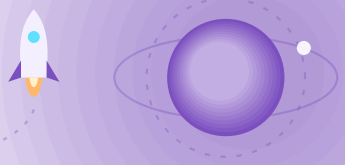
LESSON T1-01 · TIER 1 · ANATOMY, FORCE & STABILITY

Force Cart in Vacuum

GRADES 6–12



Name _____ Date _____ Class / Period _____

Welcome to the Flight Academy!

Sir Isaac Newton discovered that pushing an object makes it accelerate: F = m × a. In deep space there is no air or ground friction to slow us down, so we can see exactly what the push does. Let's see how engine thrust changes our speed.

Mission goal: find out how the engine's push and the rocket's weight change how fast we speed up.

Standards practiced: MS-PS2-2, HS-PS2-1 · Words to know: force, mass, acceleration, vacuum, 1d-rail

1 LOOK

OBSERVE BEFORE YOU TOUCH A CONTROL

Step 1 · A bigger push

- Our craft has a mass of _____ kg and sits on the Moon, where there is no air and no friction to slow it down.
- Its engine can push with _____ N at full throttle. Half throttle pushes with _____ N.

Step 2 · A heavier rocket

- Our craft started with a mass of _____ kg. Imagine loading it until it is twice as heavy: _____ kg.
- The engine would still push with _____ N. Acceleration = push ÷ mass.

Step 3 · The acceleration target

- Acceleration = push ÷ mass.
- Engine push at 100%: _____ N. Craft mass at the start: _____ kg.

Write the numbers shown in the sim in the blanks above, then record what you notice:

2 PREDICT

COMMIT TO A HYPOTHESIS FIRST

Prediction 1. If we double the engine's thrust from 50% to 100%, what happens to our acceleration?

Hint: Acceleration is how quickly our speed changes. A bigger number means we speed up faster.

□ It stays the same

□ It doubles

□ It gets cut in half

Because...

Prediction 2. If our rocket is twice as heavy, what happens to our acceleration under the same thrust?
Hint: Thrust is how hard the engine pushes. Mass is how much stuff the engine has to push.
□ It accelerates slower
□ It accelerates faster
□ No change
Because...

Prediction 3. At full thrust, how fast will our speed grow every second? Mark the range you expect.
Hint: The unit m/s² means "metres per second, every second". An acceleration of 10 m/s² adds 10 metres per second to our speed each second. Aim for a band about 4 m/s² wide.
My prediction (circle or fill in): _____ to _____
Because...

3 EXPERIMENT

CHANGE ONE VARIABLE AT A TIME

Step 1. Press **[Space]** to fire the engine at 100% for 3 seconds. Then press **[C]** once to snap the throttle to exactly 50% and wait 3 seconds. Press **[X]** to cut the engine.

Step 2. Read the numbers above, then press Got it. If the craft starts to fall toward the ground, tap **[Z]** for a burst of full throttle and **[X]** to cut it.

Step 3. Press **[Z]** for 100% throttle and hold it for 3 seconds. Watch the Acceleration number in the live readout, then press **[X]** to cut the engine.

Trial	What I changed	What I measured / saw	Matched my prediction?
1			Yes · No · Partly
2			Yes · No · Partly
3			Yes · No · Partly

4 EXPLAIN

CLAIM · EVIDENCE · REASONING

Claim – What did you find out? (answer the mission goal in one sentence)

Evidence – Which numbers or observations from the sim support your claim?

Reasoning – Which science idea connects your evidence to your claim?

Self-check: □ I made a prediction before experimenting □ I used numbers from the sim □ I explained *why*, not just *what*