bot to make it go straight? in a curve?

What else could you use to make a Brush Bot?

What are some games and contests you can have with your Brush Bots? Create one and test it out with your friends.

How did your Brush Bot do in the competitions? What could you do to it to make it do better?



You can either order Brush Bot kits from Make, or create your own kits using inexpensive motorized toothbrushes, copper tape, and 3 volt batteries.

> Brush Bots: http://makezine.com/projects/building-brushbot-kits/

Introduce the students to Brush Bots using the video on this page. Ask them if they've ever played with hex bugs before and explain that Brush Bots are very similar.

> Hex Bugs: https://www.hexbug.com/nano/

Give each student a brush bot kit (either ordered or self-prepared). Have them follow the project steps in their journals. You might have to modify the steps slightly if you made your own kit. For younger age groups, consider making the brush bots as a class.

After the basic bots are done, give them extra materials (i.e. pipe cleaners) and have them modify their bots to make them go straight or in a curve. Hint: If you put the motor on top of the battery, it should go in a circle; if you put it next to the battery, it should go straight.

Students should use the questions as a guide to the self-exploration.

Have them compete in Brush Bot games! Create your

own or use these:

> Race: Your bot must go in the straight line course in the least amount of time to win.
>
> Brawl: Put three bots in a dish together. The last one to fall over wins!

The Race game can be made with rulers taped together in a line, or straight pieces from a hex bug nano kit. The Brawl game just needs a dish or a hex arena from a hex bug nano kit.

End the lesson by discussing the questions at the bottom of their journal pages.

**Lesson length estimate:** 1 hour

# Introduction to Robotics

Before Discussion
Finish this sentence:
*A Robot is* _____

Draw a picture of what you think a robot looks like.

After Discussion
By definition a robot is something that:

needs _____ and then

1. _____,
2. _____, and
3. _____.



Begin the robotics lesson by seeing what students already know. Don't give them any additional guidance besides what's already on the sheet.

Next, discuss what robots are. Give examples of various machines and decide if they are robots (i.e. upright vacuum cleaner vs. Roomba). Ask students what they think a robot is and then fill in the definition at the bottom of their worksheet.

By definition, a robot is something that needs power, and then senses, thinks, and acts.

**Lesson continued with Cubelets and MOSS.**

## Cubelets

You will be given three blocks. Draw pictures of six different ways you put the blocks together and describe how they behave differently each time you change them around.

| Write: | | |
|---|---|---|
| Draw: | | |
| | | |
| | | |



Cubelets are a modular robotics education tool developed by Modrobotics. Check out the Cubelets page on their website to order them. This page also has short descriptions and pictures of each block.

Modrobotics: http://www.modrobotics.com/

Watch this short training video before the session starts to become familiar with how Cubelets work.

Cubelets introduction video:
https://goo.gl/XgXY2G

Have kids work in groups of two or three. Start by handing each group three blocks. You can do this exploration with either Battery, Brightness, and Flashlight, or Battery, Distance, and Drive. Use the video below to give yourself some ideas, but let the kids explore on their own!

Seven ways to build a robot:
https://goo.gl/ae6qr2

Switch out the brightness sensor for a distance sensor, or vice versa. Without telling the students what the new sensor block does, let them explore and figure out what it senses.

Using just the **battery**, **distance**, and **drive** blocks, make a robot that goes straight. Now change something to make it go in a circle. What did you change?

Now add a **passive** block. How does this change your robot?

See what you can make with six blocks. Draw a picture of your robot below and describe what it does, how it moves, and how the blocks communicate with each other.



Now, switch out their cubes for Battery, Distance, and Drive. Have them make a robot that drives straight and then in a circle. As a class, discuss what they changed about the robot to change its direction.

Questions to guide discussion:

> What can you do to make your robot go fast?
>
> What makes the robot go slow?
>
> How do you think you could make the robot drive across the table and stop when it reaches the edge?

Give each group a passive block and have them explore the new possibilities for construction. Finally, give them your choice of six blocks and have each group create their own robot.

CHALLENGE:
Build something that will serve a purpose or solve one of the challenge problems. Circle the one you picked.

