THE EDUCATION FUND

FOR EXCELLENCE IN MIAMI-DADE PUBLIC SCHOOLS

2017-2018

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idea packet

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Makey Makey Makerspace

MAKEY MAKEY MAKERSPACE

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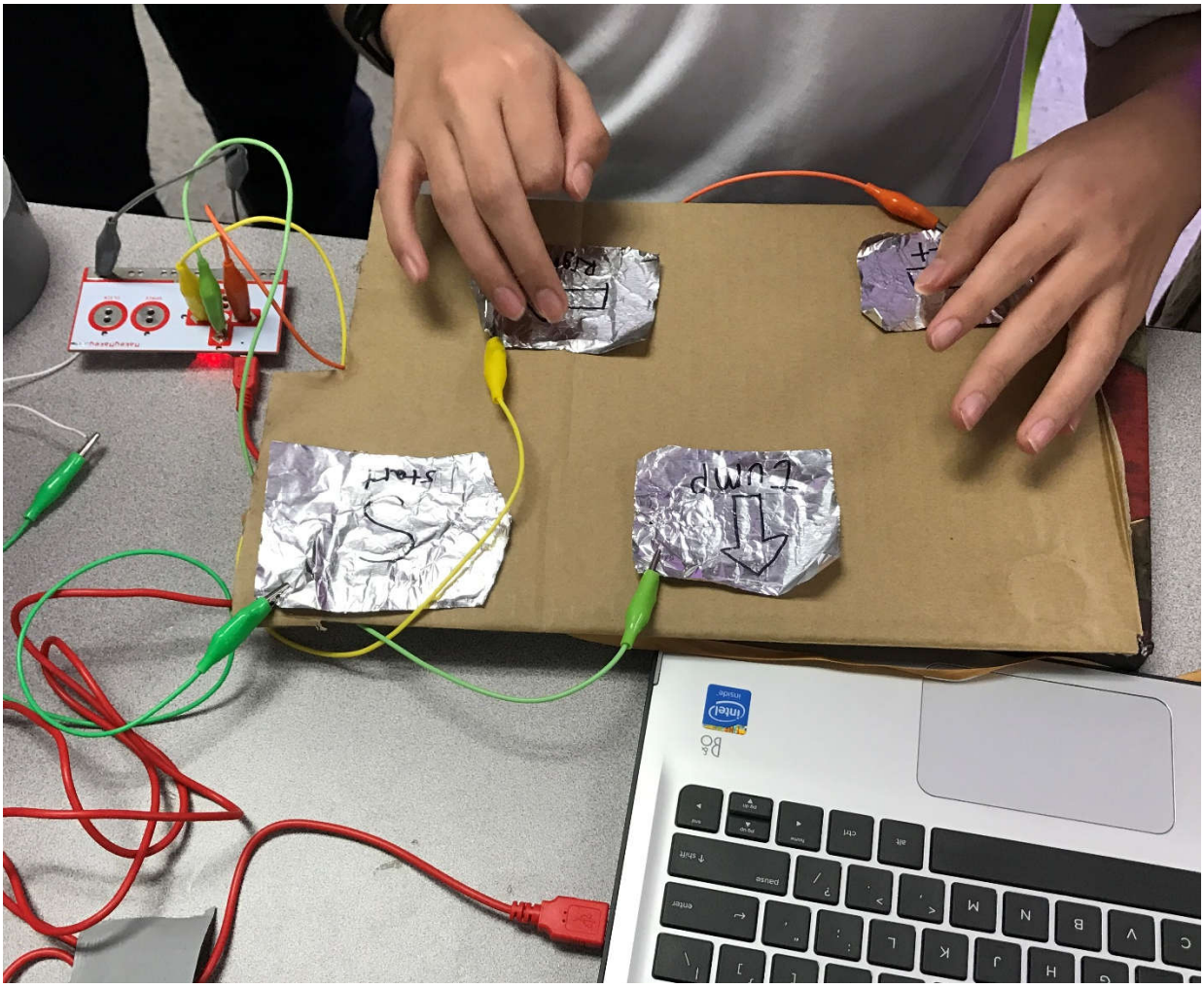

