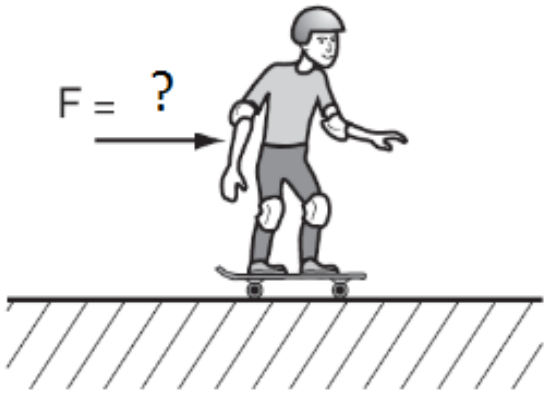
Daily Science

- *Brian is his school's skateboard champion. He has a mass of 60 kg and is currently moving at an acceleration of 1.5 m/s^2.* What force is Brian experiencing on his skateboard as shown in the diagram?

$$F = m \times a$$



Goals

Define gravity and describe the relationship among the force of gravity, the mass of objects, and the distance between objects (PS-M-B2)

Predict how the gravitational attraction between two masses will increase or decrease when changes are made in the masses or in the distance between the objects (PS-M-B2)

Relate the Newton's laws of gravity to the motions of celestial bodies and objects on Earth.

Students in a fifth-grade class were asked to write a definition of gravity. Here are some of their definitions:

Elena: Gravity is a force between two things with mass.

Lei: Gravity is like a glue that keeps things from falling off the ground.

Sue: Gravity is what makes everything fall except balloons and planes.

Kat: Gravity is how heavy we are.

Which student wrote the most accurate definition of gravity?