1. Someone keeps stealing your toys! How can you make a motion activated light that will alert you when someone gets close to your toys?
2. Your power has gone out and your freezer won't stay cold forever. Can you make an alarm that will let you know when things are warming up so your ice cream won't melt?
3. You're having a party with 4 different kinds of cupcakes! How can you make a robot that will turn without stopping, while holding a paper plate on it?
4. You are in a dark basement. and don't know where the lights are. You don't have a flashlight or candle, but you do have Cubelets! How can you make a robot flashlight that will stay lit while it's dark but go out and conserve power when you get into the light?

Describe the problem for the challenge you chose in your own words.

Draw or write out your solution below.

How will you know if it is successful?



Finish the lesson by explaining some real-world applications of what they've been learning. See if they can think of some applications of their own for Cubelets in their own lives before flipping to the challenge page in their journals.

Groups should choose a challenge to work on. They should describe the problem for the challenge they chose in their own words and plan their solution before getting the Cubelets to build a robot.

Have each group present their problem, their solution, and any challenges they overcame during the building process, including changes to their original plans.

**Lesson length estimate:** 2 hours

## MOSS Robotics

Our first task today is to create the beginnings of something that drives. We need to start with a **power source** (the green face). Then we need a **sensor** and an **actuator** (something that has an action.)

Important things to remember:

- Green to Green passes power (think of green as your electrical wire that keeps the power flowing)
- Red is data INPUT.
- Brown is data OUTPUT

This means that data comes in to the cube with the red face, and then the red face communicates it out to the brown face.

What is needed for this to be more than just a toy car, but instead a ROBOT vehicle?

It needs _____, and then it needs to _____, _____, and _____.

What could we do to create more functional, or better designed vehicles? (consider seating, steering, stability, a robust design?) Explore making different shapes of vehicles. Remember that building with 2 sensors and 2 actions allows us to build a robot where each of the sensors gives data to each of the actions so it can react and drive.



MOSS are another modular robotics education tool developed by Modrobotics. Check out the MOSS page on their website to order them. This page also has short descriptions and pictures of each block.

Modrobotics: http://www.modrobotics.com/

Watch this short training video before the session starts to become familiar with how MOSS works.

MOSS teacher training: https://www.youtube.com/watch?v=0loiNF4dI1U

Have kids work in groups of two or three and walk them through the exploration in their journals. When the groups are finished building their vehicles, have them present them to the other groups.

## Snap Circuits

Before Discussion
Finish this sentence:
*A Circuit is* _____

After Discussion
Draw a simple circuit:

| Series Circuit | Parallel Circuit |
|---|---|
| | |

Now you get to build your own circuits! Use the Snap Circuit kits to build one with a green tab on it. Then go on to one with a blue tab. Show a volunteer what you made and how it works.



Before you give the students any explanations or instructions, have them fill in what they think a circuit is.

Explain what circuits are, the difference between a closed and open circuit, and what a short circuit is. If you covered circuits when you did any of the earlier activities, like Brush Bots or robotics, you could relate back to those.

Use some Snap Circuits or Circuit Blocks to demonstrate a simple circuit. Show them how to draw the schematic diagram for what you made.

> Snap Circuits: http://www.snapcircuits.net/
> Circuit Blocks:
> http://www.ciplearningstore.com/

Next, create a series circuit and draw the schematic diagram for that together as a class. Then do the same for the parallel circuit.

Put students into groups and have them build their own snap circuit projects. You could mark a few that you feel would be good examples to build. Make sure that the students know *how* their circuit works, and not just that it does.

Have the groups share what they did with the class.

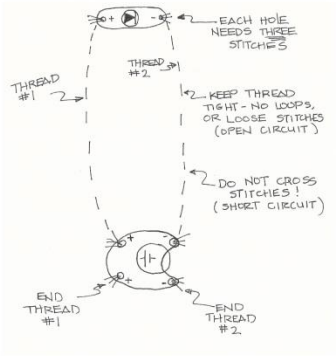
**Lesson length estimate:** 45 minutes

# e-Textiles

Now that you know a little bit about circuits and had the chance to build some using the Snap Circuits kits, you're going to get to sew an LED light and a switch onto a bookmark! Follow the project steps below and ask a volunteer for help when you need it.

Project Steps

1. Tie the thread to one side of the LED.
2. Using a pencil, draw a path on the back of your bookmark to sew over. See the diagram for help.
3. With your needle, poke holes ¼" apart along the path from the battery holder.
4. Using your first piece of thread, sew one side of the LED to the matching side of the battery holder.
5. A volunteer will help you tie off your string.
6. Repeat steps 1-5 for the other side.




