Engineering Design Process in the Classroom: Video Game Controller Design

STEM Pre-Academy Mini Workshop
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On behalf of Kathy Lin, Highlands Intermediate School

Next Generation Science Standards

MS. Engineering Design

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

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.

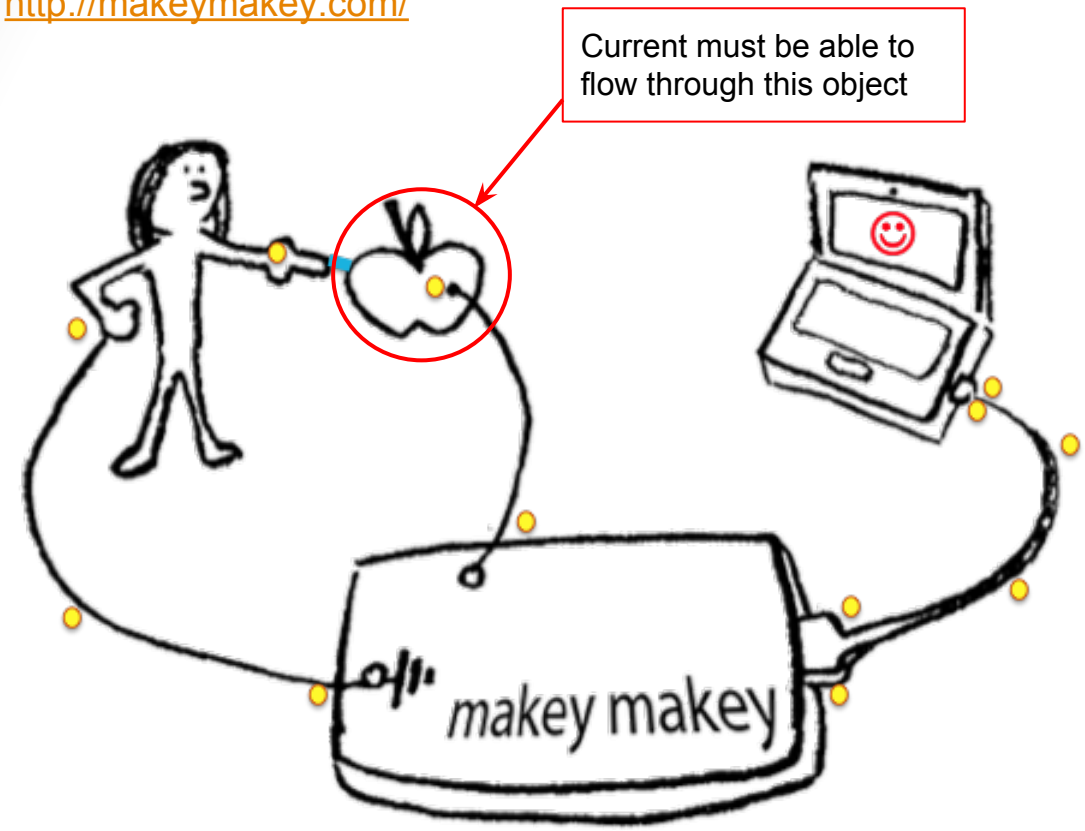
What is MakeyMakey?

http://youtu.be/rfQqh7iCcOU

http://dl.dropboxusercontent.com/u/941842/MaKey_MaKey-An_Invention_Kit_for_Everyone.mp4

The Science Behind MakeyMakey

http://makeymakey.com/



When you touch the apple, it's like turning on a switch.

When you turn on a switch, it closes a circuit.

When you close the circuit, current flows through and activates the loop!

Same thing as pushing a button on your keyboard...you're pushing a switch.

Experiment with Electrical Conductivity

Images and Detailed Lesson Plan: http://educade.org/lesson_plans/experiment-with-electrical-conductivity-with-makey-makey

Students observe that they are able to complete the circuit by connecting to one another.

Students use MaKey MaKey to test the conductivity of various materials.

Summary of MakeyMakey Pilot Project: Overview & Goals - Kathy Lin

- Hands-on experience with Engineering Design Process
- Define the tenets and processes of industrial design with an emphasis on ergonomics.
- Sketch and create video game controller prototypes.
- Assess the prototype designs through user testing (observation, survey, focus groups).
- Modify designs based on user testing.