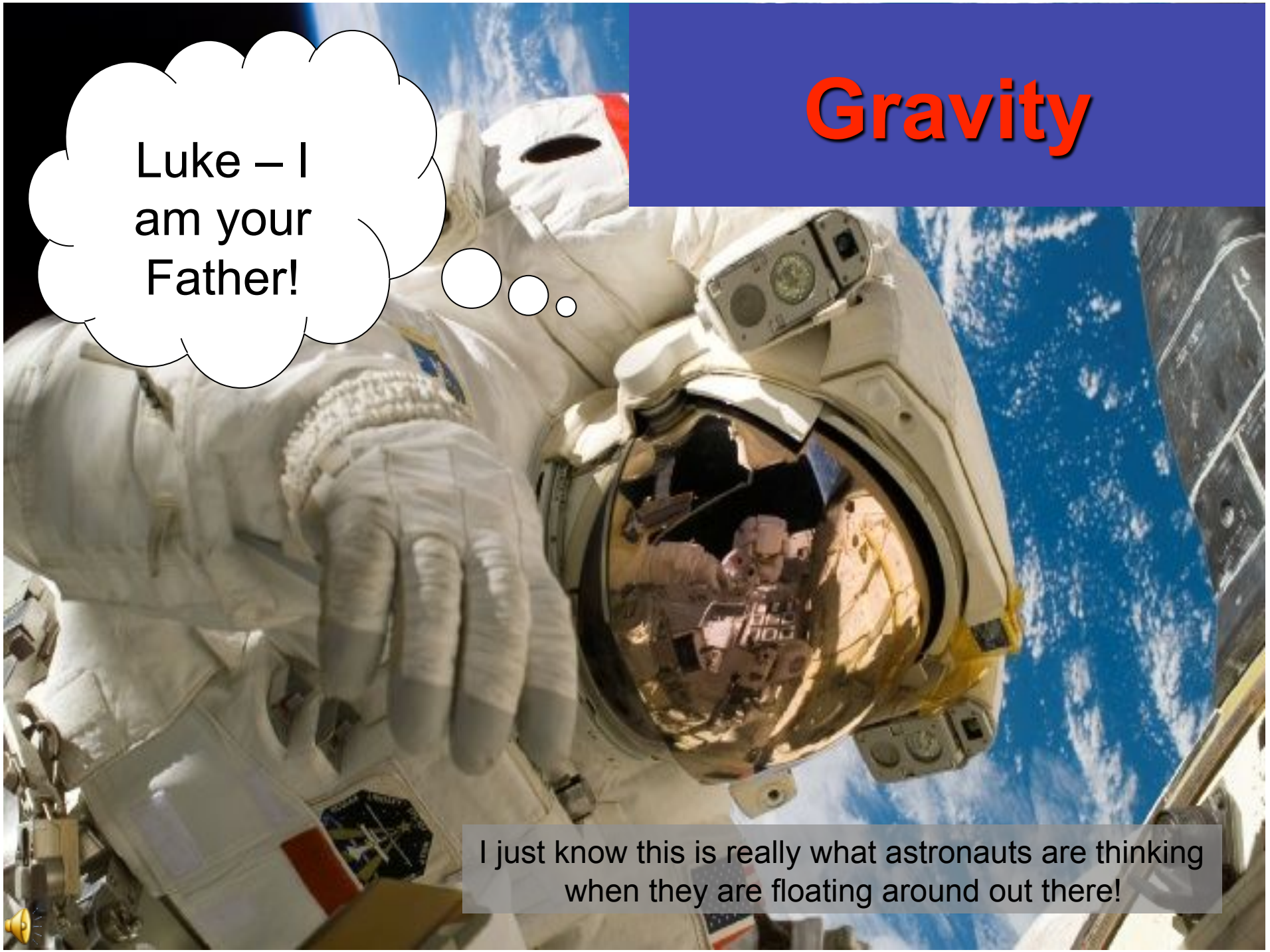
a. Elena

b. Lei

c. Sue

d. Kat

Gravity



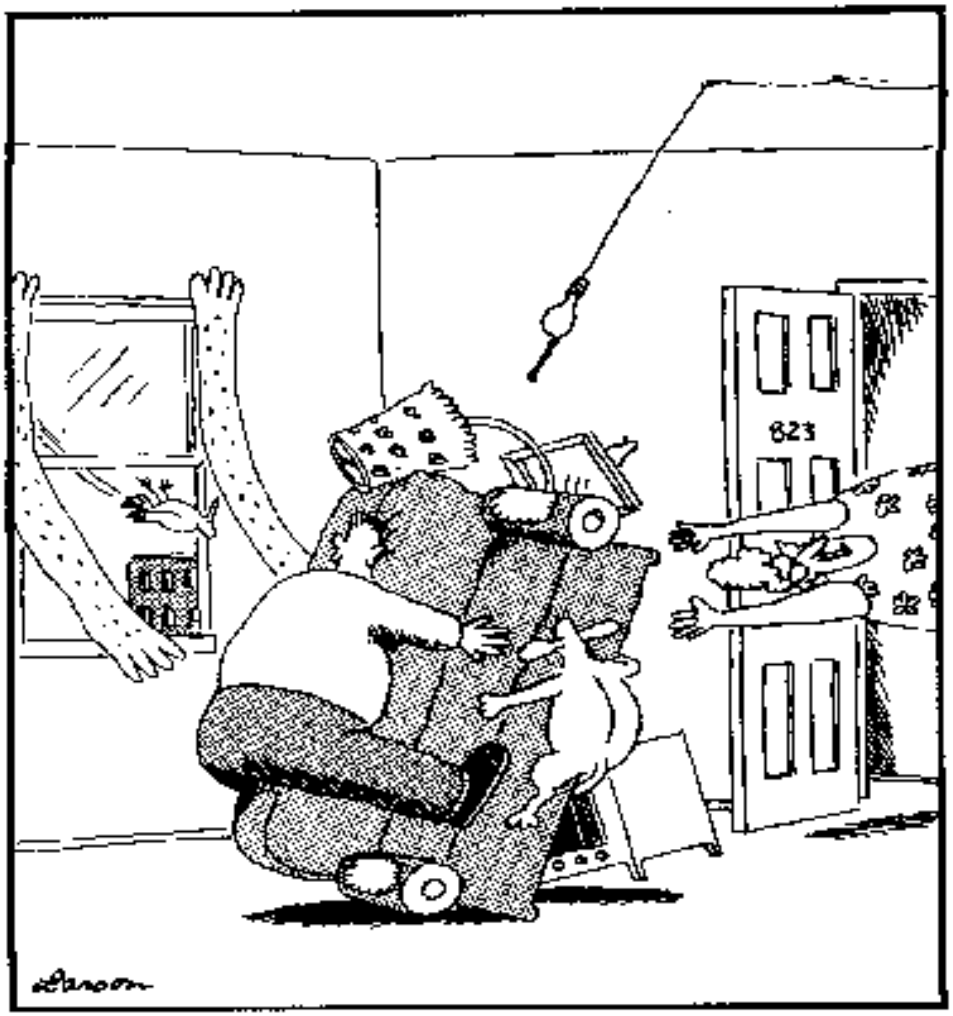
I just know this is really what astronauts are thinking when they are floating around out there!

Main Concept #1:

Gravity is the "attractive force" between all objects in the universe.

Gravity PULLS all objects towards it's source!

The force of gravity acts between all objects.



Suddenly, through forces not yet fully understood, Darren Belsky's apartment became the center of a new black hole.

Gravity is what makes all objects in our universe come together!

As you watch notice that all the objects with mass are being pulled to the source of gravity.

Source of Gravity

Also; notice that the new object being created around the source of gravity is growing larger

Basically, this is how we think planets are eventually formed!

