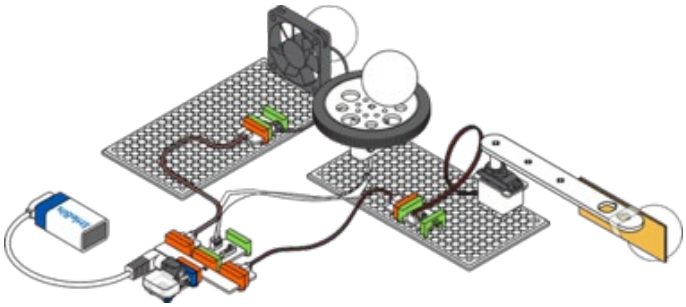
littleBits education

LESSON

Chain Reaction Machine



Overview

In this lesson, students will:

- Create and test a contraption that demonstrates forces and motion.
- Identify energy change in terms of forces (pushes and pulls) within their contraption.
- Demonstrate and explain instances of acceleration and inertia.
- Investigate how much force is required to cause a change in motion.

THE CHALLENGE

Design a littleBits circuit that exhibits three different instances of forces and motion (effects) triggered from a single source (cause).

Lesson Tags

GRADE LEVEL:

Elementary (grade 4-5)

SUBJECTS:

Science, technology, engineering

DIFFICULTY:

Beginner

DURATION:

50 minutes

PREREQUISITE KNOWLEDGE:

- littleBits basics
- Basic understanding of Newton's Laws and changes in motion

Supplies

Bits:

- STEAM Student Set (power, fan, DC motor, servo, fork, 2 wires, battery and cable, battery clip, mechanical arm and 2 mounting boards)

Tools Used:

- Pen/pencil
- Scissors
- Tape
- Glue/glue dots

Other Materials:

- 3, 1” styrofoam or ping pong balls
- Cardboard (3” x 1”)
- Optional extension: Balloon and marble

Description

LESSON OUTLINE:

INTRO: Introduce the lesson prompt and assess students’ current knowledge.

CREATE: Groups of 2-3 students start to build their circuits.

PLAY: Students test their prototypes to make sure that it works.

REMIX: Run the machine again and record observations. Optional extension activity.

SHARE: Complete the worksheet and share reflections.

ASSESSMENT STRATEGIES:

FORMATIVE ASSESSMENT: Circulate the classroom as students work, assessing their use of the Bits, teamwork, and any other relevant skills you wish to focus on. Depending on students’level of experience, you might look for students putting Bits together backwards (e.g. trying to force them together and not aligning the right sides and getting a magnetic snap), students not adding a power source etc.

SUMMATIVE ASSESSMENT Students should complete the student handout. You may choose whether this is an individual or group submission.

Standards

NGSS

4-PS3-1 Use evidence to construct an explanation relating the speed of an object to the energy of that object.

CPALMS

SC.5.P.13.1 Identify familiar forces that cause objects to move, such as pushes or pulls, including gravity acting on falling objects.

SC.5.P.132 Investigate and describe that the greater the force applied to it, the greater the change in motion of a given object.

Vocabulary

Speed	Inertia
Acceleration	Force

Resources

ATTACHMENTS

Chain Reaction Machine Student Handout

SUPPORTING LINKS

Bill Nye the Science Guy: Forces and Motion

Khan Academy: Forces and Motion

TIPS & TRICKS

#1: Keep an eye on the clock, and where students are at. Some students will want to spend too much time in the Create stage, and some students will try to speed through it.

#2: We occasionally update our Bits and accessories, so some of the names and images included in the student handout may look different from those in your STEAM Student Set. Use your Invention Guide from within your Kit to support students with the parts that they have accessible to them. Use a rubber band or glue dots if you don't have a battery clip in your Kit. If you don't have the latest DC motor or servo with attachments into the mounting board, use lots of tape to secure the pieces together.

PACING (50 mins)

Prep + Setup

Intro (10 mins)
Create (15 mins)
Play (5 mins)
Remix (10 mins)
Share (5 mins)
Close (5 mins)

Instructional Steps

Step 1: SETUP

DURATION: 10 minutes (prior to class)

This lesson can be done individually or in small groups (2-3 students). Each group will need one STEAM Student Set and a lesson handout. Set up a central location in the classroom for assorted materials and tools. Make room for students to build on a hard surface, like a tiled floor, desk or table.

Each group will need a power, fan, DC motor, servo, fork, 2 wires, battery and cable, battery clip, mechanical arm and 2 mounting boards. If you don't have a battery clip in your kit, use tape, glue dots or elastic bands to secure the battery to the board. Younger students can start out with just these materials, so they aren't overwhelmed and don't try to add unnecessary Bits. Older/more confident students can have access to any Bits in their Kits.

For an additional challenge, make this lesson open ended by not providing the build instructions. Adapt the design challenge to be: build a multi-part circuit that demonstrates 3 different forces on 3 Styrofoam/ping pong balls from a single source (or cause).