Using MakeyMakey to Design a Video Game Controller

Detailed Lesson Plan: http://educade.org/lesson_plans/experiment-with-electrical-conductivity-with-makey-makey

LESSON STEPS VERSION 1

Design a new, more ergonomic or functional video game controller using clay, Play-Doh, or other material:

Note: There are many video game options online. Here are a few good resources: NES games, Kongregate, and Newgrounds.

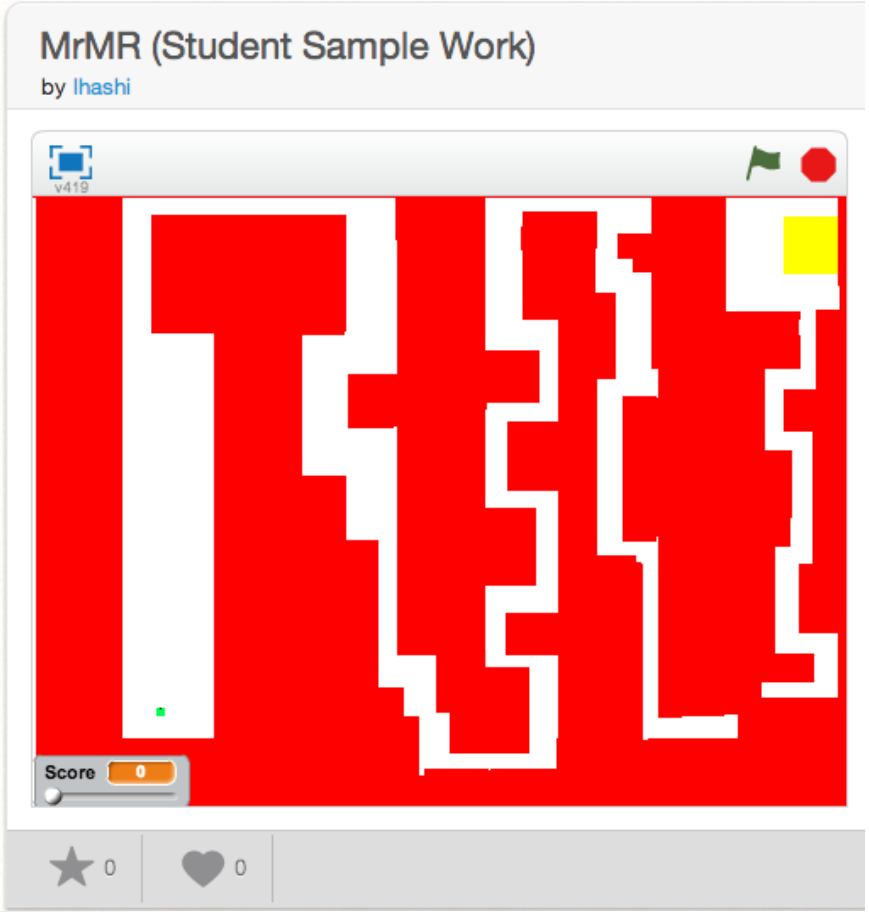
1. **Students research the fundamentals of industrial design, particularly the history of controller design across platforms.**
2. **Students should also take into consideration the design and style of the video game they are designing around.**
3. **From their research, student groups sketch designs and decide on materials for their own controllers.**
4. **Students create a prototype controller (or many). Students test their prototypes with other students, gather feedback (e.g. survey, focus group), and redesign.**
5. **Teacher facilitates discussion on students' experiences and thought processes, in particular how they incorporated their initial research and play-tested research into their designs.**

By the end of the process, students will have a video game controller optimally designed for their class and will have gone through the design cycle process.