Main Concept #2:
Gravity is what affects all of the motion in space.

Would any of the planets orbit the sun if the sun had no gravity?

Law of Gravity

Gravity PULLS all objects towards it's source!

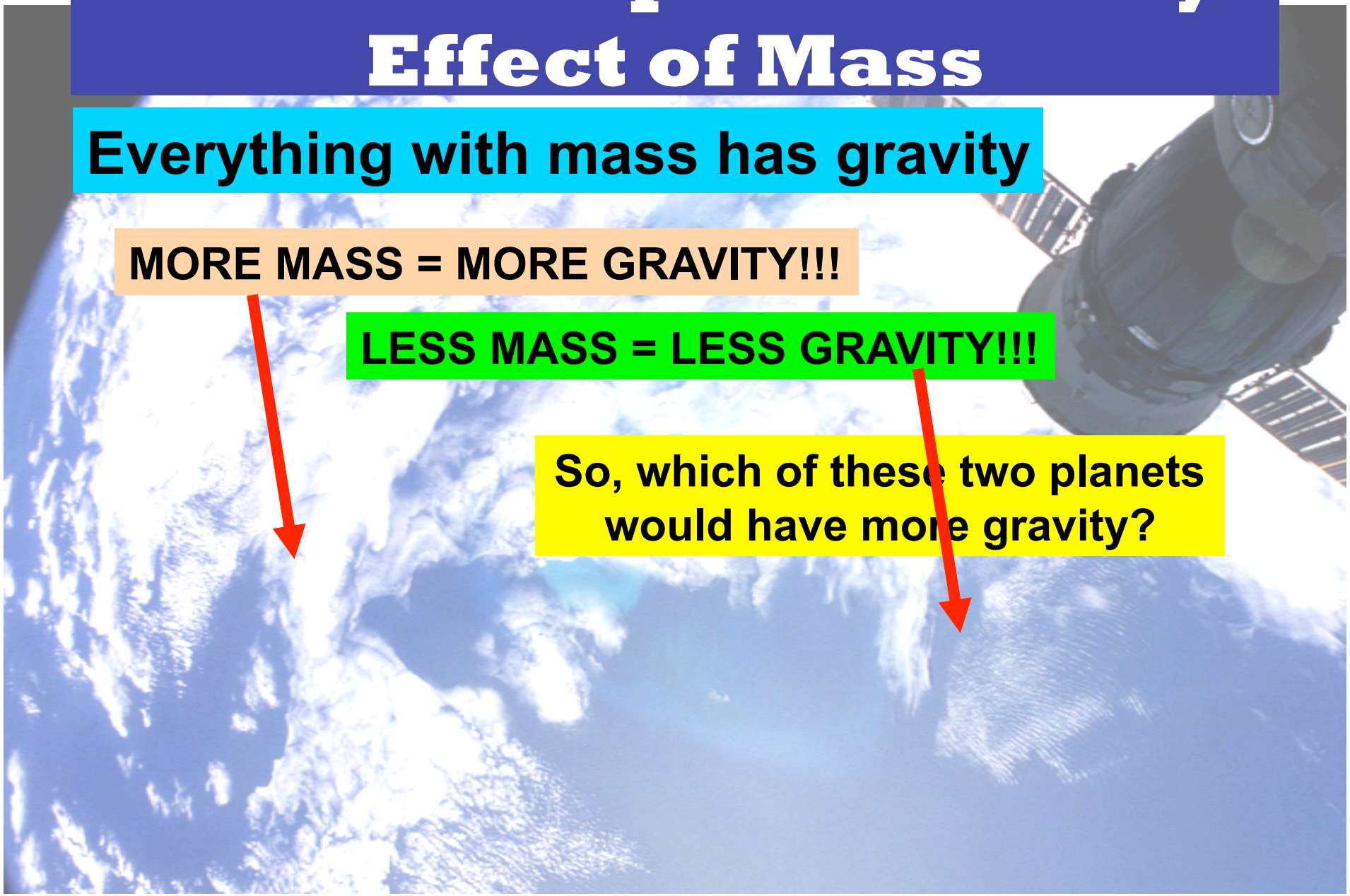
The source of gravity is almost always right in the middle

This is why all objects in the universe have a "round" shape!