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PROJECT GOALS AND TARGET AUDIENCE

The purpose of this project is to promote critical thinking and creativity while teaching students about circuits, electronics, and computer science. Throughout this project, students use Makey Makey circuit boards and basic computer programming to blur the lines between the world as we know it and the world as it could be. Students completing this unit will learn about the Engineering Design Loop and will become Makers. It is important for students to learn the value of innovation and to have the freedom to take creative risks. This unit will teach students how to create simple circuits and the basics of using Scratch to build computer programs. The unit includes a culminating project where students will use their Makey Makey and Scratch skills to complete a design challenge. Finally, students will conduct a maker fair where they will share their maker experience with their peers.

This lesson was developed to be used with Middle School students in grades 6-8. Most of the activities could be modified to use with students in upper elementary and with high school students. No prior experience with circuits, coding, or engineering is required on the part of the student or teacher. Teachers without any experience with circuits or with Scratch that would like assistance working through the process are invited to attend a Makey Makey session at the Idea Expo with Mr. Dale Adamson.

STANDARDS

NGSS- MIDDLE SCHOOL

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

MS-PS3-5. Construct, use, and present arguments to support the claim that when the motion energy of an object changes, energy is transferred to or from the object.

FLORIDA STANDARDS- ELA

CCSS.ELA-LITERACY.RST.8.3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

CCSS.ELA-LITERACY.RST.8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.

CCSS.ELA-LITERACY.RST.8.7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

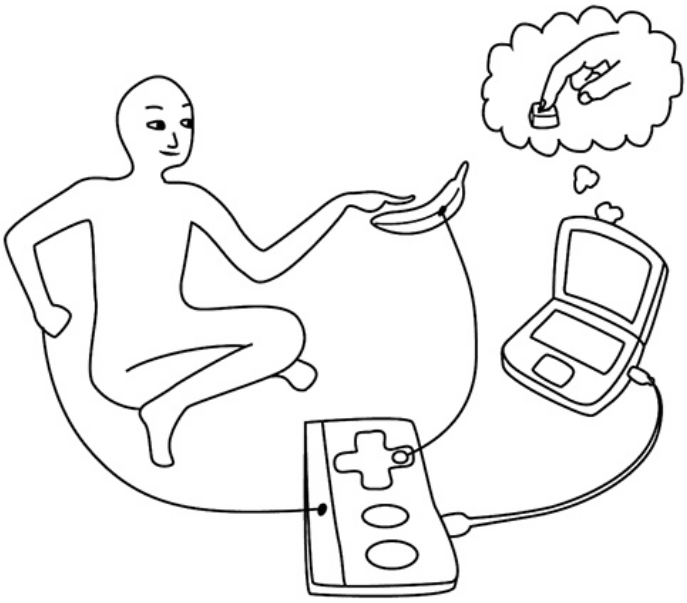
CCSS.ELA-LITERACY.WHST.8.7. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

CCSS.ELA-LITERACY.WHST.8.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

INFORMATION ABOUT MAKEY MAKEY

Makey Makey is an invention kit for the 21st century. It turns everyday objects into touchpads and allows them to work with the internet. It's a simple Invention Kit for beginners and experts doing art, engineering, and everything in between.

How Does it Work?



Alligator Clip two objects to the Makey Makey board. For example, you and a banana. When you touch the banana, you make a connection, and Makey Makey sends the computer a keyboard message. The computer just thinks Makey Makey is a regular keyboard (or mouse). Therefore it works with all programs and webpages, because all programs and webpages take keyboard and mouse input.

What materials work with Makey Makey?

Any material that can conduct at least a tiny bit of electricity will work. This includes ketchup, pencil graphite, finger paint, lemons, plants, coins, your grandma, silverware, anything that is wet, most foods, cats and dogs, aluminum foil, rain, and hundreds of other household items...

Why Makey Makey?

Everyone can be creative, inventive, and imaginative. We believe that everyone can create the future and change the world. So we have dedicated our lives to making easy-to-use invention kits. We believe that the whole world is a construction kit, if we choose to see it that way.

