

SCRIBBLER MACHINES

A great STEAM (Science, technology, engineering, art and math) activity!

Timeframe

1-2 Fifty minute class periods

Target Audience

Middle School (6-8)

Materials

- Motor (1.5v-3v) – 1 per group
- Battery (AA) – 1 per student group
- Markers
- Electrical wire – 2 short pieces per student group
- Wire Stripper – for prepping wires for student use
- Masking tape
- Wooden craft sticks
- Plastic cups or plastic berry container (used to attached the motor and markers together)
- Odds and Ends that could be used to offset the motor (clay, clothespins, small gears, KEX pieces, rubber bands)

Description

A hands-on activity that allows students to combine art and engineering skills while focused on building a simple machine. Students will design a scribbler machine which uses markers to draw designs on paper. Incorporating critical thinking and problem-solving skills, students modify and redesign their machine to achieve a variety of designs.

Objectives

Students will:

- Design and build a simple machine to accomplish a task
- Use an electric circuit and motor to make a scribbler machine
- Modify and redesign the simple machine to achieve different designs
- Collaborate with a partner to problem-solve an engineering challenge

Teacher Background

The activity lends itself easily to authentic engineering practices as students problem-solve the building of a simple machine. Next Generation Science Standards (NGSS) focuses on the core concept of energy transfer and circuits are a good way to highlight this. Depending on the age of the students, you may need to teach or simply review the basics of building a simple circuit. In order for a load (motor) to operate the circuit must be closed. The wires must connect the power source (battery) to the motor. (If your goal is to have students in complete “tinker-mode”, then set out supplies and let them go!)

This is a great opportunity for problem-solving, and collaborative

Contact:

SMILE Program

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work amongst students. There are intentionally no step-by-step instructions, encouraging students to “tinker” and go through the process of trial and error. You will observe success, when you hear students ask each other, “I wonder if we can make the scribbler draw _____. Let’s see!” When students are engineering scribblers to meet their own goals (student-generated challenges), they are working through a NGSS performance expectation. Keep in mind that by limiting the step by step instructions, you are challenging the students to be creative.

Preparation

1. The movement of the scribbler machines may be unpredictable, and could potentially bounce off a table. Arrange a barrier on the edge of the testing table, or have the testing zone on the floor. With a common testing area, the students can create an interesting scribbler mural.
2. Prepare the wire. For each scribbler machine, you will need 2 pieces of wire, with 10cm on each end stripped and bare wire.
3. A variety of materials can be used to offset the motor, such as clay or other small objects (these additions will make the scribbler travel and create interesting designs). To spark student interest, you could show them a design made from a scribbling machine.
4. Make your own scribbler machine to demonstrate with students, or share a design as an example.
5. Teachers may want to focus students by listing steps for building the scribbler on the board:
 - *Attach (tape or rubber band or twist tie) a battery to the frame of what will become the scribbler.*
 - *Attach the motor on top and to one side of the frame, so that you can make the scribbler machine a bit unstable. (This will make it move.)*
 - *Attach a ball of clay, or something to the motor’s axle, creating a sort of propeller.*
 - *Attach wires to the frame so that they reach the battery and motor.*
 - *Attach markers to the scribbler as the “legs” of the machine. (As the machine shakes, the markers will scribble as they “walk”.)*
 - *Connect wires to the battery and the motor, and watch your machine scribble!*

Essential and Guiding Questions

What is the best design for a scribbler machine?

- Can the machine make big and small circles?
- What other shapes/designs can the scribbler create?
- How can you make the machine move very slowly?

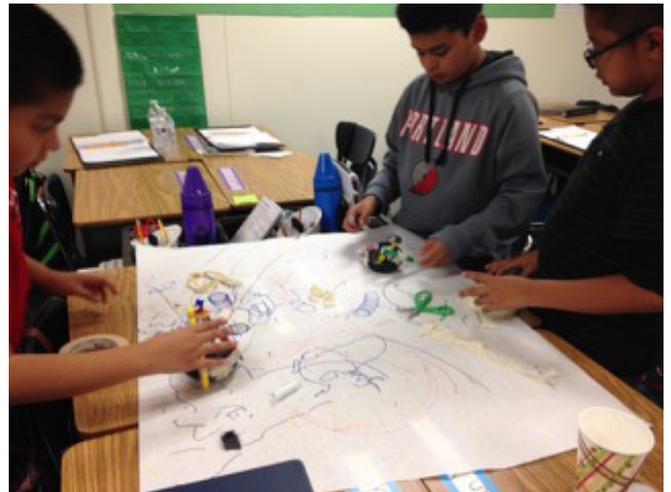


Activity Introduction

Discuss the process of engineering “tinkering” with students, explain that it may be chaotic at times, and they will need space for this activity. Tell them that it is okay to “fail” and learn to “fix” the scribbler machines until they work. There are endless opportunities for students to challenge themselves as they attempt to create different designs with the scribbler machines. If your students are very young, begin the lesson by talking about circuits. This is a great opportunity to review. Depending on the grade, you may want to talk about how the machine will create a pattern with the markers.

Procedure

1. Have students get into groups of 3-5 and hand out materials. Show them the SMILE Program [Scribbler Activity Video](#) which walks students through the process of building a scribbler machine. Refer students to the activity directions if you wrote them on the board.
3. Ask students to demonstrate a functional circuit before attaching markers to the scribbler frame (plastic cup). If the motor is spinning consistently, then the circuit is complete. Students may not understand the importance of making the machine “unbalanced”. To create a design on the paper, the machine will need to “bounce” about the paper. Since students will want to make frequent adjustments, make sure the classroom is arranged with room to build and test.
4. Tell students that they should create prototypes and go through many iterations until they are satisfied with their machines. Emphasize the importance of prototyping and testing (fail and fix).
5. If time allows have students create a prototype that is itself a work of art. Provide students with additional craft materials that would allow them to create an “Art Bot”.



Discuss

After all students have built and revised their scribblers, have a class discussion. During the discussion, students have the opportunity to hear and use the academic language specific to engineering. Let students explain the problems they encountered (constraints.) Listen as they talk about what a successful scribbler embodied (criteria). Make the conversation richer by asking probing questions, or better yet have students ask about each other about the specifics tricks they used, or clever adjustments.

Next Generation Science Standards

DISCIPLINARY CORE IDEAS:

ETS1- A. Developing possible solutions

ETS1- B. Developing possible solutions

PSS3- B. Conservation of energy and energy transfer

PERFORMANCE EXPECTATIONS:

4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

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

SCIENCE AND ENGINEERING PRACTICES:

Constructing explanations and deriving solutions

Engaging in argument from evidence

CROSSCUTTING CONCEPTS:

Structure and Function

Energy and Matter

Resources

<https://tinkering.exploratorium.edu/scribbling-machines>

https://www.teachengineering.org/lessons/view/cub_electricity_lesson01

<http://thecurrent.educatorinnovator.org/sites/default/files/media/%5Buid%5D/Scribble%20Machines.pdf>

<http://blogs.oregonstate.edu/smile/2014/10/17/grand-engineering-challenges/>