Main Concept #3: There are two factors that effect the force of gravity:

Mass & Distance

Main Concepts of Gravity: Effect of Mass



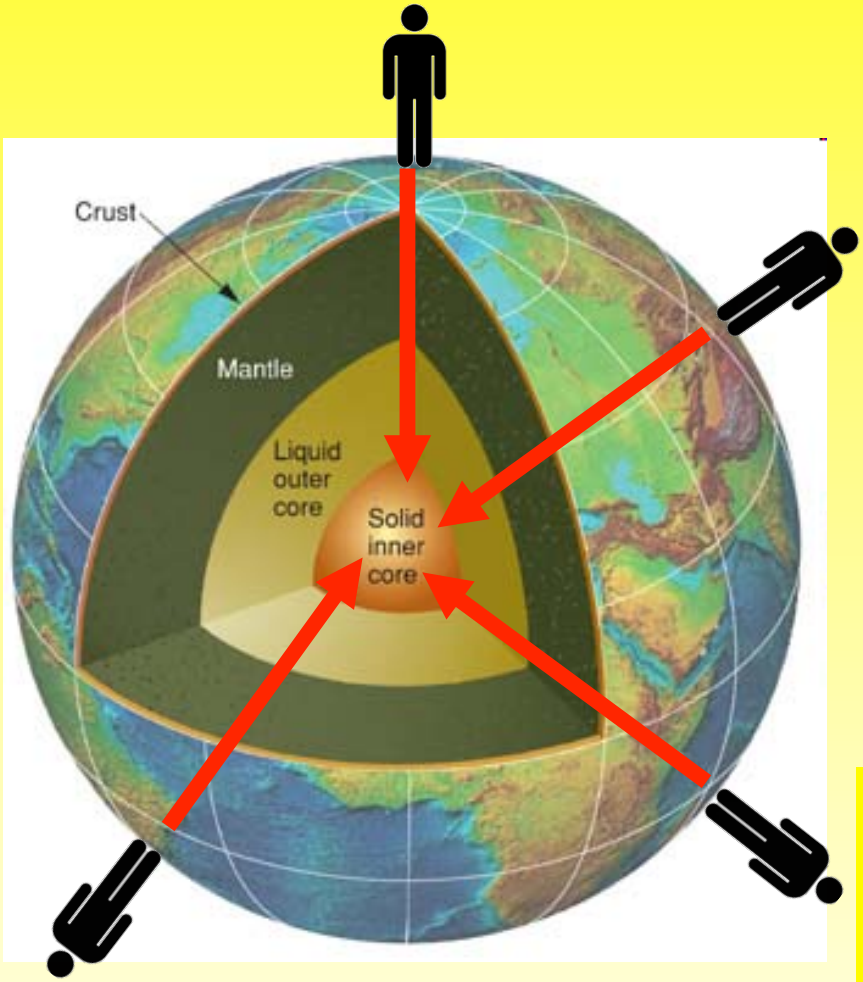
Everything with mass has gravity

MORE MASS = MORE GRAVITY!!!

LESS MASS = LESS GRAVITY!!!

So, which of these two planets would have more gravity?

Effect of Mass on Gravity:



The more planet's mass…the more its gravity effects you!

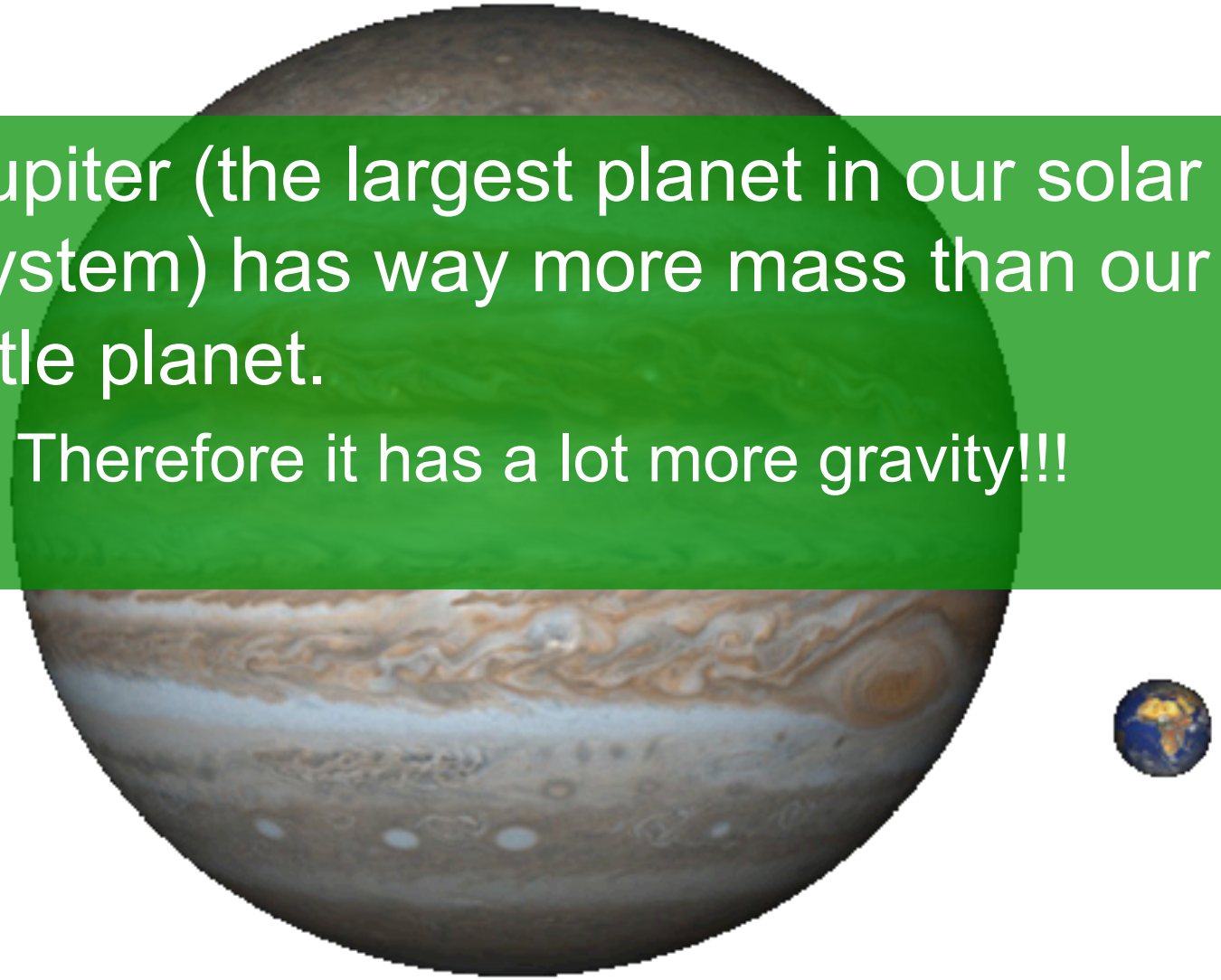
Gravity pulls everything towards its source!

