

Gravity Strength Lab

Mission: Mission planners need to know how strongly gravity pulls on objects so astronauts can plan moonwalks and Mars landings. Test how mass and distance change the pull, then weigh a student on four worlds.

Big question: How do mass and distance affect the strength of gravity?

★ Warm-up: Estimation station

Estimate and explain.

On the Moon, would you weigh more, less, or the same as on Earth? ✓ **Less: about 1/6.**

Does your MASS change on the Moon? ✓ **No, only your weight.**

Key vocabulary

Gravitational force	The pull between two objects with mass.
Mass	The amount of matter (kg).
Weight	The pull of gravity on you, in newtons (N).
Inverse square	Double the distance → one-fourth the force.

1 Box 1

Mass trials

Keep distance = 1 and Mass B = 1. Record the pull.

Mass A	Pull (units)
1x	from simulator
2x	from simulator
4x	from simulator

2 Box 2

Mass pattern

When Mass A doubled, the pull...

☐ doubled ☐ stayed the same ☐ went down

✓ **doubled**

3 Box 3

Distance trials

Keep both masses at 1. Record the pull.

Distance	Pull (units)
1	from simulator
2	from simulator
4	from simulator

4 Box 4

Distance pattern

When the distance doubled ($1 \rightarrow 2$), the pull became...

☐ one-fourth as strong ☐ half as strong ☐ twice as strong

✓ **one-fourth as strong**

5 Box 5

Weigh a student

In the simulator: Weigh the 50 kg student on all four worlds.

How many times heavier is the student on Earth than on the Moon? (Round to a whole number.)

Answer: _____ times ✓ **6**

Show your thinking:

6 Box 6

Legend: predict 🏆 Legend only

Two objects pull with 24 units. You triple the distance. What is the new pull?

Answer: _____ units ✓ **2.67**

Show your thinking:

7 Box 7

Mission memo (CER)

How do mass and distance affect gravity?

Claim

Look for: Names mass; Names distance; at least 8 words

Evidence

Look for: Uses force data; a number from the simulator; at least 12 words

Reasoning

Look for: Applies it to space or weight; at least 10 words

Exit ticket: answer the big question in your own words

How do mass and distance affect the strength of gravity?

Look for: Every object with mass pulls on every other object. More mass means a stronger pull. More distance means a much weaker pull: twice as far is one-fourth the pull. That is why the Sun (huge mass) holds the planets, and why you weigh less on the Moon (less mass).

Completion codes

Students see a code like **ABC-I3** when they finish. The first part must match below. The letter is the level (E = Explorer, I = Investigator, L = Legend), and the number at the end is how many stars they earned.

Level	Code starts with
 Explorer	AFZ-E
 Investigator	1FZ-I
 Legend	UMN-L

! Watch for these misconceptions

- "There is no gravity in space." Gravity reaches across space; astronauts float because they are falling around Earth.
- "Moon phases are caused by Earth's shadow." Only lunar eclipses involve Earth's shadow.
- "Summer happens when Earth is closest to the Sun." Earth is closest in January. Tilt causes seasons.