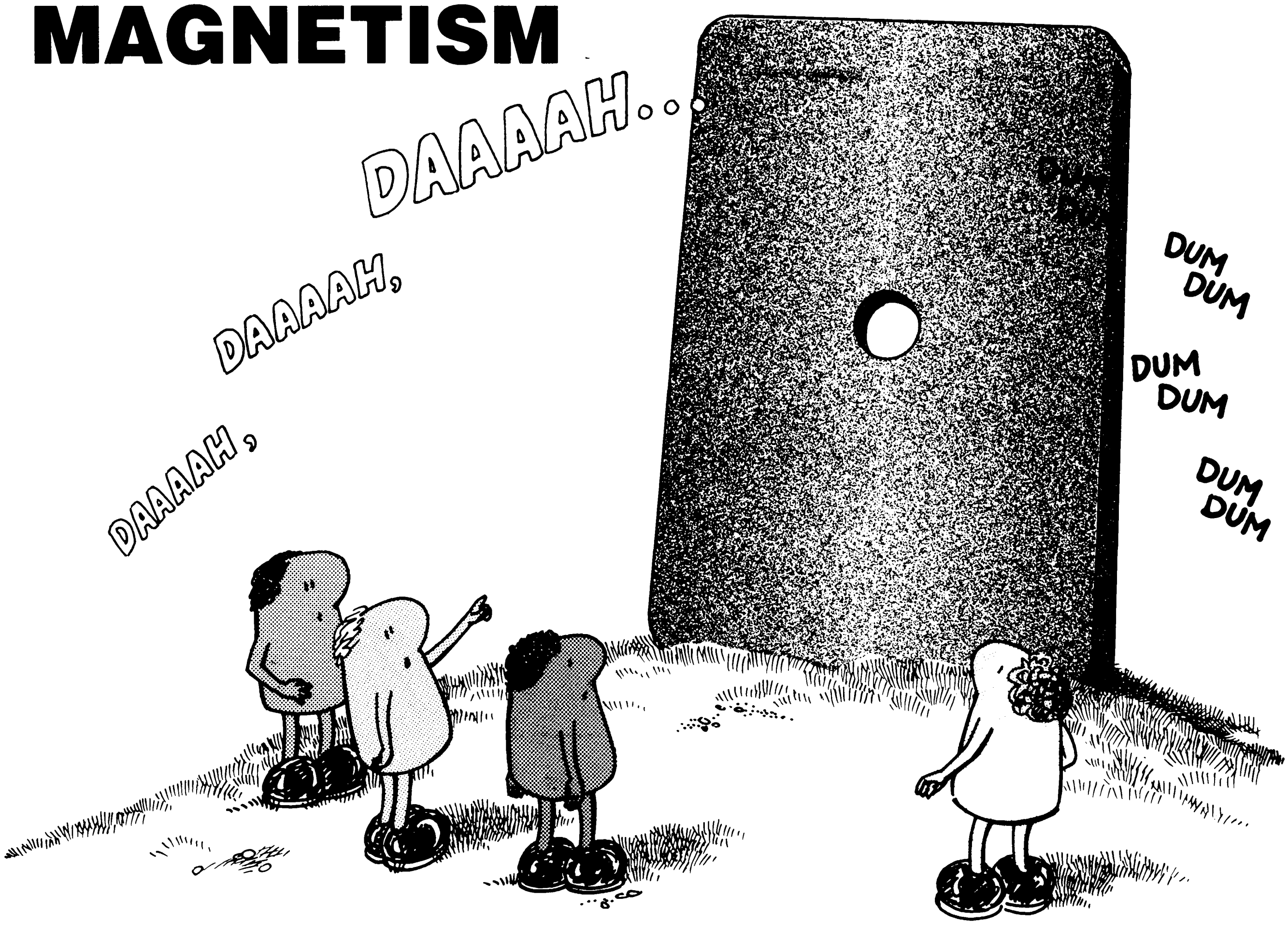
MAGNETISM



TASK CARD SERIES

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TOPS LEARNING SYSTEMS

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INTRODUCTION

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REPRODUCIBLE STUDENT TASK CARDS

Gathering Materials

Listed below is everything you'll need to teach this module. You already have many of these items. The rest are available from your supermarket, drugstore and hardware store. Laboratory supplies may be ordered through a science supply catalog. Hobby stores also carry basic science equipment.

