

1. What is your gender?

- Female
- Male
- Other: _____
- Prefer not to say

2. At school I am in...

- 1st Year
- 2nd Year
- 3rd Year
- Other: _____

3. How old are you?

4. Astronauts “float” around in the space shuttle as it orbits Earth because... (TICK ONLY ONE OPTION)

- There is no gravity in space
- They are falling in the same way as the Space Shuttle
- They are above earth’s atmosphere
- There is less gravity inside of the Space Shuttle

5. What is gravity? What do you think of when you hear the word gravity? (Bar et al., 2016)

6. Where can you find gravity? Describe locations anywhere in the universe where you believe gravity acts. (Bar et al., 2016)

7. An astronaut standing on the Moon's surface has a pen in his hand and releases it. What happens to the pen? (TICK ONLY ONE OPTION) (Keeley & Sneider, 2012)

- It falls to the surface at a slower rate than it would on Earth.
- It falls to the surface at a faster rate than it would on Earth.
- It doesn't fall and floats where it is.
- It doesn't fall and slowly drifts away.

8. What is the meaning of weight? (Bar et al., 2016)

- Object is big or small
- Object is heavy or light
- Force of gravity exerted on the body
- Quantity of matter the body contains
- Force exerted on the support

9. Put an X next to all the other places where gravity exists. (YOU CAN TICK MORE THAN ONE OPTION) (Keeley & Sneider, 2012).

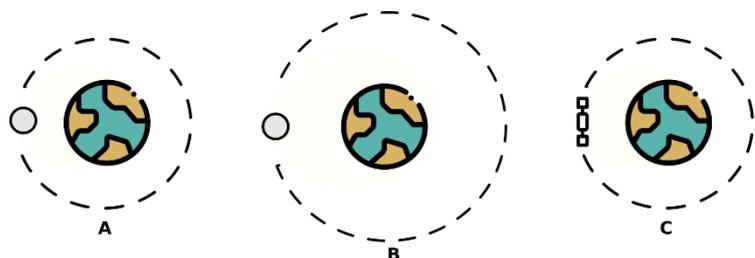
- | | |
|--|---------------------------------------|
| _____ Earth's atmosphere | _____ Pluto |
| _____ just outside of Earth's atmosphere | _____ Sun |
| _____ the Moon | _____ distant stars |
| _____ Mars | _____ galaxies |
| _____ Jupiter | _____ far out in the distant universe |

How did you decide where gravity exists?

Planets A, B and C are identical. A and B each have a moon orbiting them, while C has an artificial satellite orbiting it, as shown in the diagram. Each moon is twice the mass of the satellite. Which planet has the strongest gravitational interaction with its orbiting body? (TICK ONLY ONE OPTION) (Williamson, Willoughby & Shannon, 2013)

10. Prathe

- Planet A
- Planet B
- Planet C
- Both Planets A and B



- All the same

11. Pretend that a tunnel was dug all the way through the Earth. Imagine that a person standing at the surface holds rock and drops it. Which answer best represents the path taken by the rock? (Sneider & Ohad, 1998)

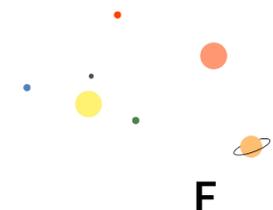
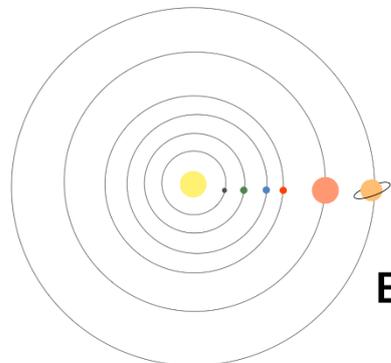
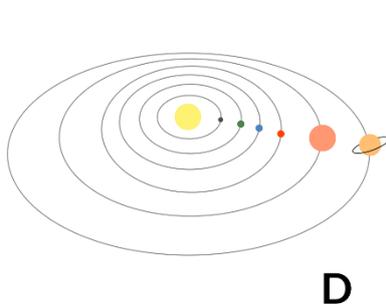
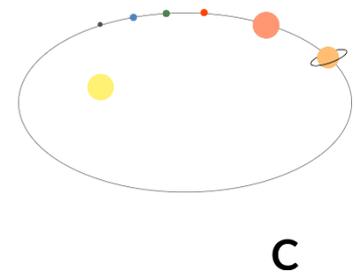
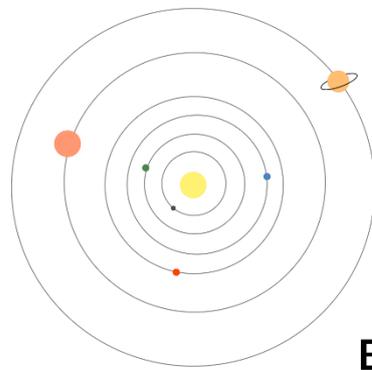
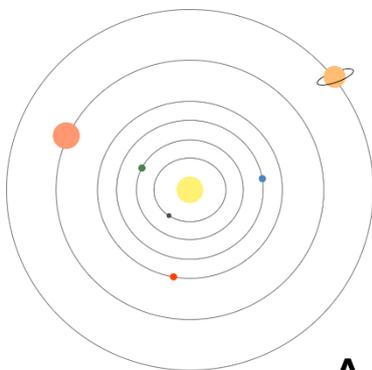
- Rock falls toward Earth centre
- Rock falls on the Earth's surface
- Rock passes through the tunnel to outer space
- Rock falls oscillating up and down
- and stop at the Earth's centre