NOTES

- You should use a classroom timer or digital timer to help keep students on track.

Step 2: INTRODUCE

DURATION: 10 minutes

Discussion

Elicit student responses to gauge understanding and warm-up for the activity.

1. Ask students to remember force and motion vocabulary words as you write them on the board. Students may suggest F=ma, speed, mass, acceleration, inertia and Newton's Laws. To get students focused and confident with these words, say them together as a class as you point to the word on the board.
2. Writing Box #1: Give students a few minutes to record and define these vocabulary words.

Introduce the Challenge

Explain that they'll use littleBits and the littleBits Invention Cycle to build a machine that illustrates the causes and effects in force and motion in order to bring our vocabulary to life! The activity will be broken up into the following steps:

CREATE: Build your circuit following the directions given.

PLAY: Test your circuit to see how well it works.

REMIX: Run the machine again and record observations.

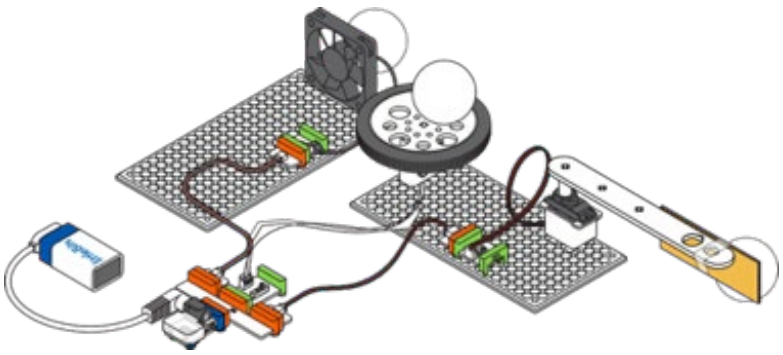
SHARE: Complete the worksheet and share reflections.

Divide the class into groups of 2-3 and have them set up their workstations.

Step 3: CREATE

DURATION: 15 minutes

Students will follow the instructions and diagrams in the student handout to build their machines.



NOTES

- If students need a little extra help getting started, reference the Bit Index in their STEAM Student Set Invention Guide or the littleBits website to learn how specific Bits work.
- The Create phase may take more or less time, depending on the group and students' familiarity with littleBits. You may want to give students guidance on what they should do after assembling their circuit (e.g. move on to the Play phase to test their circuit), so they can self-pace.

Step 4: PLAY

DURATION: 5 minutes

Test your invention!

Turn on the power Bit and analyze the three different motion "effects." Encourage students to talk to their group about what you noticed. If students are having trouble getting the ball in front of the fan to move, they likely flipped the fan so that the air is moving towards the board, instead of the ball.

Instruct students: Power off your circuit, reset the balls and test your model again but this time assign different members of your group to watch the three different circuits: one person will power on the circuit and watch the fan, another the bat, and another the wheel. Talk to your group about the differences you saw in the speed of the balls. You may hear students say things like: the ball on the wheel was going at a steady speed; the ball at the fan only moved slightly; the bat knocked the ball off the table and it fell to the floor.

Step 5: REMIX

DURATION: 10 mins

Writing Box #2: Allow students time to run their model a few times and record their observations and answers on their handout. Move around the room to listen for any misconceptions, and remind students to use the vocabulary words that they reviewed at the beginning of the activity.

Optional extension: Sub out two of the styrofoam balls with a blown up balloon in front of the fan and a marble on top of the wheel. Ask students their predictions about how the balloon and marble will move once the circuit is powered on. Facilitate a discussion surrounding F=ma and how each item has a different mass. Now try it out and see what happens.

Step 6: SHARE

DURATION: 5 minutes

Call on groups to share their responses and correct any misunderstandings. Which ball appeared to move the fastest? How did gravity play a role in our experiment?

Step 7: CLOSE

DURATION: 5 mins

Students should take apart their inventions and put away the Bits according to the diagram on theback of the Invention Guide. Students should clean up their workspace and return any usable materials/tools.

Step 8: EXTENSIONS

Consider the possibility of one motion triggering another! A “Rube Goldberg Machine” is a machine in which one motion triggers another.

- Discussion: Show students this video of a Rube Goldberg machine: OK GO Music Video, Inspired by Rube Goldberg: https://www.youtube.com/watch?v=qybUFnY7Y8w
- Ask them to describe the causes and effects in terms of forces within the contraption. Where does the machine exhibit applied forces to instigate motion? Where are the forces we can’t see? Where does an object’s mass dictate its motion? Where do we see instances of acceleration and inertia?
- Challenge students to add onto the circuit they built! Before the fork Bit, could they engineer a more elaborate “cause” circuit? Or, could the balls fall off the table to activate another reaction?
- For an advanced challenge, have the whole class collaborate to invent a massive contraption in which each group’s circuit triggers the next!
- For inspiration, check out submissions from the littleBits’ Chain Reaction Contraption Challenge