Keep this classification key in mind as you review what's needed:

special in-a-box materials: Italic type suggests that these materials are unusual. Keep these specialty items in a separate box. After you finish teaching this module, label the box for storage and put it away, ready to use again the next time you teach this module.	general on-the-shelf materials: Normal type suggests that these materials are common. Keep these basics on shelves or in drawers that are readily accessible to your students. The next TOPS module you teach will likely utilize many of these same materials.
(substituted materials): Parentheses enclosing any item suggests a ready substitute. These alternatives may work just as well as the original, perhaps better. Don't be afraid to improvise, to make do with what you have.	*optional materials: An asterisk sets these items apart. They are nice to have, but you can easily live without them. They are probably not worth the extra trip, unless you are gathering other materials as well.

Everything is listed in order of first use. Start gathering at the top of this list and work down. Ask students to bring recycled items from home. The teaching notes may occasionally suggest additional student activity under the heading "Extensions." Materials for these optional experiments are listed neither here nor in the teaching notes. Read the extension itself to find out what new materials, if any, are required.

Needed quantities depend on how many students you have, how you organize them into activity groups, and how you teach. Decide which of these 3 estimates best applies to you, then adjust quantities up or down as necessary:

Q_1 / Q_2 / Q_3

- **Single Student:** Enough for 1 student to do all the experiments.
- **Individualized Approach:** Enough for 30 students informally working in 10 lab groups, all self-paced.
- **Traditional Approach:** Enough for 30 students, organized into 10 lab groups, all doing the same lesson.

KEY: *special in-a-box materials* (substituted materials) general on-the-shelf materials *optional materials

Q_1 / Q_2 / Q_3	
2/20/20	*rectangular ceramic magnets — see notes 1*
1/2/2	rolls masking tape
1/10/10	scissors
1/2/2	boxes paper clips
1/1/1	spool thread
2/20/20	wooden spring-type clothespins
3/20/30	baby food jars (small beakers)
1/6/10	meter sticks
5/50/50	blank index cards
10/100/100	steel (iron) straight pins
1/1/1	roll aluminum foil
1/6/10	marking pens — black or other dark color
10/100/100	meters thin insulated wrapping wire, 30-32 gauge — see notes 15
1/10/10	meters copper or aluminum wire, 20-24 gauge
1/4/10	medium-sized empty cans
1/4/10	wire cutters
1/4/10	candles and matches (alcohol lamps or Bunsen burners)
2/20/20	straight drinking straws
2/20/20	textbooks of equal thickness
1/2/5	exterior windows for tracing onto paper (light tables)
1/4/10	*rectangular pocket mirrors
1/1/1	roll clear tape
1/4/10	paper punches
.1/1/1	cup modeling clay
1/10 /10	size-D dry cells with magnetic outside casings
1/10/10	*large paper grocery bag (heavy wrapping paper)*
5/50/50	rubber bands - medium width or wider
2/10/20	large nails, about 3.5 inches or 9 cm long
50/200/500	washers, about 3/4 in. outside diameter, with central holes smaller than nail heads
1/10/10	*feet wood dowel, 3/16 inches in diameter — see notes 23*
2/20/20	thumbtacks
1/3/10	lab balances — those improvised in the TOPS module *Weighing 05* are suitable

