



WHY DID IT STOP?! (FRICTION, $F = m \times a$ & 45° LAUNCH)

Physics & Engineering Lab Sheet • Watch & Take the Quiz at CurioTreeShow.com/ep1 • @CurioTreeShow

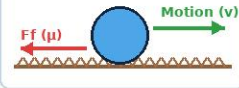
Student Name: _____ Date: _____ Grade: _____ XP / Score: _____

PART 1: KEY SCIENCE & MATH FORMULAS FROM EPISODE 1

1. FRICTION (μ) & INERTIA

Zara & Tess • 1,000x Holo-Zoom

$$F_f = \mu \times N$$



An object in motion stays in motion unless acted on by an outside force! Carpet fibers have microscopic bumps (high μ) that grab the wheels and turn motion energy into heat.

2. NEWTON'S SECOND LAW

Milo • Engineering & Force

$$F = m \times a$$



Force (Newtons) equals Mass (kg) times Acceleration (m/s^2). Smooth wheels lower friction (μ), and our elastic booster increases Forward Force (F) for high acceleration!

3. THE 45° OPTIMAL LAUNCH

Nova • Math & Trajectory

$$\theta = 45^\circ \text{ Max Range}$$



Too flat (20°) hits the ground early. Too steep (70°) goes high but not far. A 45° launch splits vertical lift and horizontal speed equally for maximum jump distance!

PART 2: EPISODE 1 REVIEW QUESTIONS (CIRCLE OR WRITE YOUR ANSWER)

1. When Tess zoomed in 1,000x on the living room carpet and skateboard wheel, why did the board stop so fast?

- ☐ A) Gravity turned off in the treehouse ☐ B) Microscopic bumps collided, creating high Friction (μ) that opposed motion
- ☐ C) The skateboard had zero mass ($m = 0$) ☐ D) The air temperature was too cold

2. According to Nova's trajectory math, which ramp angle gives Build-O-Bot the longest horizontal jump?

- ☐ A) 15° (Almost flat) ☐ B) 45° (Equal vertical lift & forward speed)
- ☐ C) 75° (Almost straight up) ☐ D) 90° (Vertical wall)

3. MATH CHALLENGE ($F = m \times a$): Build-O-Bot and his skateboard have a total mass (m) of 2 kg. If the rubber-band booster accelerates him at $a = 4 \text{ m/s}^2$, how much Force (F) in Newtons did it produce? Show your multiplication:

Formula: $F = m \times a \rightarrow F = \underline{\hspace{1cm}} \text{ kg} \times \underline{\hspace{1cm}} \text{ m/s}^2 = \underline{\hspace{1cm}} \text{ Newtons (N)}$

4. THINK LIKE AN ENGINEER: Why did switching from rough plastic wheels on carpet to smooth wheels on a wooden ramp reduce the Coefficient of Friction (μ)?

PART 3: HANDS-ON KITCHEN / CLASSROOM MINI-LAB — THE RAMP & FRICTION CHALLENGE

SUPPLIES: 1 Hardcover Book (Ramp) • 1 Toy Car, Marble, or Coin • 3 Surfaces: Towel/Carpet, Bare Floor/Table, & Smooth Wax Paper • Ruler

INSTRUCTIONS: Prop one end of your book 10 cm high to make a ramp. Let your toy car/coin roll down onto each surface below WITHOUT pushing it. Measure how far it travels (in cm) before Friction stops it!

Surface Tested	Predicted Friction (High / Med / Low)	Trial 1 Distance (cm)	Trial 2 Distance (cm)	Average Distance (cm)
1. Rough Towel or Carpet	[] High [] Med [] Low	____ cm	____ cm	____ cm
2. Smooth Table or Wood Floor	[] High [] Med [] Low	____ cm	____ cm	____ cm
3. Wax Paper or Foil Sheet	[] High [] Med [] Low	____ cm	____ cm	____ cm

TEACHER / PARENT ANSWER KEY: Q1: B (Microscopic bumps create friction) • Q2: B (45° optimal angle) • Q3: $F = 2 \text{ kg} \times 4 \text{ m/s}^2 = 8 \text{ Newtons (N)}$ • Q4: Smoother surfaces have shallower microscopic bumps, reducing μ .

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