



MAGNETS

SECTION 7-THE ELECTROMAGNET: INCREASING MAGNETIC FORCE

From *Hands on Science* by Linda Poore, 2003.

STANDARDS:

Students will conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

Students know electric currents produce magnetic fields and know how to build a simple electromagnet.

Students will follow a set of written instructions for a scientific investigation.

Students know the role of electromagnets in the construction of electric motors, electric generators, and simple devices such as doorbells and earphones.

MATERIALS:

For Each Pair:

rivet	coil
small steel disk (50?)	battery
worksheet (at the end of plans)	

NOTE:

Do not short the battery by holding wires on the battery for more than 30 seconds.
Each experiment is tried 3 times.

EXPLORE:

HOW CAN AN ELECTROMAGNET BE MADE STRONGER? CHANGING VARIABLES IN AN ELECTROMAGNET SYSTEM

[S, instructions][S, electromagnet]

1. Pass out materials and the worksheet at the end of this section.
Discuss the experiments and show how to wrap the coil around the rivet carefully. Demonstrate what 3 turns, 4 turns, and 5 turns around the rivet looks like. Tell the students to ask the teacher to make the coil turn 6 times.
2. Have students do each experiment 3 times and average results.

DISCUSS:

WHAT VARIABLES AFFECTED THE EXPERIMENT RESULTS?

[S, results] [S, electromagnet]

1. Discuss students' results and the variables affecting their results. Variables: disks were different sizes, the number of seconds the rivet was touching the disks, laying the rivet on its side rather than head down so both magnetic

poles can then attract the disks, strength of the battery, location of the coil on rivet (a coil pushed down close to the head of the rivet, near disk, is stronger.)

2. Have students list variables on their paper as they are discussed.

3. **MAKING A STRONGER ELECTROMAGNET**

Students could brainstorm and then try their ideas using the materials.

(see assessment answers below)

[S, electromagnet]

ASSESSMENT:

Have the students write (or draw) how they would make a strong electromagnet. (*answers:* 2 batteries, more turns of the coils, connect 2 coils together so you could make 12 turns, thicker nail in coil, 2 nails in coil, a thick bolt in the coil.)

ASSESSMENT:

GRAPH

Use the worksheet, *Graphing*

Evaluate students' ability to read a chart and graph information.

[S, graph]

RESEARCH:

HOW ARE ELECTROMAGNETS USED IN OUR LIVES?

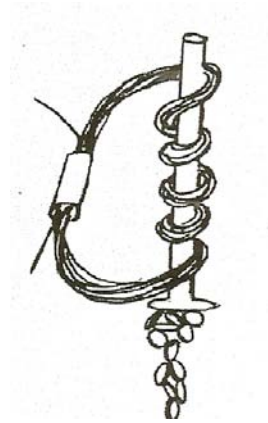
Use an encyclopedia, the Internet, or other resources to find the answer.

Examples: An electromagnet under the street makes the traffic light change when your car drives over it. Telephone earphones and audio speakers, buzzers and alarms use electromagnets to transform electrical energy to acoustic energy (sound). Electric motors use electromagnets to transform electrical energy to mechanical energy (motion). Electromagnets are used to read and write data on magnetic media, such as diskettes, tapes, credit cards, phone cards, motel card 'keys,' etc. *Xerox the information below for students to summarize.*

[S, electromagnet-uses]

TESTING THE ELCTROMAGNET

Make an electromagnet with your nail, coil, and battery and see how many disks you can pick up with it. Do not hold both wires from the coil on the battery for more than 10 seconds or you will ruin (short) the battery. How is the magnetic force affected by counting the number of disks picked up and recording answers.



Number of turns of the coil	Trial 1	Trial 2	Trial 3	Trial 4
3 turns				
4 turns				
5 turns				
6 turns				

CONCLUSION: How do you make an electromagnet stronger?

