Magnet on Demand

Build a magnet, then test what changes its strength.

8.12.a "Design and construct an electromagnet and modify the design to change its strength."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the steps that start or stop the current, circle two design features that can affect lifting strength, and number the steps used to compare turn counts. Use your marks to trace how each change affects the electromagnet.

A Magnet That Lets Go

1. At a school science fair, a team wants a magnet that can pick up steel washers but let go on command. They wrap insulated copper wire around a large iron bolt, keeping the coils close together. They remove the insulation from the two wire ends so metal can touch the battery contacts. One end goes to each contact of a single low-voltage battery. When the circuit is complete, electric current flows through the wire and makes the bolt magnetic. Disconnecting the battery stops the current, so the washers drop.

2. The team first winds 15 turns around the bolt and records how many identical washers it lifts. Next, they unwind the wire and wind 30 turns on the same bolt. They keep the battery, bolt, washer size, and test time the same. With enough current flowing, more turns can make a stronger magnetic field around an iron core. But a coil held against a battery for too long can heat the wire and drain the battery. The team disconnects the wire promptly after each test and lets it cool.

3. They also wonder whether the core matters. To test this, they build one coil around an iron bolt and another around a wooden dowel of the same size. Each coil has 30 tight turns of the same wire and uses the same battery. Iron becomes magnetized inside the coil and usually makes a much stronger electromagnet than wood. A loose connection can reduce current and weaken either device. The team checks connections before comparing washers lifted, changing only one feature at a time so the cause of any difference is clearer.

2 ANSWER WITH EVIDENCE

Use the passage

1. You have a wire-wrapped bolt and a battery, but insulation still covers both wire ends. What must you do to make the bolt magnetic, and why?

2. You want to find out whether changing from 15 to 30 turns changes how many washers the bolt lifts. Name two things you must keep the same, and explain why.

3. Two coils have 30 turns and use the same battery. One is wrapped around iron and the other around wood. Which should lift more washers, and why?

4. A bolt coil suddenly lifts fewer washers than it did earlier, although its design has not changed. What should the team check before rebuilding it, and how could that help?

3 YOUR TURN

Your own words

A museum needs a hand-held tool that lifts small steel screws from a narrow tray and releases them into a jar. In four sentences, describe how you would build and operate it, one design change you would try to make it lift more screws, and a fair test of that change.

Magnet on Demand

PART 1 · READ AND MARK

Underline the steps that start or stop the current, circle two design features that can affect lifting strength, and number the steps used to compare turn counts. Use your marks to trace how each change affects the electromagnet. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	You have a wire-wrapped bolt and a battery, but insulation still covers both wire ends. What must you do to make the bolt magnetic, and why?	**Remove the insulation from both ends and connect one end to each battery contact. This completes the circuit so current can flow.**
2	You want to find out whether changing from 15 to 30 turns changes how many washers the bolt lifts. Name two things you must keep the same, and explain why.	**Keep any two of these the same: battery, bolt, washer size, or test time. Then a difference in lifting is more likely to be caused by the number of turns.**
3	Two coils have 30 turns and use the same battery. One is wrapped around iron and the other around wood. Which should lift more washers, and why?	**The iron-core coil should lift more because the iron becomes magnetized inside the coil and strengthens the electromagnet.**
4	A bolt coil suddenly lifts fewer washers than it did earlier, although its design has not changed. What should the team check before rebuilding it, and how could that help?	**Check for a loose connection. Securing it can restore current through the coil and strengthen the electromagnet.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would wrap insulated copper wire tightly around a narrow iron bolt, expose the wire ends, and touch them to opposite contacts of one low-voltage battery only while lifting screws. I would disconnect the battery over the jar to release the screws. If the tool lifts only two screws, I would add more turns of wire to try to lift four. I would compare screws lifted before and after while keeping the bolt, battery, screw size, and contact time the same.

Accept a different workable change to the coil or core if the student explains how it could increase strength. The fair test should change only the chosen design feature and measure lifting in the same way each time.