Crane Force Test

Plan a fair test of an electromagnet.

MS-PS2-3 "Ask questions and design a plan to determine the factors that affect the strength of electric and magnetic forces. [Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the factor the team changes, circle what they measure, and number three things they keep the same to check whether the test is fair.

How Much Can the Crane Lift?

1. At the school makerspace, a team wants a small crane to lift steel paper clips. They wrap insulated copper wire around an iron nail and connect the wire to a battery. While electric current flows, the nail acts as an electromagnet and attracts the clips. When they disconnect the battery, the pull fades. The team wonders whether adding more turns of wire around the nail changes how strongly the crane pulls. A good test must show which change caused any difference they observe.

2. One student suggests building three coils with 20, 40, and 60 turns. For each coil, the team could count the greatest number of identical paper clips the nail can lift at once. Each coil should use the same kind of wire and the same kind of iron nail. The team should also use the same battery and connect each coil for the same short length of time. If they change the battery along with the number of turns, they cannot tell which change affected the pull.

3. Another student points out that a single lift might be unusual. A clip could slip, or a loose wire connection could interrupt the current. The team decides to make three lifts with each coil and record every clip count, not just the largest count. They will let the wire cool between lifts and disconnect the battery when they are not testing, because a connected coil can get hot. Comparing the repeated counts can help them decide whether the number of turns made a consistent difference.

2 ANSWER WITH EVIDENCE

Use the passage

1. Write a testable question that names what the team changes and what they measure.

2. Why should the team use the same battery for all three coils?

3. What should the team measure during each lift to compare the coils' magnetic pull?

4. Why should the team make three lifts with each coil and record every count?

3 YOUR TURN

Your own words

Plan a different test using one bar magnet, one paper clip, and a ruler to find out how distance affects magnetic pull. State a testable question, choose three distances, tell what you will keep the same and record, and explain how repeated trials will help you decide.

ANSWER KEY # Crane Force Test

GRADE 7 · MS-PS2-3

PART 1 · READ AND MARK

Underline the factor the team changes, circle what they measure, and number three things they keep the same to check whether the test is fair. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Write a testable question that names what the team changes and what they measure.	**How does the number of wire turns affect the number of paper clips the electromagnet can lift at once?**
2	Why should the team use the same battery for all three coils?	**If they also change the battery, they cannot tell whether the battery or the number of turns caused a difference in the pull.**
3	What should the team measure during each lift to compare the coils' magnetic pull?	**Count how many identical paper clips the nail can lift at once.**
4	Why should the team make three lifts with each coil and record every count?	**A clip might slip or a connection might come loose during one lift. Repeated counts help show whether a difference is consistent.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Does the distance from a bar magnet affect whether a paper clip moves toward it? I will place the same clip on the same marked spot and hold the same magnet still for three seconds at distances of 0.5, 1, and 2 centimeters from the clip. I will record whether the clip moves at each distance. I will repeat each distance three times. If the clip moves more often at shorter distances, that suggests the magnetic pull is stronger when the magnet is closer.

Accept test plans that change only distance, use the same magnet and clip, record an observable result, and repeat each distance. Movement shows whether the pull is strong enough to move the clip under those conditions.