List the variables that affect the amount of disks you pick up

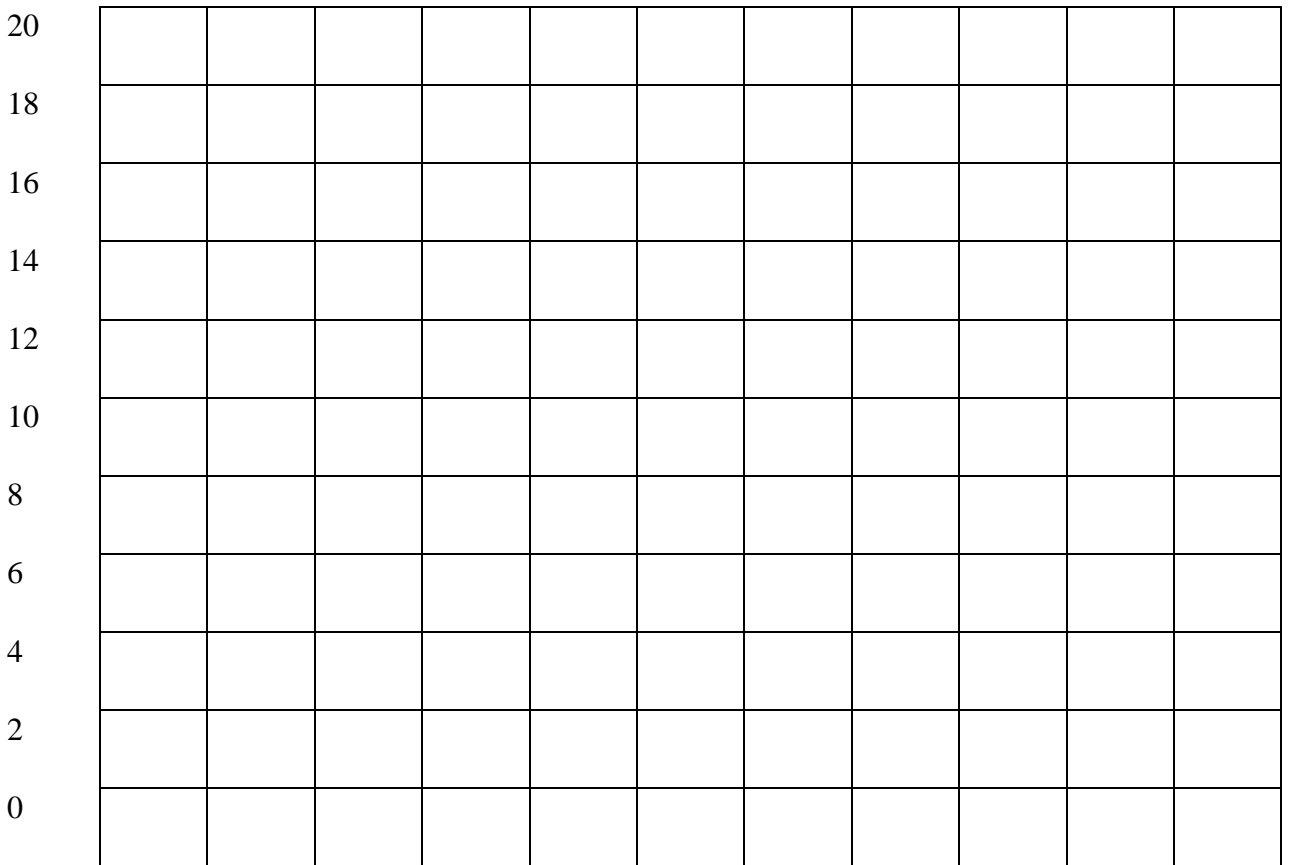
Draw an electromagnet:

GRAPHING

How many paper clips were picked up?

Graph the data on this chart. Number the horizontal axis.
Label the axes of the graph.

ELECTROMAGNET Number of turns of wire on the nail	Number of paper clips picked up
10	3
20	6
30	10
40	13
50	17



PREDICT: How many paper clips would be picked up if the electromagnet had 100 turns of the wire? I predict: _____ paper clips for 100 turns.

How does the number of turns of wire affect the strength of an electromagnet?
