

TALKING ABOUT GRAVITY

Two friends were talking about gravity.

Ben said, "Gravity needs an atmosphere or air. If there is no air or atmosphere, there will be no gravity."

Kelly said, "Gravity doesn't need an atmosphere or air. If there is no air or atmosphere, there will still be gravity."

Which friend do you agree with?

14 agreed with Ben (46.7% of total). 16 agreed with Kelly (53.3% of total).

Responses for Ben:

1. In order for something to have gravity it has to have mass.
2. Space has no atmosphere.
3. There is no gravity in space as well as the absence of air and atmosphere.
4. There is air in space and no atmosphere, so there is no gravity.
5. The moon does not have no atmosphere, then why should gravity.
6. The book said gravity needs an atmosphere. Also because the moon doesn't have gravity and also doesn't have an atmosphere.
7. The moon doesn't have an atmosphere and there's no gravity, but earth does have an atmosphere and has gravity.
8. You need an atmosphere to have gravity. If there is no atmosphere there is no gravity just like the moon.
9. The moon doesn't have a lot gravity because there is no atmosphere, so there can't be a lot gravity without atmosphere.
10. Gravity does need an atmosphere and air, therefore Ben is correct for an atmosphere and air you need a gravitational force.
11. Kelly is wrong because space has no atmosphere or air and there is no gravity. That's why astronauts float and become light. I think gravity needs an atmosphere or air because the only way to have atmosphere or air is by an object with mass then where there is mass there is atmosphere and air and where that is there is gravity so Ben is right.
12. I thought of space in space gravity is what keeps the solar system turning or even Earth could be an example.
13. Without an atmosphere there is no gravity. If there wasn't an atmosphere (Earth) we would float around as if we were in space. Without an atmosphere, Mr. Armstrong wouldn't have been able to land on the moon. What is the push and pull on gravitation if there's no atmosphere.
14. You would need air for there to be gravity. The moon doesn't have any atmosphere, but there might be enough for there to have gravity on the moon.

Recurring or interesting responses:

Gravity needs an atmosphere and air to exist. Gravity needs mass to exist (which is somehow tightly coupled to ideas of atmosphere and air). One student specifically ties the idea of gravity to weightlessness. The atmosphere is the push and pull on gravity. Space has no atmosphere (and therefore no gravity).

Responses for Kelly:

1. Because out of all the planets, most don't have an atmosphere and there is still gravity.
2. Because for any object that has mass has gravity.
3. Other planets have gravity.
4. The moon has no atmosphere but has gravity.
5. No explanation provided.
6. Because you don't need one to have gravity.
7. I agree with her because it makes the most sense.
8. Because in order to have gravity you must have mass.
9. Because an object does not need any atmosphere or air. For any object to have gravity it must have mass. The higher the mass the higher gravity force. If there was no mass, there will be no gravity, just like space. Space does not have gravity. This proves why Kelly is correct and Ben is wrong.
10. If there is no air or atmosphere then there will still be gravity. An example of this would be the moon and Mars. Ben is not right because the moon and Mars have no atmosphere.
11. Because the moon has no atmosphere but there is still enough gravity. I disagree with Ben because his statement is not true.
12. Because just like the moon, if there is no air and atmosphere, there can still be gravity, just not a lot of gravity.
13. Because I know that the moon doesn't an atmosphere or air but it still has gravity. While we have an atmosphere and air but we get our gravity from another planet.
14. A lot of planets do not have stable atmosphere but they still have a gravitational pull. For example, the moon does not have a good atmosphere or the sun but they still have a gravitational pull.
15. Because the moon has a gravitational force with no air or atmosphere. We can't live on the moon so that is why I believed this.
16. I go with Kelly because in space there are planets that have no atmosphere such as the moon, there is still gravity on and around the moon because without the gravity then the moon wouldn't stand up in space.

Recurring or interesting responses:

Mass is required for gravity. You don't need air or an atmosphere. Higher mass means higher gravitational pull. Most of these ideas are tied to other planets without atmospheres, or the moon. "Without the gravity then the moon wouldn't stand up in space."

Teacher notes

Purpose

The purpose of this assessment probe is to elicit student's ideas about gravity. The probe is designed to determine whether students recognize that gravity is a universal force that exists everywhere in space, regardless of whether air is present.

Explanation

Gravity is a universal attraction between any two objects with mass. Every object in the universe is affected by the force of gravity. The two factors that affect the magnitude of gravity are the mass of the attracted objects and the distance between them. The greater the masses the greater the gravitational force between two objects. The greater the distance between two objects, the less the gravitational force between them. Each object with mass in the universe is attracted to all other objects regardless of size or distance. Whether you are on the Moon, Earth or deep in outer space, gravity is present. Air or an atmosphere is not needed for gravity.

Elementary students

Most students know that things fall toward the Earth, have heard the word gravity, and have begun to understand that gravity pulls things toward the Earth. They have seen videos of astronauts in space and have heard the misuse of terms in the media such as zero gravity and weightlessness. These images and terms may result in students formulating early ideas that gravity affects objects on Earth but not in space, particularly since their experiences and contexts deal with terrestrial gravity.

Middle school

Students expand on their previous knowledge of gravity to include the idea of gravity in space. They develop the idea of a gravitational force that is center-directed, affects all objects, and depends on objects mass and distance. They develop a notion of weight as being distinct from mass. This is also a time when students learn about moons that lack an atmosphere, and hear references to astronauts being weightless in space.

High School

Students continue to build a more sophisticated understanding about gravity by using proportional relationships to explain increases or decreases in gravitation attraction. Even though students may quantitatively understand gravitational force, there is a likelihood that they may hold on to their preconceived ideas about air being necessary. This may be compounded by confusing air pressure with gravity. The probe is useful in uncovering misconceptions that may go unnoticed during formal instruction.

Research

- Students confusion about air being necessary for gravity may be related to their view of weight as a force. Some students think air is the force that results in weight. A large sample of middle school students also think that air must be present for gravity to act.

- Relating gravity to air provides insight into students ideas about gravity being something that resides outside of objects rather than all objects exerting a gravitational pull.
- Misconceptions about the cause of gravity persist even after high school physics instruction.
- Some students describe a holding idea that an atmosphere holds gravity in.
- Some students think that Earth's magnetism and spin cause gravity.
- Some studies show that very few middle and high school students believe all objects exert a gravitational force.

Suggestions:

- Explicitly point out that air or an atmosphere is not a factor in gravity and provide evidence like men walking on the Moon.
- Place an object in a vacuum jar and remove all the air. Ask students to predict what would happen to the object if there were no gravity acting on it as a result of removing all the air from the jar. Ask if students want to revise their opinion about air being necessary. If they still maintain this, show a video of astronauts dropping objects on the Moon, where there is no air (or videos showing objects falling in a vacuum tube).
- Gravity keeps an atmosphere in place and not vice versa. Use planets as an example of large objects exerting a strong gravitational pull and contrast it to smaller objects like the moon, which are not large enough to exert a pull that will maintain an atmosphere.
- Use the term microgravity to refer to a small gravitational effect.
- Demonstrate weightlessness and floating by using diagrams to show that astronauts are actually in free fall around earth.