The source of gravity for us is in the "core" (center) of the Earth!

No matter where you are on the planet, the pull is the same. This is why "down" is always at your feet!

Planet Mass & Gravity

- Jupiter (the largest planet in our solar system) has way more mass than our tiny little planet.
  - Therefore it has a lot more gravity!!!



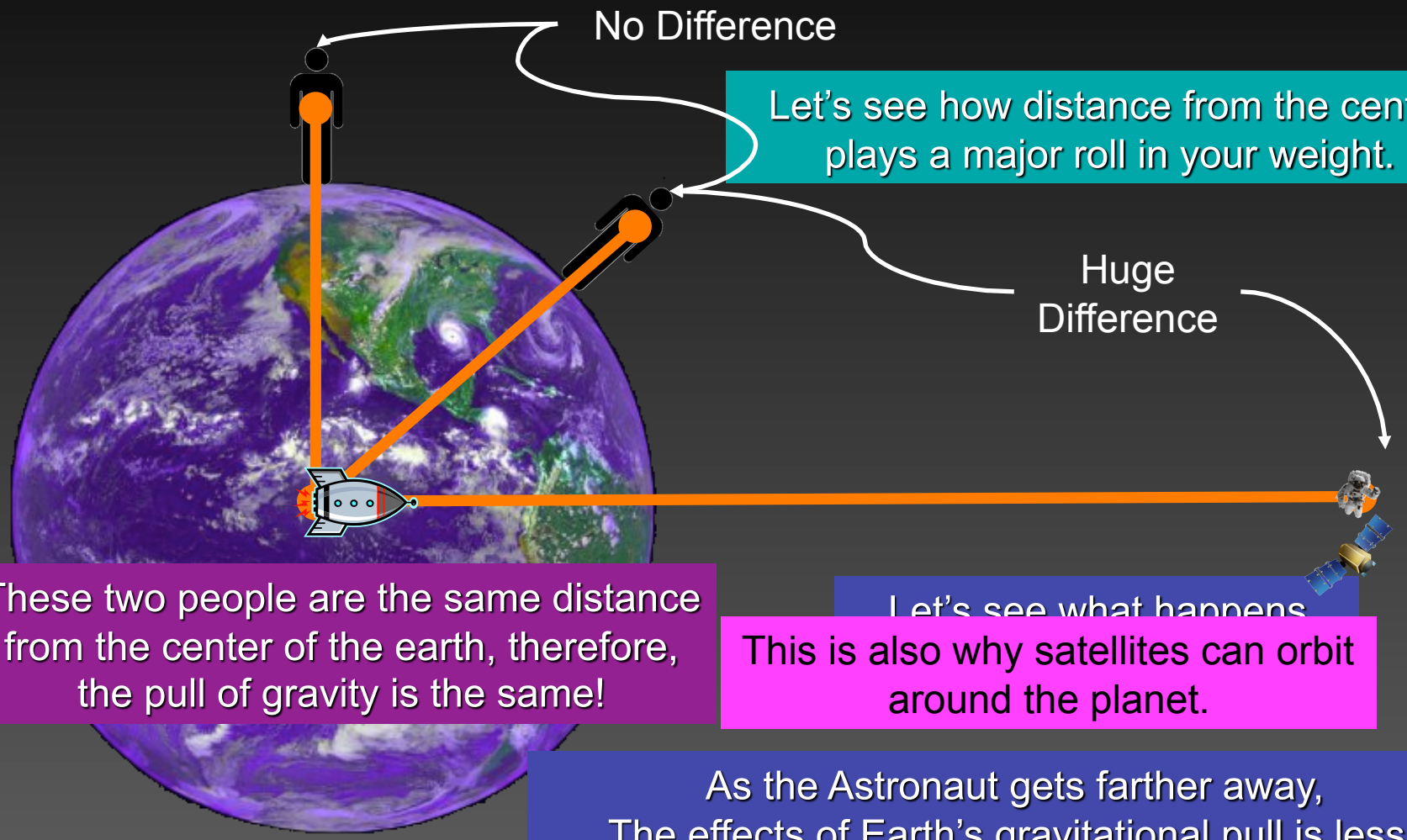
Laws of Gravity: Distance

- The closer you are to the object, the more your going to feel the effects of gravity.

- The farther you are from the object, the less your going to feel the effects of gravity.

If distance increases, the force of gravity decreases.

Distance from the center of Gravity matters!



Use the Law of Gravity to answer the question.

$$F_G = \frac{Gm_1m_2}{d^2}$$

A scientist is investigating four pairs of objects. She finds the masses and distances between the objects in each pair.

Between which pair of objects will the force of gravity be the **greatest** ?

(a) object 1: 80.0-kilogram metal weight
object 2: 50.0-kilogram metal weight
distance: 1.0 meter

(b) object 1: 10.0-kilogram rock
object 2: 10.0-kilogram rock
distance: 2.0 meters

(c) object 1: 50.0-kilogram person
object 2: 80.0-kilogram person
distance: 0.4 meter

(d) object 1: 4.3-kilogram board
object 2: 2.3-kilogram board
distance: 2.0 meters

Use the Law of Gravity to answer the question.

$$F_G = \frac{Gm_1m_2}{d^2}$$

A scientist is investigating four pairs of objects. She finds the masses and distances between the objects in each pair.

Between which pair of objects will the force of gravity be the **greatest** ?

(a) object 1: 80.0-kilogram metal weight
object 2: 50.0-kilogram metal weight
distance: 1.0 meter

(b) object 1: 10.0-kilogram rock
object 2: 10.0-kilogram rock
distance: 2.0 meters

(c) object 1: 50.0-kilogram person
object 2: 80.0-kilogram person
distance: 0.4 meter

(d) object 1: 4.3-kilogram board
object 2: 2.3-kilogram board
distance: 2.0 meters

Which statement best describes Newton's Law of Universal Gravitation?

a. Large objects, like Earth and the Sun, attract other objects everywhere in the universe.

b. Gravity is a kind of magnetic force between objects and Earth.

c. Gravity is the result of the curvature of space around a massive object.

d. Gravity exists between any two objects and depends on their masses and the distance between them .

Quick review of the 3 Laws of Motion:

- **Newton's 1st Law: Inertia**
  - Objects with mass have inertia.
  - Objects at rest will stay at rest. Objects in motion will stay in motion…unless…?
- **Newton's 2nd Law: F = M x A**
  - The more mass, the more inertia
  - The more mass, the harder it is to accelerate the object.
- **Newtons 3rd Law:**
  - For every action, there is an equal and opposite reaction.
  - When a force is exerted a reaction of some kind occurs.

Let's look at how these laws play out in space!

Think: What would the scale read if you weighed yourself out in space?

Think: What would the scale read if you put the anvil on it in space?

The scale would read: “0” wouldn’t it? Yes, it would!

Think: If you really are “weightless”, did anything actually happen to your mass?

Well, does your mass (all the atoms that make you up) go away as well when you “lose your weight” in space?

A: OF COURSE NOT!!! You still have all the same atoms that make you up as you did before (oh…and the anvil does to of course)

Think: So, If you both still have your mass, do you still have any inertia? Meaning, is it still hard to move you and the anvil? Or did it just become “easy”, because you are both “weightless”?

