Learning Target (S8P5.a): I can construct an argument using evidence to support the claim that gravitational fields exist between objects exerting forces on each other even when the objects are not in contact

FSI Reading for Meaning: The Invisible Pull, Evidence of Gravitational Fields

When you drop a pencil, it falls straight to the ground. You might say, "Gravity pulled it down." But what exactly is gravity, and how can something pull on another object without touching it? Scientists use the concept of gravitational fields to explain how this invisible force acts across space.

A gravitational field is the region around any object where another object feels a pull of gravity. The larger the mass of an object, the stronger its gravitational field. Even though you can't see or touch it, the field is always present. For example, Earth's gravitational field keeps the Moon in orbit. The Moon is not attached to Earth by a string or tether—yet Earth constantly pulls on it through this invisible field. At the same time, the Moon also pulls on Earth, creating ocean tides that rise and fall each day.

We see gravitational effects far beyond our planet. The Sun's gravitational field extends billions of kilometers into space, holding all the planets in orbit. The strength of this field decreases as distance increases, but it never completely disappears. Even a planet like Neptune, far from the Sun, is kept in orbit because the Sun's gravitational field still reaches it.

Objects don't have to be gigantic to have gravitational fields. Every object with mass—whether it's a basketball, a car, or a mountain—creates its own field. You just don't notice it because Earth's gravity is so much stronger than that of smaller objects. If you were in deep space, far from any large mass, even a small object's gravity could become measurable.

Isaac Newton was one of the first scientists to describe this invisible attraction mathematically. He realized that every object in the universe pulls on every other object, and that the strength of the force depends on mass and distance: the greater the mass, the stronger the pull; the greater the distance, the weaker it becomes. Later, Albert Einstein expanded this idea with his theory of general relativity, proposing that gravity is not just a force but a curving of space itself. According to Einstein, massive objects bend the space around them, and smaller objects move along these curves—like marbles rolling on a stretched rubber sheet.

Today, scientists use evidence from satellites, space probes, and astronomical observations to detect and measure gravitational fields. For instance, when NASA's spacecraft orbit distant planets, they use tiny changes in speed and direction to map variations in those planets' gravitational strength. These maps help us understand the planet's interior, showing where it might be denser or less dense.

The consistent behavior of falling objects, orbiting moons, and the motion of galaxies all provide strong evidence that gravitational fields are real and active—even though we can't see them. In

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short, gravity connects every object in the universe, reminding us that everything—even things light-years apart—is linked by the invisible fabric of space.

1. (DOK 3) Which evidence from the passage best supports the claim that gravitational fields exist between objects even when they are not in contact?

A. The Sun gives off light and heat that travel through space.
B. The Moon remains in orbit around Earth due to an invisible force.
C. The ocean tides are affected by changes in wind direction.
D. The atmosphere of Earth protects life from harmful radiation.

2. (DOK 4) Based on Newton's and Einstein's ideas, how did Einstein's model of gravity improve our understanding of gravitational fields?

A. It showed that gravity can be completely blocked by magnetic fields.
B. It replaced the idea of gravitational force with the concept of curved space.
C. It proved that only large planets have measurable gravity.
D. It showed that gravity can only act over short distances.

3. (DOK 3) If two objects are moved farther apart, what happens to the gravitational field between them, and why?

A. It becomes stronger because distance increases the pull.
B. It becomes weaker because distance decreases the pull.
C. It stays the same because gravity is constant everywhere.
D. It disappears because objects only attract when touching.

4. (DOK 4) A student claims, "Gravitational fields can be detected using indirect evidence." Which experiment from the passage best supports this claim?

A. Watching how objects fall on Earth
B. Mapping changes in a planet's gravity using spacecraft data
C. Observing changes in sunlight intensity over time
D. Measuring how temperature changes at night

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5. (DOK 3) How does the relationship between mass and gravitational field strength explain why Earth's gravity dominates over smaller objects?

A. Earth's smaller mass gives it a weaker pull.
B. Earth's larger mass produces a stronger gravitational field.
C. Smaller objects produce stronger gravitational fields.
D. Distance from the Sun increases gravitational strength.

6. (DOK 4) Using the example of tides in the passage, explain how this phenomenon provides evidence for gravitational fields between the Moon and Earth.

A. Ocean tides prove that the Moon emits energy that heats the oceans.
B. The tides rise and fall in response to changes in air pressure.
C. The Moon's gravitational pull on Earth's oceans demonstrates a force acting without contact.
D. The Moon's shadow blocks sunlight, causing water levels to drop.

7. (DOK 3) If the Sun's mass were suddenly reduced by half, what would most likely happen to Earth's orbit based on the concept of gravitational fields?

A. Earth would move closer to the Sun.
B. Earth would move farther away in a larger orbit.
C. Earth's orbit would stop completely.
D. Nothing would change because gravity doesn't depend on mass.

8. (DOK 4) Compare the gravitational field of Earth to that of the Moon. Which conclusion is best supported by evidence from the passage?

A. The Moon's weaker gravitational field means it cannot hold objects in orbit.
B. Earth's stronger gravitational field allows it to affect both local and distant objects.
C. The Moon's gravitational field is stronger because it causes tides.
D. Both fields are equally strong because they balance each other out.

9. (DOK 3) Which piece of evidence best demonstrates that every object with mass has a gravitational field?

A. A spacecraft detects slight acceleration near a small asteroid.
B. A comet reflects sunlight as it passes by Earth.
C. A planet's atmosphere contains nitrogen and oxygen.
D. A star emits visible and infrared light.

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10. (DOK 4) Develop a reasoning statement that connects the falling of a pencil to the orbit of the Moon around Earth. Which explanation aligns with the scientific concept of gravitational fields?

A. Both are affected by invisible gravitational fields that cause motion toward a larger mass.
B. Both occur because air resistance pushes objects downward.
C. Both involve energy produced by magnetism.
D. Both happen only when the objects are in direct contact.

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