We are inspired by the Maker Movement. We want to help people start to think of themselves as Makers and agents of change. When you have the "Maker's Mindset," you know you can change the world.

Source: http://makeymakey.com/

PROJECT TIMELINE

This unit will take approximately 2-3 weeks to complete in its entirety. What follows is a comprehensive introduction to the Engineering Design Loop, Scratch, and Makey Makey:

Day 1: The Engineering Design Loop

Day 2-3: Introduction to Makey Makey

Day 4-5: Reimagining Game Controllers

Day 6-10: Patent Pending

Day 11: Maker fair/Presentations

Note: There are several ways to quickly modify this unit to take as little as 2 days if needed. One of the best modifications for a short project is to follow the Introduction to Makey Makey lesson plan without the surrounding content.

LESSON 1: THE ENGINEERING DESIGN LOOP

Prior to beginning any STEM Engineering design challenge students should have a working understanding of the Engineering Design Loop.

> *The engineering design process is a method by which teams of engineers and scientists work together to develop solutions to problems. As with scientific investigations it is important to first identify the problem that needs to be addressed. Within the engineering design process it is also necessary to consider the design constraints that must be met and the overall desired outcome of the final product. A major step in the design process is the testing and modifications that a model or prototype must undergo until the final design is approved. (NASA, Engineering Design, 2016).*

This lesson/activity is used to help students understand the importance of prototyping and allows them to attempt to reason their way through the Engineering Design Loop.

PART 1: THE MARSHMALLOW CHALLENGE (30 MINUTES)

Infographic courtesy of Tom Wujec (https://www.tomwujec.com/design-projects/marshmallow-challenge/).

Complete guidelines for implementing the Marshmallow Challenge in the classroom can be found at https://www.tomwujec.com/design-projects/marshmallow-challenge/

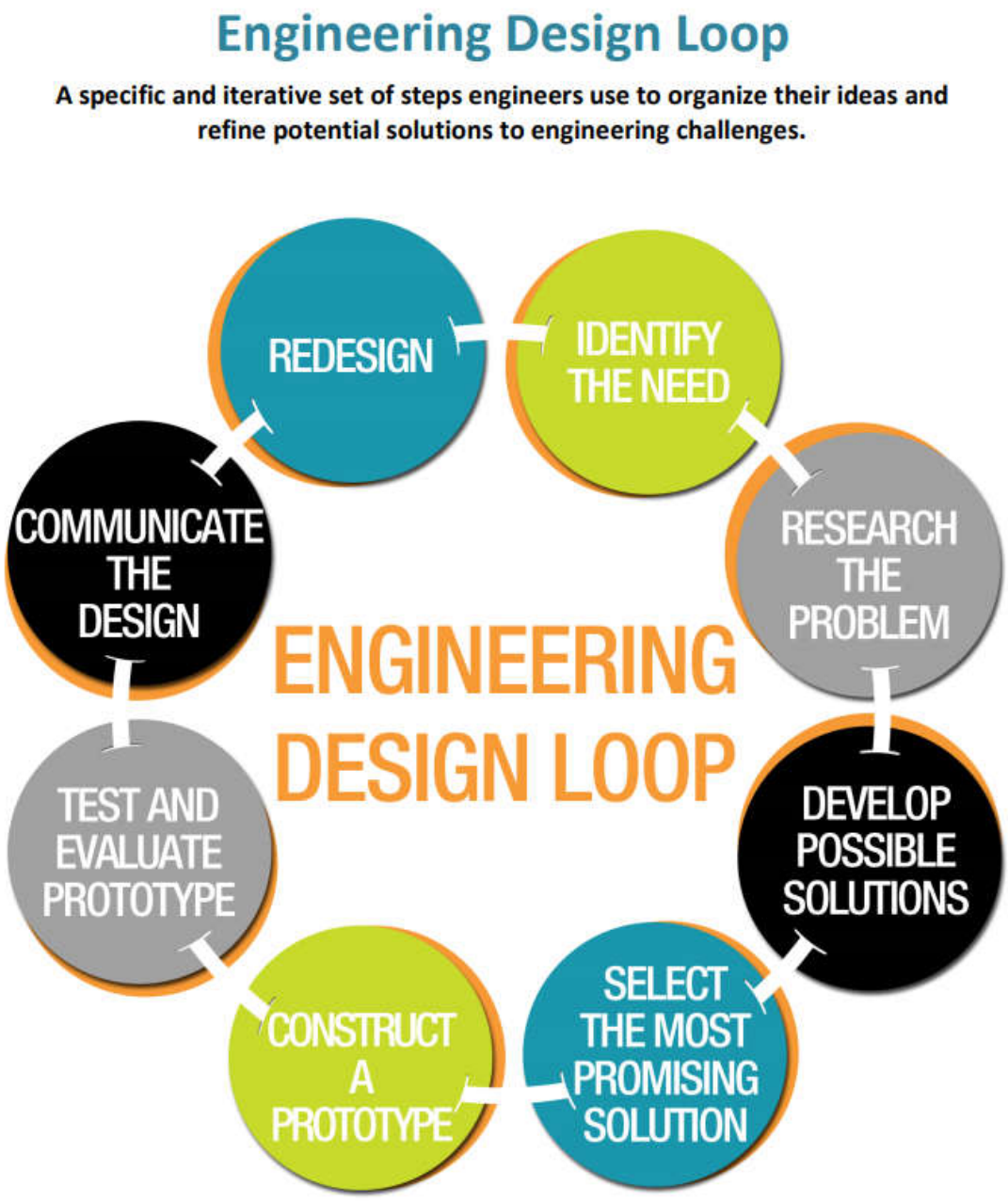
The Marshmallow Challenge teaches two important lessons. First, the importance of fully understanding the constraints of the problem and of actively prototyping throughout an engineering design challenge. Second, this activity emphasizes the importance of utilizing a diverse set of skills within a group. Students often struggle with identifying and utilizing each other's strengths. Teamwork is critical in this challenge.

