Forces Across Space

Use evidence to test invisible pushes and pulls.

MS-PS2-5 "Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline observations that show a force without contact, circle fair-test choices, and number each weakness or improvement in the investigation design.

Testing Invisible Interactions

(1) Two bar magnets rested on smooth foam trays several centimeters apart. When Maya released one tray, it slid toward the other magnet before the magnets touched. She repeated the trial after turning one magnet around. This time, the tray moved away. The changing motion was evidence of a force acting across the empty space. Scientists describe the region around a magnet where it can push or pull another magnet as a magnetic field. The magnets did not need contact, but the moving tray made the field's effect observable.

(2) To make the comparison fair, Maya used the same two magnets, the same trays, and the same starting distance in both trials. She placed the trays on a level table and released the moving tray without pushing it. These choices reduced other causes of motion, such as a slope or a different starting position. However, the investigation had a weakness. Maya watched the distance by eye and ran only one trial for each magnet position. Measuring the starting distance and repeating each setup would make the evidence more dependable.

(3) A second group investigated electric fields with two lightweight pith balls. They gave both balls the same kind of electric charge by touching each ball with the same charged object. The pith balls moved apart while hanging without touching. The group compared this result with uncharged pith balls placed at the same distance. The uncharged balls did not move apart. This comparison supported the claim that charged objects can exert forces through an electric field. A careful design also keeps objects, distance, and the method of charging as similar as possible.

2 ANSWER WITH EVIDENCE

Use the passage

1. What observation from Maya's magnet investigation is evidence that a force acted without contact?

2. Why did Maya use a level table and release the tray without pushing it?

3. Name one weakness in Maya's design and the matching improvement suggested in the passage.

4. How did the uncharged pith balls serve as a comparison, and what did their result support?

3 YOUR TURN

Your own words

In 4 to 6 sentences, plan a qualitative investigation of a magnetic or electric field. Include the objects, a no-contact observation you will record, a comparison, two factors you will keep the same, and one limitation with an improvement. Then conduct a supported magnetic-field investigation with a teacher-provided compass, bar magnet, nonmetal ruler and paper. Fix the compass position on a level nonmetal table; mark its resting direction with the magnet well away. Place the magnet beside it with a measured 10 cm gap, without contact, and draw the new needle direction. Reverse the magnet at the same gap and draw the direction again, then remove it and record the resting direction. Repeat this full sequence three times, keeping positions, compass and table unchanged. On separate paper make a three-trial table with absent, present, reversed and removed columns. Compare actual observations, explain whether they support a noncontact magnetic-field effect, and evaluate one limitation with a specific improvement. Record weak or unclear results honestly; ask the teacher to check alignment rather than fill in expected turns.

ANSWER KEY

Forces Across Space

GRADES 6-8 · MS-PS2-5

PART 1 · READ AND MARK

Underline observations that show a force without contact, circle fair-test choices, and number each weakness or improvement in the investigation design. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	What observation from Maya's magnet investigation is evidence that a force acted without contact?	**The tray moved toward or away from the other magnet before the magnets touched.**
2	Why did Maya use a level table and release the tray without pushing it?	**These choices reduced other possible causes of motion, such as a slope or a push.**
3	Name one weakness in Maya's design and the matching improvement suggested in the passage.	**She watched the distance by eye; she should measure the starting distance. Also accept: she ran only one trial per position; repeat each setup.**
4	How did the uncharged pith balls serve as a comparison, and what did their result support?	**They did not move apart at the same distance, supporting the claim that charged objects exert forces through an electric field.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I will place a compass 10 centimeters from a bar magnet without letting them touch, then record how the needle turns. I will repeat the test with the magnet removed as a comparison. I will keep the same compass and the same starting location for each trial. If the needle turns only when the magnet is present, the motion will be evidence of a magnetic force acting through a field. A limitation is that I may judge the needle angle by eye, so I will photograph the compass or measure its angle. Completed work also needs three actual trial records for all four conditions. A repeatable needle-direction change while the magnet is separated from the compass, compared with its absent/removed readings, supports a magnetic-field effect. Background magnetic objects, initial alignment and imprecise direction sketches are possible limitations. Reversing the magnet need not produce a perfect 180° change because the needle responds to the combined fields.

Accept any accurate magnetic or electric investigation that uses observable motion or direction change without contact as evidence of a field. The design should include a meaningful comparison, controlled factors, and a reasonable limitation with an improvement. The 4–6 sentences apply to the original plan; require actual investigation records and evaluation in addition. Check that the fixed gap prevents contact and the removed-magnet comparison uses the same compass position. A compass is itself magnetic; changes in its orientation reveal a torque due to the surrounding field, not a quantitative force measurement. Do not demand a predetermined angle or treat an unclear result as success. Credit the alternate single-trial weakness and repetition improvement in question 3.