Acceleration STEM Experiment

Overview:

This lesson uses the micro:bit to measure acceleration on a series of declines beginning with dropping. The fact that the acceleration is at a maximum when motion is down (in the same direction as the orientation of gravity) and slows as the direction of motion differs from straight down is evidence that the orientation of gravity does straight downward.

Students should have already:

- Planned and conducted an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. (NGSS 3-PS2-1)
- Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. (NGSS 3-PS2-2)

Students will be able to:

- Design and carry out an experiment to test the amount of acceleration experienced by the micro:bit.
- Utilize simple block code to produce a device that will measure and read out acceleration values.
- Construct a data table and graph to observe a trend
- Make a conclusion based on the data
- Use the data and conclusions to support an argument that the force of gravity by earth on objects is directed down. (NGSS 5-PS2-1)

Materials needed:

- 1 micro:bit device with USB cable
- 1 battery pack
- 1 6-foot long ramp (in the absence of a track, a series of yard sticks taped together works well for this)
- 1 frictionless cart or cart made out of legos
- masking tape
- pillow
- protractor or angle measurement app for smart phone

Recommended Procedure:

1. Download the code from the micro:bit website onto the micro:bit and connect the battery pack to each micro:bit. Tape the battery pack to the microbit. Be sure not to cover the LEDs.
2. Test the accelerometer function by placing a pillow or foam on the ground and dropping the micro:bit onto it from a height of 6 feet. Repeat each experiment 5 times to make sure that the data is reproducible.
3. Setup a track by leaning it against a chair, table, counter etc. Measure the declination angle with an angle measurement app or protractor to match one of the angles below.
4. Place the micro:bit and battery pack on the cart and secure it with tape.

Trial	Declination Angle
1	90
2	70
3	50
4	30
5	10

5. Repeat the procedure from step 2 for each of the angles listed above.

Declination Angle	Acceleration Level
90	
70	

6. After the table is completed, have the students make a scatter plot graph on a piece of graph paper.

Recommended Discussion Questions

- How does the angle of the ramp affect the acceleration of the micro:bit?
- What trends do we see in our graph? Is the trend clear? Why or why not?
- What explanation can you develop that would explain the observed trend?

- How can we use this data to support the argument that the force of gravity is oriented in the down direction?

Standard Addressed

5-PS2-1 Motion and Stability: Forces and Interactions

Support an argument that the gravitational force exerted by Earth on objects is directed down. (NGSS 5-PS2-1)

Crosscutting Concept

- Cause and effect relationships are routinely identified.

Disciplinary Core Idea

- The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.

Science and Engineering Practices

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
- Support an argument with evidence, data or a model.

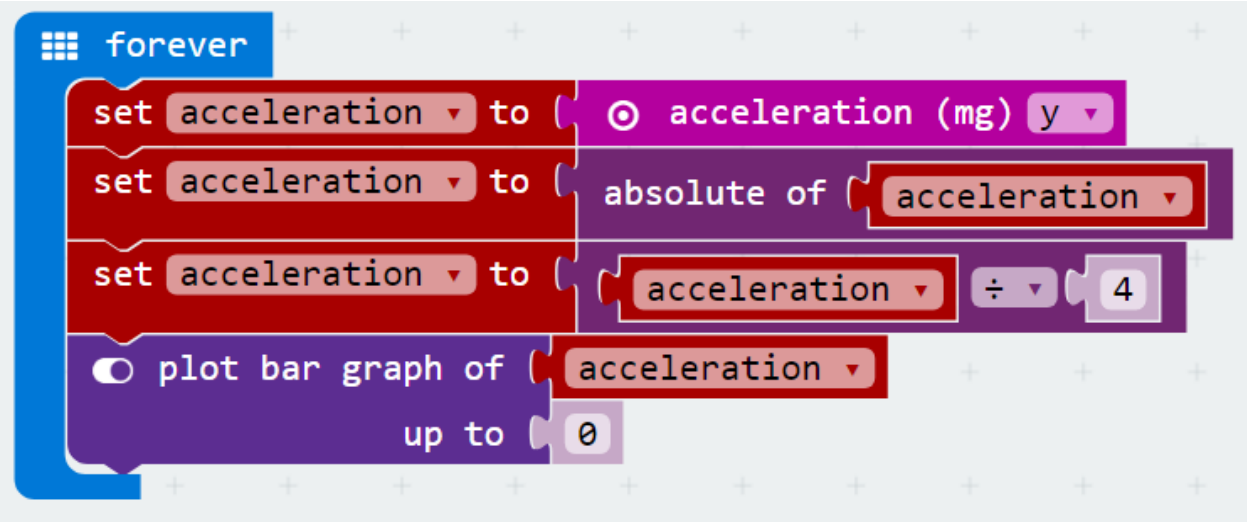
K-12 Computer Science Concepts & Practices

Concepts	Practices
• 5-8. *Computing Systems*. Devices • 5-8. *Computing Systems*. Hardware and Software • 5-8. *Computing Systems*. Troubleshooting • 5. *Data and Analysis*. Collection • 5. *Data and Analysis*. Visualization and Transformation. • 5. *Data and Analysis.* Inference and Models. • 5-8. *Algorithms and Programming*. Algorithms	• P1. *Fostering an Inclusive Computing Culture*. 1, 3 • P2. *Collaborating Around Computing*. 1-4 • P4. *Developing and Using Abstraction*. 2, 4 • P5. *Creating Computational Artifacts*. 1, 3 • P6. *Testing and Refining Computational Artifacts*. 3 • P7. *Communicating About Computing*. 1-2

• 5-8. *Algorithms and Programming*. Variables • 5. *Algorithms and Programming*. Control • 5. *Algorithms and Programming*. Program Development	

Experiment: Make Code
See: https://makecode.microbit.org/projects and scroll to STEM

.Hex file available



Experiment: Extension

- How does the spinning rate affect the the acceleration of the Microbit?
  - Description: Tie the microbit to a string and twirl it around your head at different speeds and see how many LED's light up.