Sequencing Task Cards

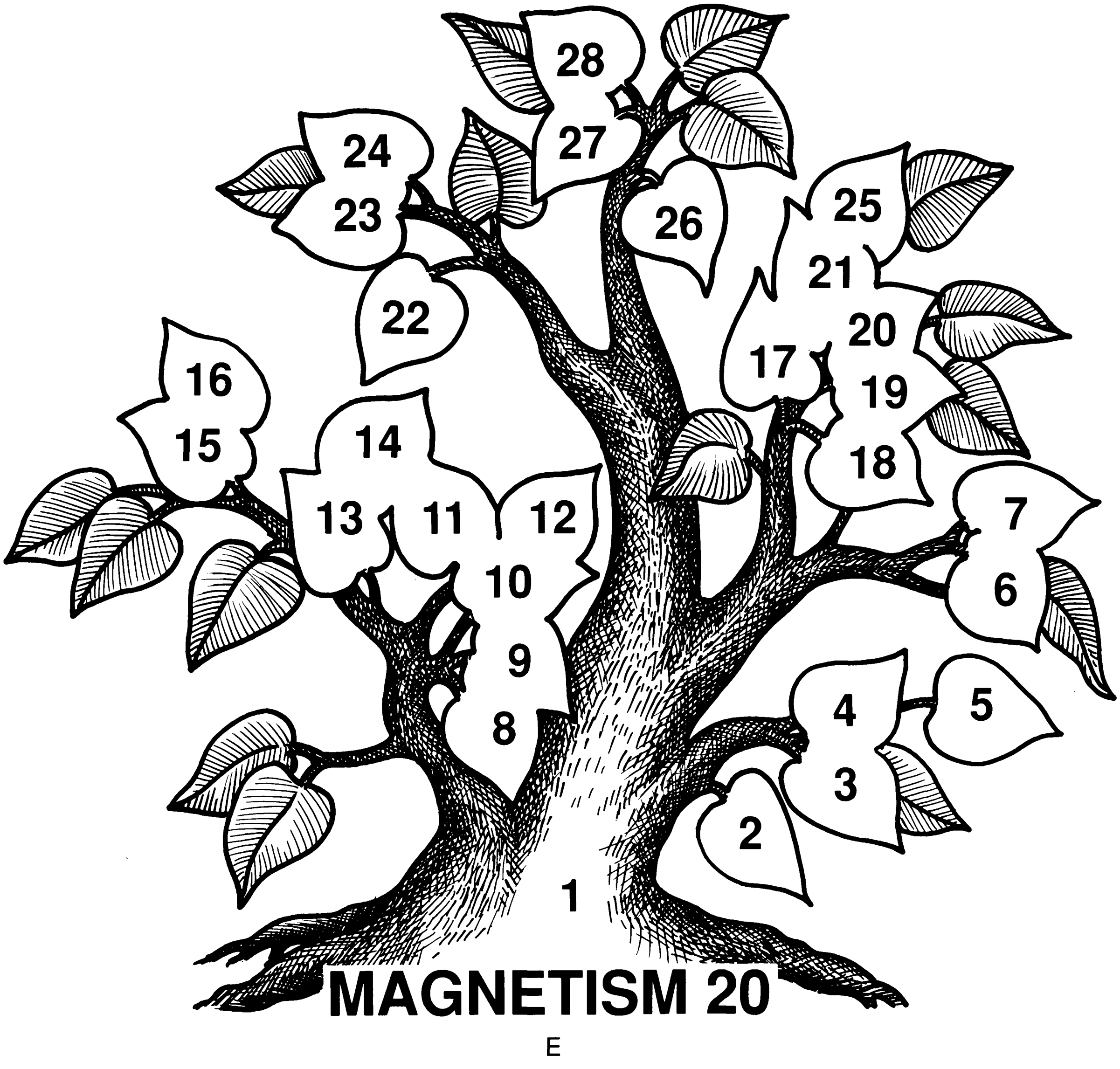
This logic tree shows how all the task cards in this module tie together. In general, students begin at the trunk of the tree and work up through the related branches. As the diagram suggests, the way to upper level activities leads up from lower level activities.

At the teacher's discretion, certain activities can be omitted or sequences changed to meet specific class needs. The only activities that must be completed in sequence are indicated by leaves that open *vertically* into the ones above them. In these cases the lower activity is a prerequisite to the upper.

When possible, students should complete the task cards in the same sequence as numbered. If time is short, however, or certain students need to catch up, you can use the logic tree to identify concept-related *horizontal* activities. Some of these might be omitted since they serve only to reinforce learned concepts rather than introduce new ones.