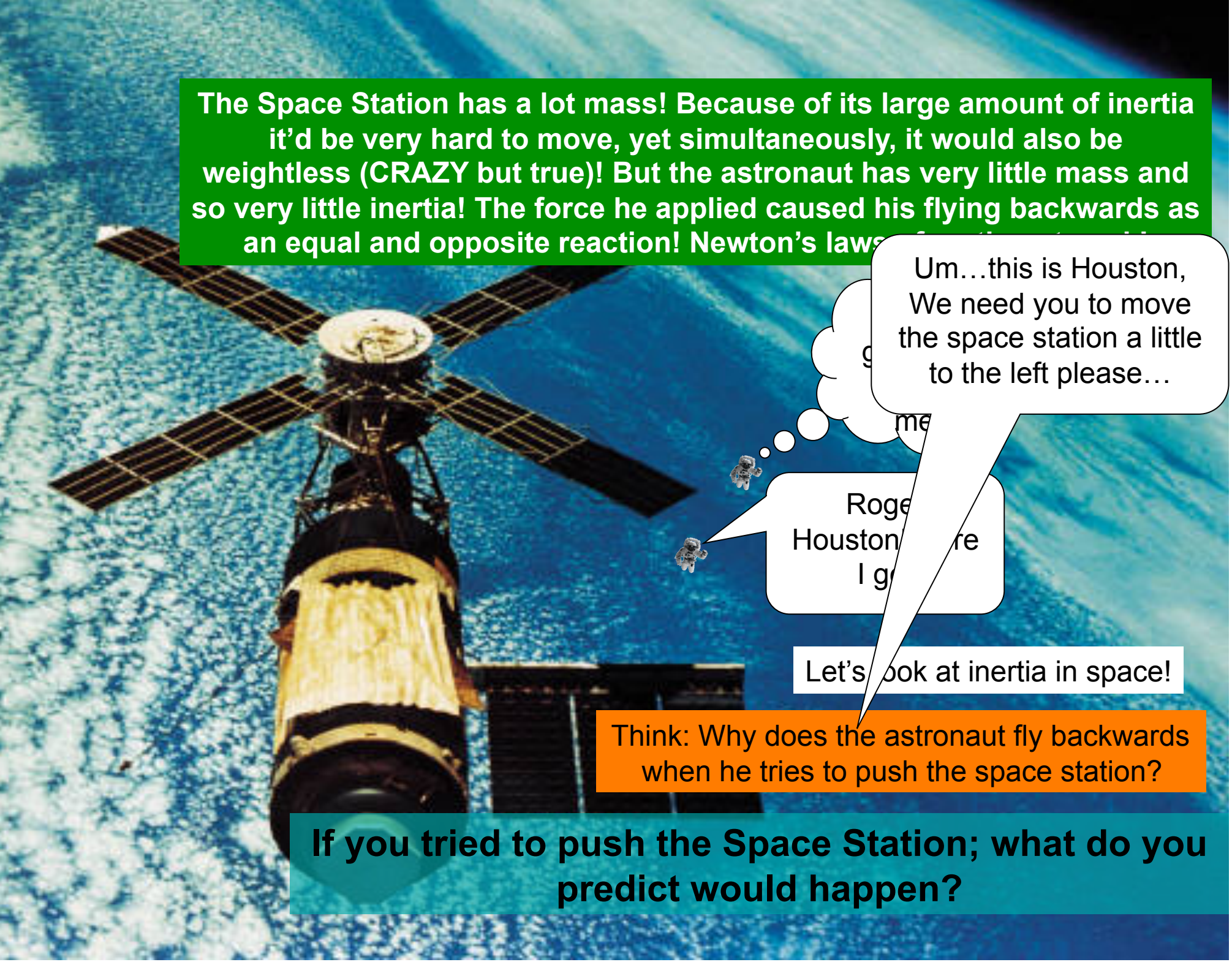
A person who weighs 600 newtons on Earth would weigh only 100 newtons on the Moon. Which statement best explains why?

a. The circumference of Earth is larger than that of the Moon.

b. The density of Earth is greater than that of the Moon.

