STEM 101
Powered by THE STEM ACADEMY

Name: _____
Period: _____

UNIT: MEASUREMENT

"FORCE FINDER" – NEWTON'S SECOND LAW LAB

OBJECTIVE:

Measure mass and acceleration to apply F = ma.

GOAL:

You're testing how the mass of a moving object (a mini rover) and its acceleration are related to the net force acting on it. You'll roll a rover down a ramp, measure time and distance, and calculate acceleration and force using physics formulas.

MATERIALS:

- ✓ Ramp (books + board or foam ramp)
- ✓ Small "rover" (toy car or weighted container with wheels)
- ✓ Stopwatch
- ✓ Ruler or measuring tape
- ✓ Washers or coins (for adding mass)
- ✓ Calculator
- ✓ Data sheet or notebook

STUDENT DIRECTIONS:

Step 1: Set Up the Ramp

- Place your ramp on a stable surface. Measure the **length of the ramp** (distance the rover will travel from top to bottom).
  Record distance (d): _____ cm or meters

Step 2: Test with Starting Mass

- Put your rover at the top of the ramp.
- Get ready with your **stopwatch**.

- Let it go and **time how long it takes** to reach the bottom.
  Record time (t): _____ seconds

Step 3: Repeat with More Mass

- Add 1–2 washers or coins to your rover to increase mass.
- Repeat the test. Do this **at least 3 times** with different masses.
- Each time, record the time it takes and keep the ramp angle the same.

Step 4: Calculate Acceleration

Use the formula:

$$a = \frac{2d}{t^2}$$

Where:

- aaa = acceleration
- ddd = distance traveled down the ramp
- ttt = time measured

Use a calculator and show your work!

Step 5: Calculate Force

Next, use the formula: $F = ma$

Where:

- FFF = Force
- mmm = Mass of rover (use total mass including added washers—estimate in kg if possible)
- aaa = Acceleration from the last step

Record in a chart:

Trial	Mass (kg)	Time (s)	Acceleration (m/s²)	Force (N)
1				
2				
3				

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Discussion Prompt:

- What happened to the acceleration when the mass increased?

  _____

  _____

- Did the net force increase or stay the same? Why do you think that happened?

  _____

  _____

- How did using a stopwatch or measuring tools help improve the accuracy of your calculations?

  _____

  _____

STANDARDS ALIGNMENT

NGSS: HS-PS2-1 **STEL:** STEL 1E, STEL 4E, STEL 6F, STEL 8F, STEL 11F **CCSS:** CCSS.MATH.CONTENT.HSN.Q.A.1, CCSS.MATH.CONTENT.HSN.Q.A.2, CCSS.MATH.CONTENT.HSN.Q.A.3, CCSS.MATH.CONTENT.HSA.CED.A.2, CCSS.MATH.PRACTICE.MP4, CCSS.MATH.PRACTICE.MP5