Forces Across Gaps

Use observations to explain fields and test an electromagnet.

8.12 "Use a model to identify factors affecting the strength of noncontact forces, including magnetic, gravitational, and electrical forces, and demonstrate that fields exist even though the objects are not in contact. a..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline one example each of magnetic, gravitational, and electrical forces acting across a gap. Circle factors that can change force strength, then number the building, comparison, and measurement steps in the electromagnet test.

What Moves Without a Touch?

1. At a museum, a compass needle turns as a magnet moves beneath a sheet of cardboard. The magnet never touches the compass, yet the needle responds. A magnetic field extends through the space around the magnet and passes through the cardboard. As the magnet moves farther away, the needle turns less, showing a weaker effect at the compass. Two magnets can also push apart without touching when like poles face each other. Their motion gives evidence of a field even when the space between them looks empty.

2. Space can carry other fields, too. Earth pulls a dropped ball downward through a gravitational field, even before the ball touches the ground. Objects with more mass exert stronger gravitational forces; increasing the distance between objects weakens the force. An inflated balloon rubbed on a sweater can attract tiny paper scraps without touching them. Rubbing transfers electric charge, and the balloon's electric field acts across the gap. More charge can make the electrical force stronger, while more distance makes it weaker. Unlike gravity, electrical forces can attract or repel.

3. A student builds an electromagnet by wrapping insulated wire around an iron nail and connecting the ends to a small battery. Current through the coil produces a magnetic field, and the nail helps concentrate it. The nail picks up steel paper clips while the circuit is closed, then releases them when it opens. More coil turns can make the electromagnet stronger. To test this, the student compares 20 and 40 turns, using the same nail and battery, and counts clips lifted. The battery is disconnected between trials.

2 ANSWER WITH EVIDENCE

Use the passage

1. What shows that the magnet's field reaches the compass through the cardboard? How does moving the magnet farther away change its effect?

2. Suppose Earth had more mass but the ball stayed the same distance away. How would the gravitational force change, and what shows that it acts without contact?

3. How could you change the balloon's charge or its distance from the paper scraps to strengthen its pull? What makes this a noncontact force?

4. Which coil in the passage should lift more clips, the one with 20 turns or 40 turns? Name two things kept the same, and explain why the clips drop when the circuit opens.

3 YOUR TURN

Your own words

Design a new test that compares an electromagnet with an iron nail core to one with a plastic drinking straw core. In one paragraph, describe how you would build and compare them fairly, predict which would lift more steel clips, and explain how you could show that a magnetic field acts without contact.

ANSWER KEY

Forces Across Gaps

GRADE 8 · 8.12

PART 1 · READ AND MARK

Underline one example each of magnetic, gravitational, and electrical forces acting across a gap. Circle factors that can change force strength, then number the building, comparison, and measurement steps in the electromagnet test. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	What shows that the magnet's field reaches the compass through the cardboard? How does moving the magnet farther away change its effect?	**The needle turns without touching the magnet. It turns less when the magnet is farther away, showing a weaker effect at the compass.**
2	Suppose Earth had more mass but the ball stayed the same distance away. How would the gravitational force change, and what shows that it acts without contact?	**The gravitational force would be stronger. Earth pulls the ball downward before it touches the ground.**
3	How could you change the balloon's charge or its distance from the paper scraps to strengthen its pull? What makes this a noncontact force?	**Increase the balloon's charge or move it closer to the scraps. The scraps can be attracted before the balloon touches them.**
4	Which coil in the passage should lift more clips, the one with 20 turns or 40 turns? Name two things kept the same, and explain why the clips drop when the circuit opens.	**The 40-turn coil should lift more clips. The nail and battery stay the same. Opening the circuit stops the current that produces the coil's magnetic field.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would wrap 30 turns of insulated wire around an iron nail and 30 turns around a plastic straw. I would connect each coil to the same small battery, one at a time, and test each for the same short time. I would count how many steel clips each can lift. I predict the nail coil will lift more because iron helps concentrate the magnetic field. I would also hold each coil just above one clip and watch for movement before contact. Motion across the gap would show that the magnetic field acts without touching.

Accept other fair plans that change only the core while keeping the coil turns, battery, and test method the same. Evidence of a field must involve a response before contact, not just clips sticking to the core.