On the other hand, if students complete all the activities at a certain horizontal concept level, then experience difficulty at the next higher level, you might go back down the logic tree to have students repeat specific key activities for greater reinforcement.

For whatever reason, when you wish to make sequence changes, you'll find this logic tree a valuable reference. Parentheses in the upper right corner of each task card allow you total flexibility. They are left blank so you can pencil in sequence numbers of your own choosing.



Review / Test Questions

Photocopy the questions below. On a separate sheet of blank paper, cut and paste those boxes you want to use as test questions. Include questions of your own design, as well. Crowd all these questions onto a single page for students to answer on another paper, or leave space for student responses after each question, as you wish. Duplicate a class set and your custom-made test is ready to use. Use leftover questions as a review in preparation for the final exam.

task 1 A

You are starting a business that recycles scrap metals. How might a strong magnet help you do your job?

task 1 B

A pin floats on the surface of water with its head pointing north.

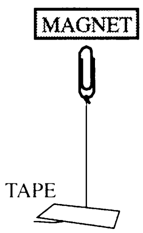
a. Draw this pin, labeling its north and south poles.

b. A second magnet repels the point of this pin. What magnetic pole is interacting with this pin point? Explain.

c. Is this pin made from aluminum?

task 2

A paper clip is tied to a thread, then held up in the air by a magnet like this:



a. Compare the relative strengths of the gravitational and magnetic fields acting on the paper clip. How could you prove your answer is correct?

b. Predict what happens if you place an index card in between without touching; a bottle cap.

task 2-3

A compass needle is acted upon by two fields of force that come from the earth.

a. Name them.

b. How might you demonstrate that each force field is present?

task 3,5

The head of a pin on an improvised compass doesn't seek north as it should. How should you remagnetize it so it does? Explain your reasoning.

task 4, 13

Sketch the earth's globe. Locate and label its equator, its north and south geographic poles, its north and south magnetic poles.

task 4,14 A

a. Where on Earth does a compass needle point to true geographic north?

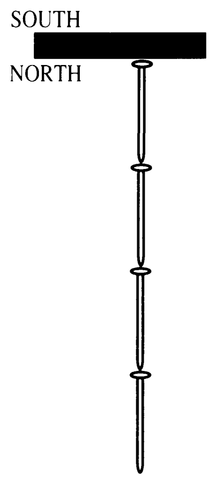
b. How is it possible to find true geographic north at other locations? Illustrate your answer with an example.

task 4, 14 B

Why are opposite magnetic and geographic poles paired together in the same hemisphere?

task 3, 5

Label both magnetic poles of each pin on this chain. Explain how to make this chain as long as possible.



task 6-7 A

You are given three pins that all look the same. How could you use your compass to determine which pin is...

a. an iron magnet?

b. made from iron, but not magnetized?

c. made from aluminum?

task 6-7 B

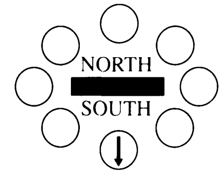
A permanent magnet is melted and then cooled into its original shape. Will it still be magnetic? Explain.

task 6-7 C

Explain how to magnetize a pin so it develops a south pole at both ends. Label *all* its poles.

task 8-10

A compass needle aligns itself with the south pole of a magnet as shown. Fill in the needles on all the other compasses.



task 8-12 A

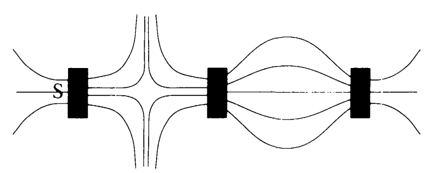
Sketch in the force field surrounding this magnet. Use arrows to indicate which direction the lines of force are said to move.

task 8-12 B

Sketch in the force field for 3 magnets arranged like this. Use arrows to show its direction.

task 8-12 C

Label the other 5 poles not shown.



task 11, 14

Draw a 2-dimensional view of the magnetic field surrounding...

a. a permanent magnet.

b. Earth.

task 13-14

The head of a pin is magnetized north, then mounted to pivot vertically rather than horizontally. How could you use this instrument to locate Earth's magnetic poles?