Free Video Games for Makey Makey: http://scratch.mit.edu (search “MakeyMakey”)

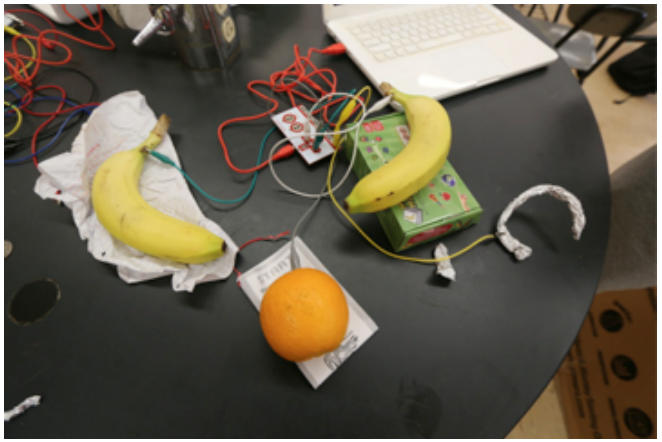
Video Game Controller Design Student Examples

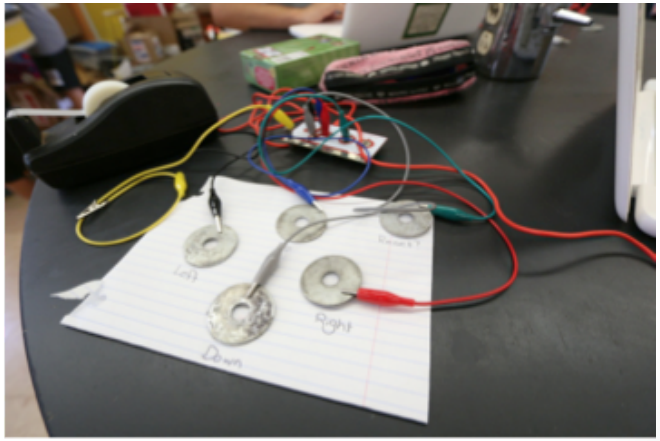
Video Games



scratch.mit.edu

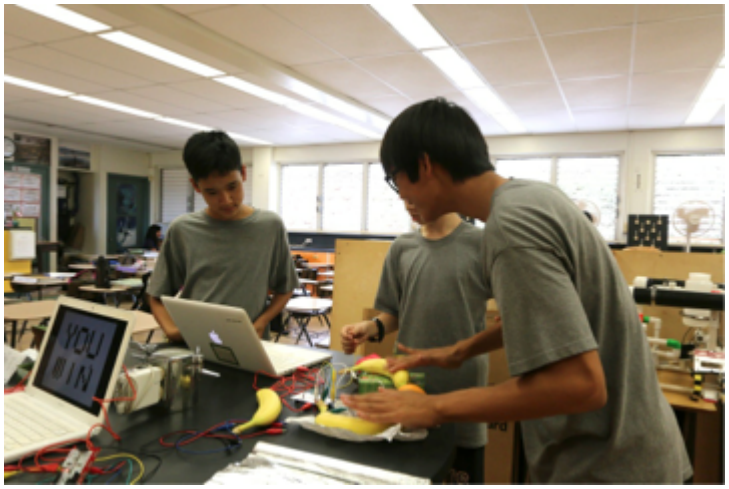
Controllers





Photos by Lori Hashimoto

Video Game Controller Design
User Testing, Feedback, and Iterations



Photos by Lori Hashimoto

Video Game Controller Design Feedback from Kathy & Students

- Depending on what part of the school year and how much the students know, just the video game controller design may be too easy.
  - Would be a good lesson for an Intro to Engineering Design Process.

- Found a lesson online that has the students design the video game controller AND the video game itself. http://www.ms-metter.com/wp-content/uploads/2014/02/MaKey-MaKey-Rubric.pdf

  - Design simple video games for MakeyMakey here: www.scratch.mit.edu
    - Sign-up is FREE
    - No need to know programming language, just the programming logic.
      - Students said it was easy to figure out.
      - Students liked interface: drag & drop commands. Very intuitive.
    - Quick tutorial for users to understand how to create a game
      - Students suggested people new to programming to do the tutorial.
    - Students can modify game templates, like mazes, to add their own unique design components, instead of creating it from scratch.

- Did Video game controller and Video game design lesson in 1 week (Monday to Friday). Students were having a lot of fun and asked why they didn't get more time and start this earlier? :)
  - Kathy recommends 2 weeks for this lesson.

- Instead of teaching programming or conductive materials, Kathy just showed the website and let them learn from there. They asked questions as needed, but had fun figuring it out themselves and with their classmates.

