Forces Across Gaps

Build a claim from observations of motion without contact

PS.3.a "Construct an argument using evidence to support the claim that field forces exist between objects and act on the objects even when the objects are not in contact."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB In each paragraph, underline where a gap remains between objects, circle a change in motion, and number any details that help rule out another cause. Use your marks to build arguments about forces that act without contact.

Three Stations, No Touching

1. At a lab station, Maya sets a steel ball on a level track. With no magnet nearby, the ball stays still. She then holds a bar magnet beside the track, about two centimeters from the ball. The ball rolls toward the magnet, although a visible gap remains between them. Maya repeats the trial with a plastic block held at the same spot. This time the ball does not start rolling. She checks that neither object touches the ball or the track. The track stays level, and no one blows on the ball during either trial.

2. At another station, Ari hangs a lightweight plastic rod from a thread. A second rod brought near it causes no noticeable motion. Ari then rubs both rods with the same wool cloth and brings them close again. The hanging rod swings away from the other rod before they touch. Ari holds the second rod still and repeats the test several times. Each time, the hanging rod swings away while a gap remains. No one pushes the hanging rod, and the windows are shut. The thread allows the rod to move sideways.

3. At a third station, a small metal sphere hangs from a thread inside a sealed chamber. The air has been removed from the chamber. When the thread is cut, the sphere moves downward and strikes the chamber floor. After the cut and before impact, no solid object touches the sphere. A camera records the sphere moving faster as it falls. Repeating the trial from different starting heights changes the travel time, but not the downward direction. There is no magnet near the chamber, and removing the air rules out moving air as the cause of the sphere's motion.

2 ANSWER WITH EVIDENCE

Use the passage

1. Make a claim about the force on Maya's steel ball. Use the ball's motion and the plastic-block trial as evidence.

2. What evidence supports a claim that the two rubbed rods exerted a force without touching?

3. Use evidence from the chamber trial to argue that Earth exerted a force on the sphere before it hit the floor.

4. Someone claims that touching or moving air caused all the motion. Use evidence from two different stations to challenge that claim, and name each field force.

3 YOUR TURN

Your own words

Design a new test using a charged balloon and a thin stream of water. State your claim, predict what you would observe with the balloon near the stream but not touching it, include a comparison using an uncharged balloon, and explain how the results would support your claim.

ANSWER KEY

Forces Across Gaps

PART 1 · READ AND MARK

In each paragraph, underline where a gap remains between objects, circle a change in motion, and number any details that help rule out another cause. Use your marks to build arguments about forces that act without contact. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Make a claim about the force on Maya's steel ball. Use the ball's motion and the plastic-block trial as evidence.	**A magnetic force pulled the steel ball across the gap. It rolled toward the magnet but stayed still when a plastic block was held in the same spot.**
2	What evidence supports a claim that the two rubbed rods exerted a force without touching?	**The hanging rod swung away from the other rubbed rod while a gap remained. Its repeated sideways motion supports a repulsive electric force across the gap.**
3	Use evidence from the chamber trial to argue that Earth exerted a force on the sphere before it hit the floor.	**After the cut, the sphere fell downward and moved faster without touching a solid object. With the air removed, those observations support a downward gravitational force from Earth.**
4	Someone claims that touching or moving air caused all the motion. Use evidence from two different stations to challenge that claim, and name each field force.	**The steel ball rolled toward the magnet despite a gap and no one blowing on it, supporting a magnetic force. The sphere sped up while falling through a chamber with no air, supporting a gravitational force.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I claim that a charged balloon can exert an electric force on water across a gap. I would bring the charged balloon near a thin stream without touching it and predict that the stream would bend toward the balloon. I would repeat the test with an uncharged balloon held in the same place and predict little or no bending. A bend only near the charged balloon would support the claim because the stream changes direction without contact.

Accept arguments that connect an observed change in motion across a gap to a named field force and use a relevant comparison or control. The observations support the claims; students need not present them as absolute proof.