SUMMARY:
Learners will explore electromagnetism.

GRADE LEVEL:
This activity has been used successfully with 1st to 3rd graders as well as college undergraduates.

TIME:
This activity takes approximately 45 minutes with 1st to 3rd graders. Depending on learners' prior experience this time may need to be extended or shortened.

SUBJECTS:
Physical Science (electromagnetism)

LEARNER BACKGROUND:
Learner should know how to make a simple circuit (Light Me Up activity) and what a magnet is (Stuck On Me activity).

LEARNING OBJECTIVES:
Completing this activity will allow learners to:
- ✓ understand how to turn certain metal objects into magnets
- ✓ understand how at magnets have two poles.

Discover Question:
Keeping your nail straight up and down, can you pick up a paper clip with just the tip of the nail?

Background:
This activity has learners explore how a to turn an object into a magnet.

A magnetic object may be turned into a magnet by placing another magnetic field close to it. The current in a wire creates a weak magnetic field that circles the wire. Wrapping the wire into a coil makes the magnetic field stronger along the axis of the coil (all the weak magnetic fields add up). The addition of a magnetic object, like an iron nail, down the axis of this coil then serves to further intensify this magnetic field.

Learners may be familiar with electromagnets and know that the wire needs to be wrapped around the nail. However, they may not know that they need to connect the wire to the battery. Learners will also find that a permanent magnet placed on the nail will also turn the nail into a magnet.

The educator needs to facilitate the sharing of observations and ideas. Try to avoid answering questions directly. Instead, ask questions like what have you tried? What do you notice? What else could you try? These types of questions encourage further exploration.

Materials:
- ❑ Each learner should receive a few paper clips and 30 inches of insulated wire. I use bell wire (18 or 20 gauge) that has been cut to 15 inch lengths.
- ❑ Each learner should also have
  - permanent magnet, a nail and a battery (C size works well)
  - additional objects may be useful (a few toothpicks and Q-tips some more metal objects like a penny, washer and aluminum foil).
  - ✓ If you have already done the Light Me Up and Stuck On Me activities then learners will already have these objects.
- ❑ Each group of four learners should have the following community supplies:
  - Masking tape, Markers, Paper, Scissors and extra Batteries

Resources and Handouts:
None needed.

Procedure:

1 You can introduce the activity any way that is appropriate for your class. I have told learners that I saw someone pick up paper clips using the tip of a nail (of course when I demo this it does not work). I then challenge learners to see if they can solve this puzzle and teach me how to pick up a paper clip.

2 Hand out wire and paper clips. If learners have completed the Light Me Up and Stuck On Me activities they should already have the additional supplies they need.

3 Ask questions that are open-ended "What have you tried?" "What else could you try?" "What do you notice about your objects?"

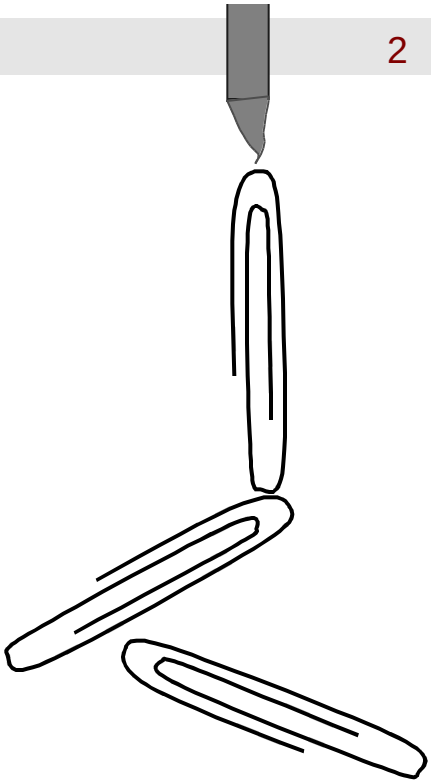
4 Once learners start having success encourage sharing of ideas (if needed). Encourage learners that have discovered one solution to the question to find other solutions.

5 How many paper clips can be picked up? How could you pick up more?

- ❑ Learners will find that increasing the current (i.e. larger voltage from more batteries in series) enables more paper clips to be picked up.
- ❑ Learners will find that adding more permanent magnets to the nail will enable more paper clips to picked up.

6 Can you use something besides the nail to pick up the paper clips?

- ❑ Use the list of magnetic and non-magnetic metal objects as a guide.



MODIFICATIONS/ ADAPTATIONS:

Older learners can be given a challenge of trying to design a circuit that would indicate when the electromagnet is on.

Younger learners (pre-K to 1st grade) may need to be shown an electromagnet that you have constructed.

7 Discuss any extensions learners may have explored and/or showcase anything that may have been created.

Safety Considerations:

- ❑ Drop any thing that gets hot! Then try again when it is cool.

Assessment Ideas:

- ❑ Can the learner make an electromagnet?
- ❑ Can the learner make the nail magnetic using the permanent magnet?

Internet Resource:

This is part of a NatureShift unit on electricity and magnetism that can culminate in controlling the Mars Rover telerobot.

The following sites are good and will give you more background information.

A little bit of history of the electromagnet:
http://k12.magnet.fsu.edu/FAQ/FAQ4.html
How an electromagnet works with diagrams:
http://www.howstuffworks.com/electromagnet1.htm
More fun stuff with electromagnets:
http://freeweb.pdq.net/headstrong/mag.htm

You may find that Ask Jeeves (http://www.askjeeves.com) is a good source of additional explanations and diagrams about electromagnets.

EXTENSIONS:

- ✓ Have the class construct a huge electromagnet.
- ✓ Have each student graph the number of paper clips picked up per additional battery (or magnet) used.
- ✓ Find pictures on the internet of huge electromagnets (try junk yards and hospital MRI machines).
- ✓ Take a trip to see an electromagnet. Hospitals, scientists as well as junk yards use them.

CREDITS:
Author
Steve Lindaas
lindaas@mnstate.edu