PART 2: DISCOVERING THE ENGINEERING DESIGN LOOP (15-20 MINUTES)

The purpose of this activity is to formally introduce the Engineering Design Loop. Students should be broken into groups of 2-3 individuals to complete the activity. The student handout includes a set of cards to be given to each group. Students are tasked with cutting out the cards and attempting to correctly order the cards to form the Engineering Design Loop. Students should be given about 5 minutes to complete this task.

After small group time, the instructor will lead a discussion that allows students to compare and contrast their individual design loops. The class will work as a group to create a consensus design loop on the board. Finally, the actual Engineering Design Loop provided in this activity will be revealed and the class will discuss any potential differences. It is recommended that this loop is posted somewhere in the classroom as a source of reference for the duration of this set of lessons as the Engineering Design Loop serves as the basis for the following engineering design challenges.

ENGINEERING DESIGN LOOP EXAMPLE



Note: There are several different versions of the Engineering Design Loop out there. For the purposes of this lesson we are using the loop provided by: https://www.teachengineering.org/content/cub_/activities/cub_creative/cub_creative_activity1_visualaid_v5_tedl_dwc.pdf

STUDENT HANDOUT

Instructions: Cut out the cards below and use them to build the Engineering Design Loop.

Communicate the design	Test and evaluate the prototype
Research the problem	Identify the need
Redesign	Develop possible solutions
Construct a prototype	Select the best solution

LESSON 2: INTRODUCTION TO MAKEY MAKEY (50 MINUTES)

The purpose of this lesson is to introduce students to Makey Makey circuit boards. This lesson includes a teacher lead exploration and some time for students to tinker. It is important to note that Makey Makey boards work by completing simple circuits that are read by the computer in the same way that a keyboard works.

PART 1: THE HOOK

Prior to students entering the classroom the instructor will set up a Banana Piano using the instructions provided by LibraryMakers (http://librarymakers.net/piano-keyboard-makey-makey) .

A simple Piano interface can be found on the Scratch website (https://scratch.mit.edu/projects/2543877/).