12. How Do Planets Orbit the Sun? (TICK ONLY ONE OPTION) (Keeley & Sneider, 2012)

A teacher asked her students to list the order of the six planets that are closest to the Sun. All of the students were able to do this by listing:

Closest to Sun—Mercury, Venus, Earth, Mars, Jupiter, and Saturn—Farthest From Sun



Then the teacher surprised her students by asking them to draw the orbits of the planets, showing how they orbit around the Sun. Different students drew the orbits in different ways. Which drawing do you think is most accurate? _____

- a. Explain why you chose that drawing and not the others.

13. Shorter Days in Winter (Keeley & Sneider, 2012)

Mrs. Souza's students checked the newspapers every morning for the times of sunrise and sunset. They used this information to determine the number of hours of daylight. The class started this project in September, and by November, they could see that the days were getting shorter and shorter. The students asked their families and neighbours to explain why days get shorter as winter approaches in the North. Here are the ideas they came to class with the next day:

Aoife: "My mom says it's because of daylight saving time."

Roisin: "My sister said Earth's tilt causes the Sun to be farther away in winter."

Sean: "My father thinks the angle of sunlight must be the cause."

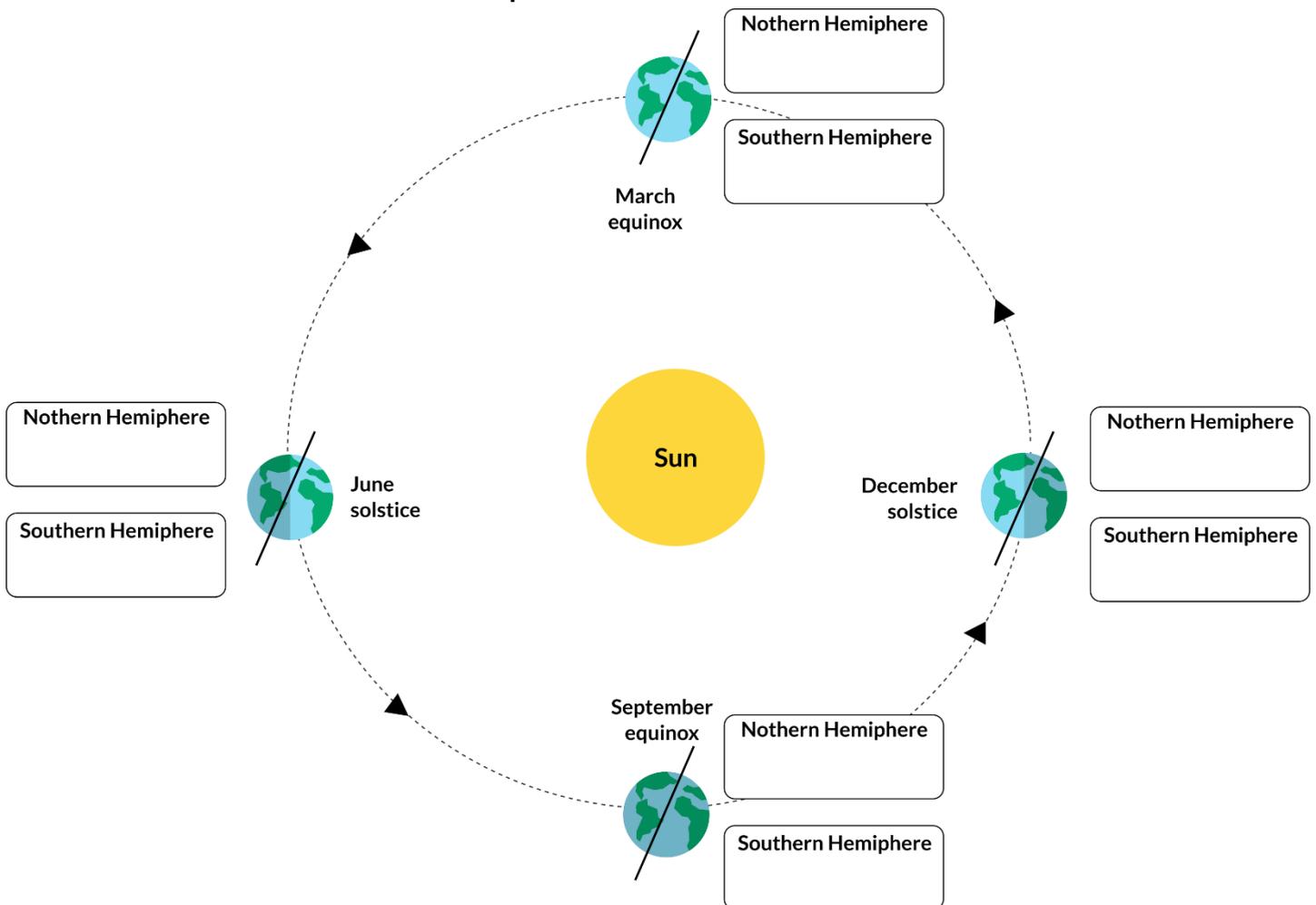
Conor: "My brother says the Sun moves across the sky faster in winter."