Review / Test Questions (continued)

task 15-17 A

a. How would you use insulated wire and a compass to improvise a galvanometer?
b. Does your galvanometer work equally well in any orientation?

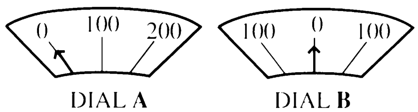
task 15-17 B

What is the 3-dimensional shape of the magnetic field when electricity flows…

a. through a coil?
b. through a straight wire?

task 17

Which is the best dial to use on a galvanometer? Why?

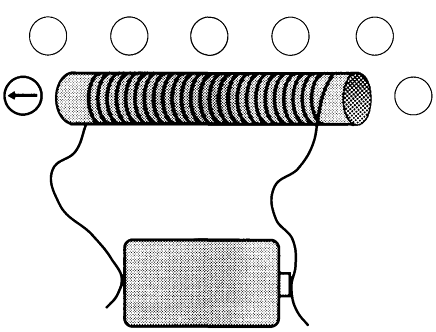


task 18

A junk yard operator moves iron objects with an electromagnet attached to a crane. Could he do his job using a powerful permanent magnet instead? Explain.

task 19 A

A compass needle aligns itself with a solenoid like this:



a. Draw in the correct needle positions for the other compasses.
b. What happens if you switch the leads?

task 19 B

Using insulated wire, a dry cell, your pencil and nothing else, explain how to magnetize a pin.

task 18-19

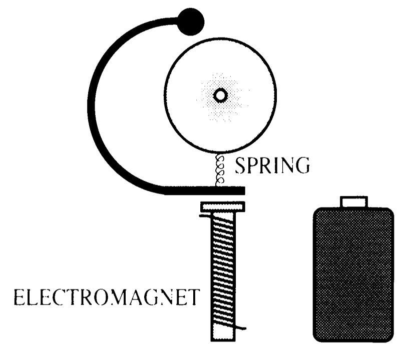
Compare and contrast an electromagnet with a solenoid.

task 20

What must you add to an electromagnet to make a telegraph? Explain.

task 21

Add lines to this drawing to show how you would wire the bell to make it ring.



task 20-21

A buzzer works like a telegraph, with one essential difference. Explain.

task 22-24

a. Identify the basic parts of your reverse-pole motor.
b. Does your on-off motor contain all these parts as well? Explain.

task 23-24

Pull apart a motor and you'll discover a permanent magnet, an armature, a commutator and brushes. How do these parts work together when connected to a dry cell?

task 25 A

There is a power failure during a basketball game. Even as the light fades away, another set of battery-operated emergency lights switch on. Nobody panics. Was an alert employee standing by, or what?

task 25 B

What different parts make up a relay switch? What does it do?

task 26 A

A generator can be thought of as a backward motor. Explain.

task 26 B

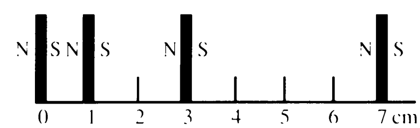
Using only a magnet and a copper ring, explain how to generate electricity.

task 27-28 A

How is the force between magnets related to the distance between their poles?

task 27-28 B

Identical magnets are glued, on center, to a centimeter ruler at these intervals. Unlike poles face each other so each magnet attracts its neighbor.



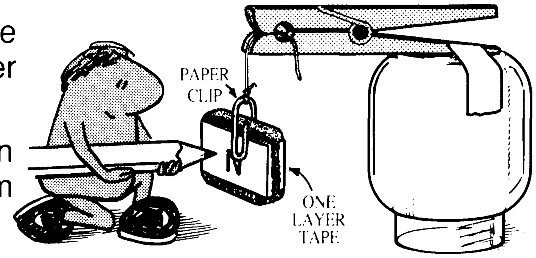
a. If the force of attraction between the magnets at 0 and 1 cm is f, what is the force between magnets at 1 and 3 cm? Between magnets at 3 and 7 cm?
b. Use the inverse square law to show that your answers are correct.

Task Objective (TO) identify and label magnetic poles. To observe how magnets characteristically interact with each other, and with a variety of classroom objects.

