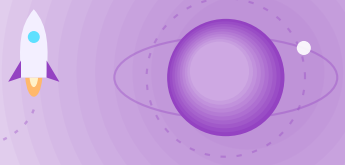
LESSON T2-04 · TIER 2 · PROPELLANT & STAGING

Nozzle Altitude Match

HIGH SCHOOL (9–12)



Name _____ Date _____ Class / Period _____

Thick air, thin air

An engine throws its exhaust out of the nozzle. Near the ground, thick air pushes back on that exhaust. High up, there is almost no air to push back. So the same engine pushes a little differently at different heights.

Mission goal: measure the engine's push near the ground and high up, then work out the push in between.

Standards practiced: HS-PS2-1 · Words to know: engine-isp, ambient-pressure, sea-level-vs-vacuum, data-interpretation

1 LOOK

OBSERVE BEFORE YOU TOUCH A CONTROL

Step 1 · Thick air or thin air?

- Air pressure near the ground is about _____ kilopascals (kPa). High up it falls close to zero.
- We will fly the rocket at full throttle and read the engine's push at both heights. The Engine push number shows it live.

Step 2 · In between

- Near the ground (_____ kPa) this engine pushes with _____ N. In empty space (0 kPa) it pushes with _____ N.
- Halfway between, at _____ kPa, the air is half as thick as at the ground.

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. The same engine at the same throttle. Where does it push hardest?

Hint: Air pressure pushes back on the exhaust leaving the nozzle. Pressure is thick near the ground and nearly zero high up.

□ Near the ground, where the air is thick

□ It pushes the same everywhere

□ High up, where the air is thin

Because...

Prediction 2. How hard will the engine push in air at half the ground pressure (about 50 kPa)? Mark the range you expect.

Hint: The unit N is newtons, a measure of push. Between the two measured points, the push changes smoothly. Aim for a band about 1,000 N wide.

My prediction (circle or fill in): _____ to _____

Because...

3 EXPERIMENT

CHANGE ONE VARIABLE AT A TIME

Step 1. Press **[Space]** to light the engine and **[Z]** for full throttle. Keep the engine burning while the rocket climbs from the ground into thin air, and watch the Engine push number. Then press **[X]**.

Step 2. Read the numbers, then press Got it.

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*