Ciara: "My neighbor thinks the Sun's path in the sky gets shorter in winter."

Which student came to class with the best idea? _____

Explain why you think that is the best idea.

14. Based on your observations, label the diagrams with the correct seasons for the northern and southern hemisphere.



15. In your own words, describe how Earth's tilt relates to the change in seasons. (Keeley & Sneider, 2012)

16. The main reason that it is hotter in the summer than the winter is that (Trumper, 2001a, 2001b)

- The Earth is closer to the Sun in summer
- The Earth is farther from the Sun in summer
- The Earth's rotational axis flips is bac k and forth as the Earth moves around the Sun
- The Earth's axis points to the same direction relative to the stars , which is tilted relative to the plane of its orbit

- The Sun gives off more energy in the summer than in the winter

17. The different seasons that we experience every year are due to: (Trumper, 2001a, 2001b)

- The varying distance between the Sun and the Earth
- The varying distances between the Earth, Moon and Sun
- The tilt of the Earth's axis as it revolves around the Sun
- Varying degrees of atmospheric pollution which dilute the Sun's rays

18. When is the longest daylight period in Ireland? (Trumper, 2001a, 2001b)

- March
- June
- September
- December

19. What is the name for Earth's movement in its orbit?

20. Expanding Universe (Keeley & Sneider, 2012)

It has been more than 80 years since the astronomer Edwin Hubble discovered that the universe is expanding. He was able to determine that fact by observing the speed and direction that galaxies are moving. Nearly all galaxies are moving away from our galaxy, and the more distant galaxies are moving away faster. That means that all of the galaxies in the universe (or at least the material from which they were formed) were all together around 14 billion years ago, and they have been moving apart ever since. That is a scientific fact. But the question of what is expanding is part of the big bang theory. According to this theory, what, exactly, is expanding? Circle the answer that best matches your interpretation of the big bang theory. **(TICK ONLY ONE OPTION)**

- Matter is expanding into a huge empty void.
- Space is expanding or stretching, so the distance between galaxies is growing.
- Space and matter are expanding, so galaxies are getting bigger and moving apart.

Describe what you know about the big bang theory to support your answer.

21. The Big Bang is best described as: **(TICK ONLY ONE OPTION)** (Slater, 2009)

- The event that formed all matter and space from an infinitely small dot of energy.
- The event that formed all matter and scattered it into space.
- The event that scattered all matter and energy throughout space.
- The event that organized the current arrangement of planetary systems.

22. Current evidence about how the universe is changing tells us that **(TICK ONLY ONE OPTION)** (Slater, 2009)

- We are near the centre of the universe.
- Galaxies are expanding into empty space.
- Groups of galaxies appear to move away from each other
- Nearby galaxies are younger than distant galaxies.

23. Is the Big Bang “Just a Theory”? (Keeley & Sneider, 2012)

Four college students—an astronomy student, a history student, a paleontology student, and a chemistry student—were discussing the big bang. This is what they said:

Astronomy student: *“In astronomy the evidence for the big bang is that today all galaxies are racing apart from each other. I made some of the measurements myself! So we know that at one point in time the galaxies must have been together in one place at one time – that’s the big bang.”*

Biology student: *“No amount of evidence will convince me – if no one was there to record it, then we can never be sure. The big bang is just a theory.”*

Physics student: *“No one was around when the dinosaurs lived, but we have evidence (e.g. fossils) that the dinosaurs existed. We have evidence of the big bang even though we weren’t there when it happened.”*

Chemistry student: *“To me the most important evidence that the big bang occurred is that when you look out into the universe today the most abundant element by far is hydrogen, followed by helium and a little lithium. That’s exactly what you’d expect if hydrogen and helium were formed in a big bang, and the other elements were added later as stars formed and died.”*

Whose argument do you **least accept**? _____

Explain your thinking.

24. Describe what existed or occurred just before the Big Bang. (Aretz, Borowski & Schmeling, 2016; Prather et al., 2003)

25. Describe how you think the universe changes over time, if at all. (Aretz, Borowski & Schmeling, 2016; Bailey et al., 2003)

26. Explain, in as much detail as possible, what astronomers mean when they say “the universe is expanding”. (Aretz, Borowski & Schmeling, 2016; Wallace, 2001)