Once students enter the classroom, the teacher shows the students how pressing on different bananas activates different keys on the piano. **Note: Make sure that you are in contact with the Earth wire to complete the circuit or this demonstration will not work.**

Next, ask for a student volunteer to come up and play the Banana Piano. Do not give the student the Earth wire. Because they will be touching the bananas without closing the circuit, nothing will happen. Next, place your hand on their shoulder (with the Earth wire in your hand) and ask them to try again. When you are in contact with the student, the circuit will close and they will be able to play the Banana Piano. This should lead to a very natural conversation about the importance of closing the circuit by using the Earth bar on the circuit board.

PART 2: THE NUTS AND BOLTS

Now that students are hooked and want to know more you will have their full attention as you describe how the Makey Makey boards work. Disassemble the Banana Piano and then walk students through the process as you rebuild it. Make sure you emphasize plugging the USB plug into the computer, attaching alligator clamps, and completing the circuit using the Earth bar. Once you have shown the students how to build a Banana Piano, show this short video from Makey Makey that demonstrates some of the possibilities of this unique board:

https://www.youtube.com/watch?v=rfQqh7iCcOU

PART 3: TINKER TIME

Now it is play time. At this point break students into small groups of 3-4. Give each group a Makey Makey kit and a collection of random items (some conductive materials and some that are not). Ask students to use their computer to access a Scratch Piano program and have them use the Makey Makey boards to build their own Piano. Have students note which materials are conductive (capable of closing a circuit) and which are not. This will be important for them to know for future design challenges.