Video Game Controller Design Rubric

http://www.ms-metter.com/wp-content/uploads/2014/02/MaKey-MaKey-Rubric.pdf

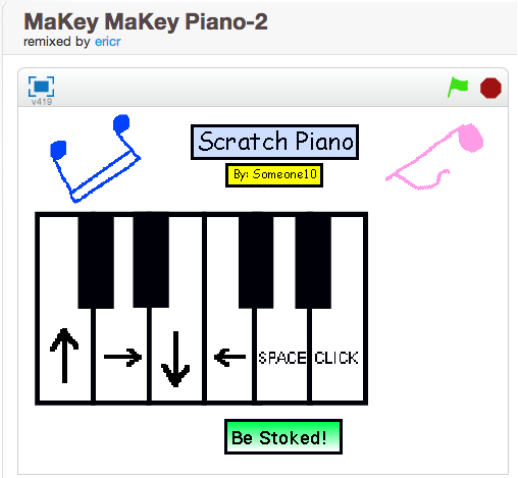
MaKey MaKey Project Rubric

	4 Exceeding Standard	3 At Standard	2 Approaching Standard	1 Needs More Practice
Design:	Student creates a detailed proposal for a program and gets Ms. Metter's approval	Student creates a proposal for a program and gets Ms. Metter's approval	Student creates a proposal for a program but does not get Ms. Metter's approval	Student does not create a proposal for a program.
Feedback:	Student receives written feedback from 2 group and makes changes based on suggestions.	Student receives written feedback from 1 group and makes changes based on suggestions.	Student receives written feedback from 1 group but does not make any changes.	Student does not receive feedback.
Programming:	Program works exactly how it was planned and uses complex tasks.	Program works exactly how it was planned.	Program works mostly how it was planned, with only one or two bugs.	Program doesn't work well or at all.
Controller	Controller works well and is in theme with the program.	Controller works well.	Controller works intermittently.	Controller does not work.

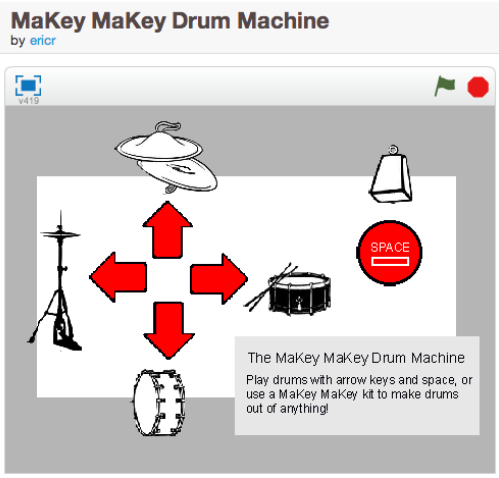
Scoring Scale:

4 =	10/10 (100%)	2=	7.4/10 (74%)
3.5=	9.3/10 (93%)	1.5=	6.7/10 (67%)
3=	8.7/10 (87%)	1=	6.1/10 (61%)
2.5=	8/10 (80%)		

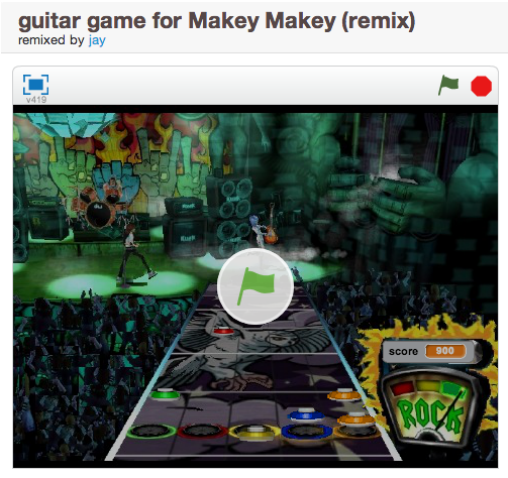
Variation: Musical Instruments



http://scratch.mit.edu/projects/2543877/



http://scratch.mit.edu/projects/2728243/



http://scratch.mit.edu/projects/22344686/

Examples of piano, drum, guitar designs
https://www.youtube.com/watch?v=DLjxB7PXBJo&feature=youtu.be&t=5m45s

For more ideas, go to the MakeyMakey Porject Page: http://makeymakey.com/gallery/

Feedback & Questions