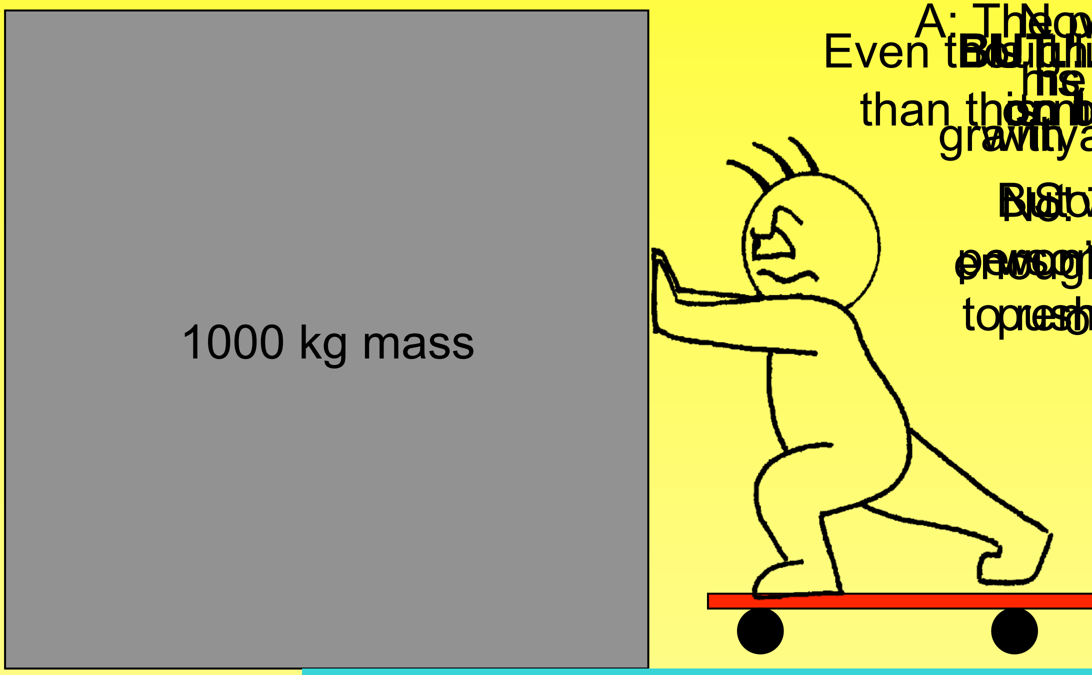
c. The mass of Earth is greater than that of the Moon.

d. The diameter of the Earth is larger than that of the Moon.


The Space Station has a lot mass! Because of its large amount of inertia it'd be very hard to move, yet simultaneously, it would also be weightless (CRAZY but true)! But the astronaut has very little mass and so very little inertia! The force he applied caused his flying backwards as an equal and opposite reaction! Newton's laws
Um…this is Houston, We need you to move the space station a little to the left please…
Let's look at inertia in space!
Think: Why does the astronaut fly backwards when he tries to push the space station?
If you tried to push the Space Station; what do you predict would happen?

Oh…now it makes sense

Q: Why would the astronaut fly backwards instead of just staying where he is?!



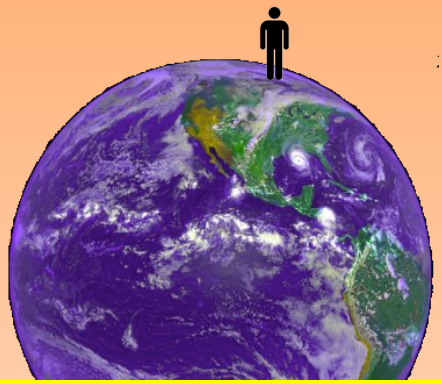
Of course, he won't move backwards as much as the astronaut, because there is still gravity pulling him down and the wheels will still have some friction with the floor! He does slow and stop. Ta-Da!

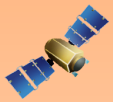
Conclusion

Gravity is dependant upon the mass of two objects and the distance between them.

- If mass increases – Force of Gravity increases
- If distance increases – Force of Gravity decreases.

Jupiter has more mass than Earth; Therefore it has more gravity





The satellite is farther from the center of Earth than we are; Therefore the satellite “feels” less pull of gravity

- “If you could increase Earth’s mass by two times, how much gravitational influence would Earth have on an orbiting satellite?” (*twice as much) “If the satellite is boosted three times farther from Earth, would the gravitational pull on the satellite be more or less?” (less) “How much of a difference would there be?” (3 x 3 = 9 times less than the original force of gravity).*

Challenge

1. “If you could increase Earth’s mass by two times, how much gravitational influence would Earth have on an orbiting satellite?”
2. *“If the satellite is boosted three times farther from Earth, would the gravitational pull on the satellite be more or less?”*
3. *“How much of a difference would there be?”*

Your weight on other worlds

- http:/www.exploratorium.edu/ronh/weight/

Gravity Variations Interactive

- http://highered.mheducation.com/olcweb/cgi/pluginpop.cgi?it=swf::800::600::/sites/dl/free/0072482621/78778/Gravity_Nav.swf::Gravity+Variations+Interactive

- Astronomers study an asteroid that is moving quickly toward Jupiter. Which statement describes how the gravitational attraction between the asteroid and Jupiter will most likely change?

a. The gravitational force will increase as the distance between the asteroid and Jupiter decreases.

b. The gravitational force will increase as the mass of the asteroid increases.

c. The gravitational force will decrease as the speed of the asteroid increases.

d. The gravitational force will decrease as the speed of the asteroid decreases.