THE BASICS ○ Magnetism ( )

1. Wrap a single strip of masking tape around a magnet. Hang it from a paper clip tied to a thread.

2. Tape *one* wing of a clothespin to an inverted jar. Suspend your magnet from the overhanging clothespin.



3. Slowly turn the jar while observing the magnet.
   a. Write a large "N" on the side of the magnet that always seeks north.
   b. Write a large "S" on the side that always seeks south.

4. Tape and label a second magnet as you did the first.

5. Hold the magnets close together. Summarize how their poles interact.

6. List objects in your room that are magnetic (attracted by a magnet) and nonmagnetic (not attracted by a magnet).
   a. What do magnetic materials have in common?
   b. Are all metals magnetic? Support your answer with examples.

 1

Answers / Notes

4. *At the end of this activity, collect all magnets and arrange them in one long row. All the north (or south) poles will point in the same direction, allowing easy identification of any mislabeled magnets.*

5. Like poles repel: south repels south and north repels north. Unlike poles attract: south attract north and north attracts south.

6.

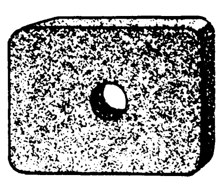
MAGNETIC	NONMAGNETIC
scissors	glass bottle
paper clip	aluminum foil
clothespin spring	wood on a clothespin
pin	copper wire
door knob	rubber band
nail	blackboard chalk

6a. All magnetic materials are made from iron. *Nickel and cobalt are also strongly magnetic (ferromagnetic), but not likely present in your classroom.*

6b. No. Aluminum and copper are both metals, yet nonmagnetic. *It has been shown with sensitive equipment that aluminum is very weakly attracted to a magnet (paramagnetic) and copper is very weakly repelled (diamagnetic). Such distinctions are beyond the scope of this module.*

Materials

☐ Ceramic magnets. These come in a variety of shapes and sizes. We recommend the kind illustrated, with a 3/16 inch central hole. Activities 27 and 28 require this hole. You may modify other experiments in this module to accommodate magnets with substantially different dimensions. Under *no* circumstances should you substitute traditional bar magnets. Order ceramic magnets through scientific supply outlets, from *Radio Shack*, from our *TOPS Ideas* catalog, or just write to us at the address on the title page and tell us how many you need. We recommend ordering 2 magnets per student or activity group. They cost $.20 each in 1991 US dollars, plus postage.

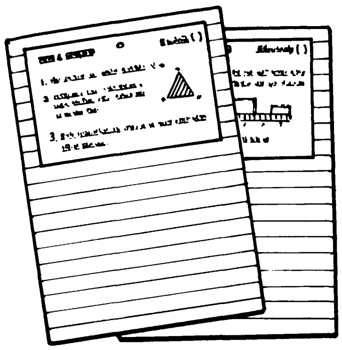


ACTUAL SIZE

☐ Masking tape.
☐ Scissors.
☐ A paper clip
☐ Thread.
☐ A clothespin.
☐ A baby food jar or small beaker.
☐ A meterstick with papers labeled "N" and "S" attached to each end. Suspend this from your ceiling so it properly indicates direction, like a giant compass needle.
☐ Objects to test for magnetism, including metal object made from iron (steel) as well as other elements. Most are probably already present in your classroom.

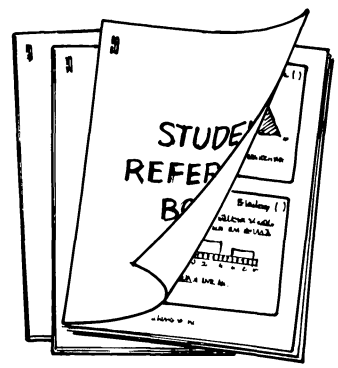
Task Cards Options

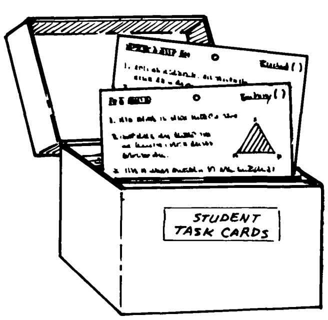
Here are 3 management options to consider before you photocopy:



1. Consumable Worksheets: Copy 1 complete set of task card pages. Cut out each card and fix it to a separate sheet of boldly lined paper. Duplicate a class set of each worksheet master you have made, 1 per student. Direct students to follow the task card instructions at the top of each page, then respond to questions in the lined space underneath.