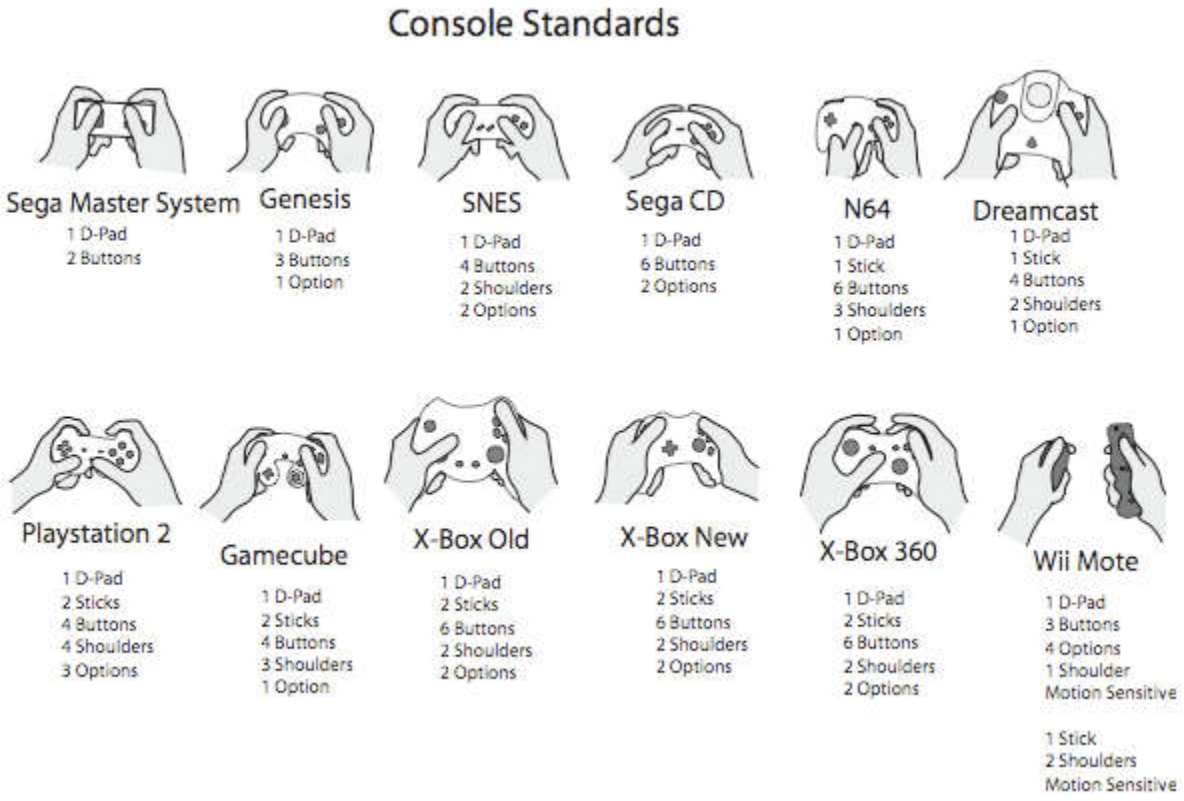
ENGINEERING DESIGN CHALLENGE 1: REIMAGINING GAME CONTROLLERS

MATERIALS

- Makey Makey boards
- Computers or Tablet (with USB input)
- Internet Access
- Miscellaneous conductive materials (student donated/recycled recommended)

GOAL

Reimagine how we play video games. Interestingly, over the past 40 years, video game controllers have remained pretty much the same.



Until very recently, with the advent of virtual reality games, there has been a stagnation in terms of how we interact with video games. Almost every video game controller for the past 30 years has been a handheld controller manipulated primarily by thumb motion.

The goal of this project is to encourage students to reinvent the video game controller. They are asked to find a new (and hopefully unique) way to play a classic video game.

BRAINSTORM

Students will be able to access classic video games on the Scratch website. Games like Pacman, Super Mario Brothers, and Pong tend to be popular choices, but the activity could be done with any game available on the internet. The students will need to select a game up front so that they have a clear picture of the constraints of their challenge.

Once students have selected a video game and know exactly what controls they will need to use, students should be given 10 minutes to brainstorm. This time should be hands off time, meaning that they should not yet have access to the materials they will use. This step important because seeing the available materials will place limits on their imagination. Brainstorming is a time for crazy ideas and fluidity of thought, and that works best before students have materials in their hands.

PROTOTYPING

Once students have had time to brainstorm, it is time to hand out materials and Makey Makey boards and let them create. As the teacher in the room, this time should be mostly hands-off. It is important to walk around and engage with students, but as tough as it is, try to refrain from solving their problems for them. Inevitably, there will be a lot of failed efforts in this process, but that is what

prototyping is all about. Let them make mistakes. Let them think critically and solve their own problems.

Note: It is generally good practice to have students take notes on their prototyping efforts. Have them keep a group log where they jot down ideas and sketches and document their prototyping efforts. I generally grade this log for completion and accuracy.

LET THEM PLAY

Inevitably, this challenge leads to a place where students are “done” and just playing their game. That is okay! The entire goal of this project is to find a new way to play their video game. Some students will need encouragement to keep creating and to push the limits, but once they feel “done” they should be encouraged to play their game. They have just gone from being a consumer of technology to a creator of one and should be able to enjoy that!

COMMUNICATE RESULTS

No prototyping effort would be complete without communicating results. After this design challenge students will be asked to briefly share their new controller and demonstrate how it works.

I prefer students share in a carousel format where the entire class moves from group to group. This allows groups to share from the “safety” of their own group space. This more informal approach to presenting their findings generally allows everyone in the group to take an active role in the sharing process.

A more formal approach to presentations could certainly be used in place of the carousel format described above.

ENGINEERING DESIGN CHALLENGE 2: PATENT PENDING

MATERIALS

- Makey Makey circuit boards
- Computer with internet access
- Miscellaneous conductive materials
- Science fair boards

GOAL

The goal of this project is to allow students to solve an open-ended problem by developing a solution that utilizes Scratch and Makey Makey. Once students see some of the ways that Makey Makey boards can be used to trigger computer actions using external stimuli, the sky is the limit.

BRAINSTORM

First, have students get into groups of three. Give the students 10 minutes to create a list of every problem they can think of. Make sure to encourage them to think not only about large global problems, but also smaller problems that affect their community, school, or fellow classmates (as these are often the most solvable for students).