Questions

1. When is this circuit closed? open?

2. Draw a schematic diagram for a bookmark just like it is, and then with four LEDs (you won't actually sew this; it's just for practice). You can either make it a series or parallel circuit.



This is an extension project to the Snap Circuit lesson. You'll find information about the project, a list of materials, and ordering information at the link below. Just click "next step" and it will bring you to the list of materials.

> http://sewelectric.org/diy-projects/bookmark-book-light/

Start the lesson by explaining how LEDs work. LED stands for "Light Emitting Diode." A diode is a special component of a circuit because it only works well in one direction (compare to an incandescent (INC) bulb), depending on the voltage of the battery it's hooked up to.

Depending on the age level of your students, you could describe a diode as a "one way street." LEDs are special because they emit light with a current. With less current, they will emit less photons, and therefore, become dimmer. They won't, however, change color like INC bulbs.

After giving the students a little background on LEDs, photons, light, electronic textiles, or whatever you choose, have them complete the e-Textiles bookmark project.

**Lesson length estimate:** 1 hour

# MaKey MaKey

Project Steps

1. Open Scratch on the doc.
2. Make a scratch project that uses the ←↕→ keys, space, and/or click.
3. When you're done, check with a volunteer. He/she will give you materials for your project.
4. Make a controller with different conductive materials that you can play your project with.
    a. Use alligator clips to connect the MaKey MaKey to your controller.
    b. Connect a wire between your hand/arm and the ground input.
    c. Play your game!

Questions:

1. How does the MaKey MaKey know you're pressing a key?

2. Why do you have to hold the ground wire?

3. What real world uses could this technology have?



A MaKey Makey can make conductive materials into keys for Scratch games! Find out about them at their site.

MaKey MaKey website: http://www.makeymakey.com/

In order to complete this lesson, you'll also have to download Scratch, a free programming software developed by MIT.

Scratch: https://scratch.mit.edu/

If the students have not covered Scratch or programming in class yet, consider doing a lesson on basic programming first.

After the students have created their games, discuss what kinds of materials are conductive. Bring in a variety of materials (aluminum foil, bananas, apples, etc.) to try. Have the students come up with a way to test if the materials are conductive. For example, hook up a battery to a lightbulb to the material to see if the light lights up.

Next, have the students connect the MaKey MaKeys and share their games with each other!

**Lesson length estimate:** 1.5 - 2 hours

# Feedback Survey

1. What did you like most about tech camp this week?

2. Which activity did you like the most?
   a. 3D printing
   b. Brush Bots
   c. Module Robotics (Cubelets and MOSS)
   d. Snap Circuits
   e. e-Textiles
   f. Makey Makeys
   g. Marble Runs

3. Tell us why you liked the activity you chose.

4. Which of these activities would you like to do again or learn more about?
   a. 3D printing
   b. Brush Bots
   c. Module Robotics (Cubelets and MOSS)
   d. Snap Circuits
   e. e-Textiles
   f. Makey Makeys
   g. Marble Runs



On the last day of the camp, the students should fill out this survey to help you improve for next year. Consider creating a version of this survey using google forms. Also consider creating a survey to give to the parents.

Don't forget to have them fill out the “After Class” part of the survey on page 1!

5. List three cool things you learned at camp.

6. Circle the snacks you liked and cross out the ones you didn't like.
   a. pop tarts
   b. chocolate chip cookies
   c. oreos
   d. cheese sticks
   e. animal crackers
   f. popsicles
   g. bananas

7. What is one thing you think the teachers/volunteers could do better?

8. Would you recommend this camp to a friend?

9. Should we have another Maker Tech Camp next year?

Thanks for a great time, everyone!!



Don't forget to thank the kids for what a great time you had at camp, and send them home with their journals.

**Additional Resources:**

Check back next summer on Team Neutrino's website (www.teamneutrino.org) for more lesson plans so you can mix and match activities for a new camp.

Check out these sites for tons of ideas!

| | |
|---|---|
| Make: News | http://makezine.com/blog/ |
| Maker Faire | http://makerfaire.com/ |
| Maker Shed | http://www.makershed.com/ |
| MakerCon | http://makercon.com/ |
| Maker Camp | http://makercamp.com/ |

**Let us know how your Maker Tech Camp went!**
Go to http://www.teamneutrino.org/about-us/contact-us/ and email the current team Co-Captain. Thanks!