2. Nonconsumable Reference Booklets: Copy and collate the 2-up task card pages in sequence. Make perhaps half as many sets as the students who will use them. Staple each set in the upper left corner, both front and back to prevent the outside pages from working loose. Tell students that these task card booklets are for reference only. They should use them as they would any textbook, responding to questions on their own papers, returning them unmarked and in good shape at the end of the module.





3. Nonconsumable Task Cards: Copy several sets of task card pages. Laminate them, if you wish, for extra durability, then cut out each card to display in your room. You might pin cards to bulletin boards; or punch out the holes and hang them from wall hooks (you can fashion hooks from paper clips and tape these to the wall); or fix cards to cereal boxes with paper fasteners, 4 to a box; or keep cards on designated reference tables. The important thing is to provide enough task card reference points about your classroom to avoid a jam of too many students at any one location. Two or 3 task card sets should accommodate everyone, since different students will use different cards at different times.

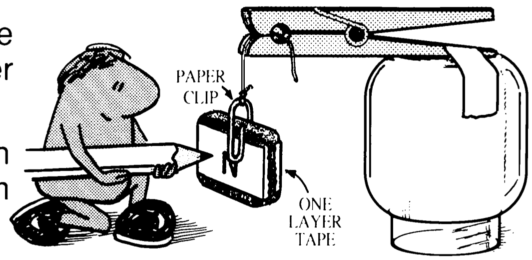
THE BASICS

O

Magnetism (   )

1. Wrap a single strip of masking tape around a magnet. Hang it from a paper clip tied to a thread.

2. Tape *one* wing of a clothespin to an inverted jar. Suspend your magnet from the overhanging clothespin.



3. Slowly turn the jar while observing the magnet.
   a. Write a large "N" on the side of the magnet that always seeks north.
   b. Write a large "S" on the side that always seeks south.

4. Tape and label a second magnet as you did the first.

5. Hold the magnets close together. Summarize how their poles interact.

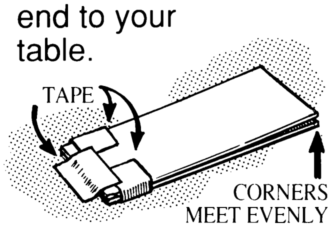
6. List objects in your room that are magnetic (attracted by a magnet) and nonmagnetic (not attracted by a magnet).
   a. What do magnetic materials have in common?
   b. Are all metals magnetic? Support your answer with examples.

FORCE FIELD

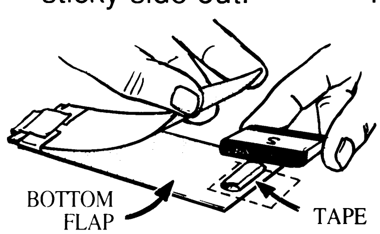
O

Magnetism (   )

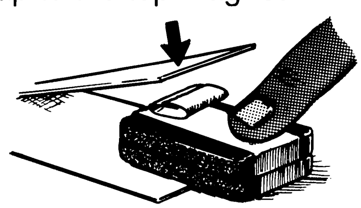
1. Cut a 4x6 index card in half the long way. Tape the strips together at two corners where shown, then tape that end to your table.



2. Attach a magnet to the center of the bottom open flap with masking tape rolled sticky side out.



3. Press your second magnet directly over the first so it *repels*. Use masking tape, as before, to attach the top flap to the top magnet.



4. Now release the top magnet so it comes to rest over the bottom one.
   a. Write your observations. b. Name 2 *force fields* that affect the top magnet.
   c. When you change the distance between the magnets, how does this affect the strength of the force field between them?
   d. Why does the top magnet oscillate up and down when you bump it?
   e. Does the magnetic force field affect all objects that enter it? Pass various test objects through it, then report your findings.