After they have created a list, have the students narrow the list down to 3 problems that they may want to try to solve. Then allow them ample time to begin to brainstorm how Makey Makey could be used to help them solve the problems they have chosen. This brainstorm will take students a while, but with perseverance most groups will come up with an idea with very little teacher input.

GROUP ROLES AND ENGINEERING NOTEBOOK

Prior to spending any time developing their solution, students should discuss group roles and everyone should be given a job: team leader, scientist, engineer.

Team Leader: Responsible for all contact with the instructor and making sure that everyone else in the group is on task.

Scientist: Keeps accurate records of all data and maintains the engineering design notebook.

Engineer: Responsible for gathering materials and clearing all building plans.

Defining roles up front ensures that everyone in the group is actively engaged in the process. The engineering notebook should be maintained by the Scientist. The purpose of this notebook is to document the prototyping process. Entries can contain sketches, notes, measurements, graphs, or anything else related to group progress.

PROTOTYPING

The prototyping process will likely take several days. Students will need to be encouraged to test, reimagine, and improve their designs. The engineering design loop is an iterative process used to steadily improve a product. All prototypes should be thoroughly documented in the engineering notebook.

Students should be encouraged to photograph or sketch each prototype and take note of the changes in each successive iteration.

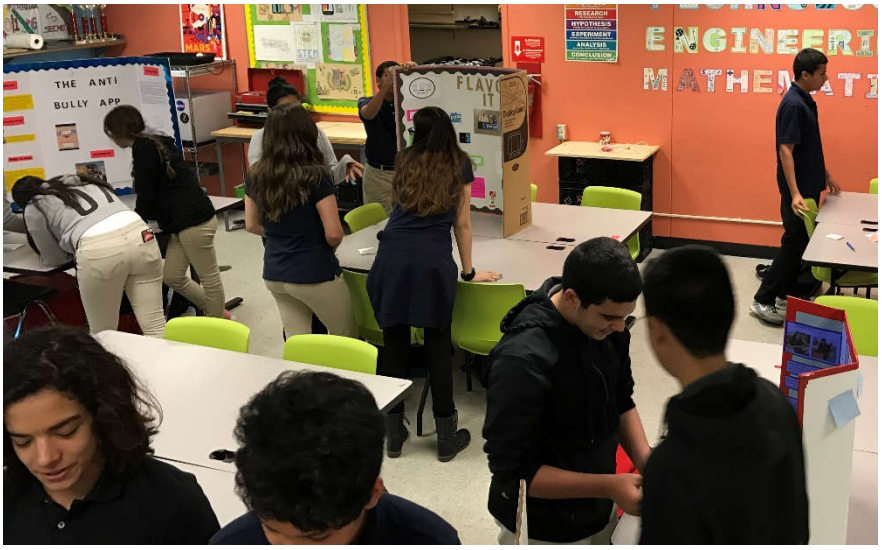
PRESENTATION BOARDS

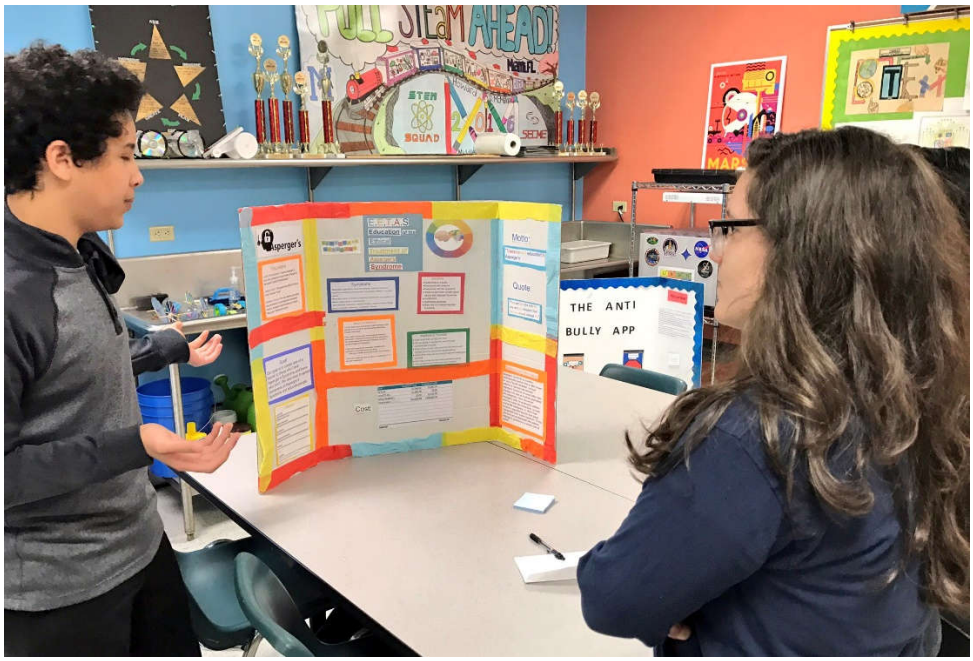
Once students completed the design loop several times and have a product that they deem “done” they will begin to create a presentation/demonstration board that summarizes their design process and final product. The board should include:

- Title
- Group Members
- Problem Statement
- Evidence of their brainstorm
- Prototyping efforts (sketches, photos, etc.)
- Final product
- Possible future modifications

MAKER FAIR

Final presentations are made in the format of a maker fair. Students set up in different locations around the classroom (or media center for more space). Three 10-minute shifts are created so that all team members take a turn working at their own board and exploring the creations of others. While visiting othe projects, students are encouraged to ask questions and us eachother's new inventions.





OPTIONAL EXTENSION: LET THE STUDENTS CREATE THEIR OWN SCRATCH PROGRAM

Scratch is a block-based coding platform created by MIT to make computer coding accessible to everyone, regardless of experience. Scratch takes away many of the hurdles that students face trying to learn coding for the first time. I recommend walking the students through the creation of a simple program so that they get a feel for some of the abilities of Scratch. If your students have experience using block-based code or you feel comfortable with their ability to watch tutorials to figure it out on their own, this is a great opportunity to embed coding into an Engineering Design Challenge. Challenge students to write their own program to use with their new Makey Makey invention.

Scratch tutorials can be found at:

https://scratch.mit.edu/projects/editor/?tip_bar=getStarted

MORE FROM MAKEY MAKEY

Makey Makey has developed their own set of Educator guides, lessons, and design challenges that can be accessed at: http://makeymakey.com/education/

The Educator Guide includes the following lessons:

Lesson 1 – Simple Circuits Challenge

Lesson 2 – Makey Makey ELA Candid Camera

Lesson 3 – Math/Science Classify and Sort

Lesson 4 – Interactive Word Problem Posters

Lesson 5 – Makey Makey Game Controller Challenge

Lesson 6 – Makey Makey Musical Water

Lesson 7 – Distance, Rate and Time for Math/Science/Physics 4

Download from: http://makeymakey.com/lessons/lesson-plans.php

RESOURCES

Makey Makey:

http://www.makeymakey.com/

Makey Makey Labz (for inspiration):

https://labz.makeymakey.com/

Makey Makey Educator Lesson Plans:

http://makeymakey.com/lessons/lesson-plans.pdf

Marshmallow Challenge:

https://www.tomwujec.com/design-projects/marshmallow-challenge/

NASA Engineering Design Process:

https://www.nasa.gov/pdf/630754main_NASAsBESTActivityGuide6-8.pdf

Dadeschools SECME:

http://science.dadeschools.net/secme/default.html

Scratch:

https://scratch.mit.edu/

Scratch Online Tutorial:

https://scratch.mit.edu/projects/editor/?tip_bar=getStarted

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To apply, you must contact the teacher who developed the idea before submitting your application. Contact can be made by attending a workshop given by the disseminator, communicating via email or telephone, by visiting the disseminator in their classroom, or by having the disseminator visit your classroom.

Project funds are to be spent within the current school year or an extension may be requested. An expense report with receipts is required by Friday, June 1, 2018.

APPLICATION DEADLINE: December 13, 2017

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