SCOPE, SEQUENCE, and COORDINATION

A National Curriculum Project for High School Science Education

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Student Materials

Learning Sequence Item:

945

Magnetism

March 1996

Adapted by: Bill G. Aldridge, John Craven, and Charles Hunter

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This micro-unit was adapted by: **Bill G. Aldridge** (SS&C Project Director)**,**
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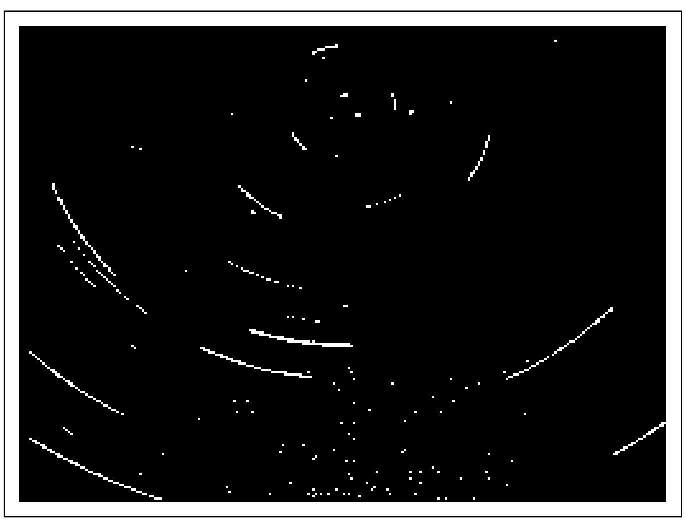
Science as Inquiry

Which Way Is North?

This activity must be done on a clear night. On such a clear night, with the stars in view, set up a camera on a tripod so that you can take a time-exposure picture of the night sky. You will need to aim the camera in several directions and take several pictures. Do this in such a way that you have pictures of the entire night sky, straight up and toward the horizon in increments of 90 degrees. The best pictures will be roughly two-hour time exposures, so you will need the right film speed and correct aperture for the light from the stars. This will require that you study your camera instructions carefully and that you learn more about photography.

For each picture taken, make a note of which way you have the camera facing relative to some arbitrary horizontal line that you draw. This could be expressed as a certain number of degrees from that line. If you can make this observation yourself, you will find it is very interesting. If you are careful, one of your photographs of the night sky will look like that shown below. If you do not have a camera, just observe the pattern of stars in the night sky. Draw your own pictures of certain patterns you can make out and watch those patterns of stars over an hour or two.

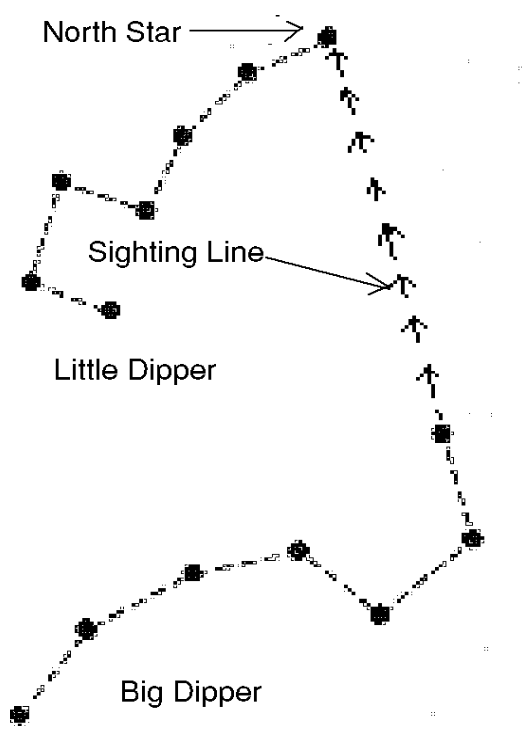


1. What do the small bright arcs represent?

2. Where is the place around which these arcs are centered?

3. What is the direction on your horizontal line corresponding to this photograph called? What do we call this star?

4. What does your sketch of the night sky for that photograph show? Many others over the course of history have observed what you photographed. They simply watched for several hours and saw the pattern of stars making circles around the one central star. What they saw looked like the following:



5. You should now go outside on a clear night and watch the Big Dipper and Little Dipper over several hours. What do they appear to do?

6. As long as it was a clear night, ancient people could navigate on the seas by knowing the time and watching the stars. Why did they have to know the time? If they knew where they were, could they tell the time from the stars?

7. This way of finding North is fine in the Northern Hemisphere. But what if you live in the Southern Hemisphere? How did ancient mariners navigate by the stars in that hemisphere? How did they determine the direction, South? Have you ever heard of the *Southern Cross*?

Science as Inquiry

A Strange Rock

You have probably seen, or even played around with, a lodestone. The peculiar properties of lodestones have been observed by humans for more than 2,000 years, from the time of the ancient Greeks. Nevertheless, you can always learn more by careful observation. In this experiment, you should examine a lodestone (now given the name *magnetite*) to gain a better understanding of what it does.

Using the piece of lodestone provided by your teacher, make several observations, and do so in terms of the following questions:

1. What kinds of material does the lodestone attract and what kinds does it appear not to attract? What are their properties?

2. Are there locations on the lodestone that attract better than other locations? If so, try to identify how many such places there are.

3. Does the force exerted by the lodestone pass through some materials but not through others? To find out, you will need to place thin sheets of those materials between the lodestone and something that it is attracting.

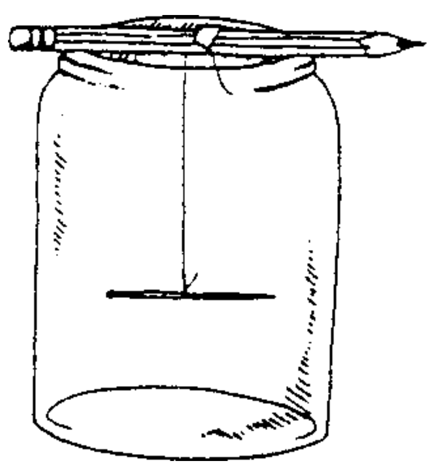
4. What happens when you place the end of a steel needle against one of the strongest places on a lodestone and drag the needle along that spot, repeating this stroking motion, but always dragging it in the same direction? How do the ends of the needle interact with small bits of iron or small paper clips?

Science as Inquiry

The Swinging Needle

Tie a magnetized steel needle to a sewing thread. Lay a pencil across the opening of a jar and tape the free end of the thread to it, allowing the magnetized needle to swing freely. Place the jar on a wooden or other nonmetallic table, and away from any metal material. What do you observe?

Rotate the pencil and see if you can get the needle to point in a different direction. What happens? Compare the direction of one end of this needle with the direction of the North Star that you found in Activity 1.



1. What do we call the end of the magnetized needle that points toward (seeks) north, as defined by the direction of the North Star? What do we call the other end of the magnetized needle? How would someone living in the Southern Hemisphere use this same experiment and their observations of the Southern Cross (Crux) to label a magnet?

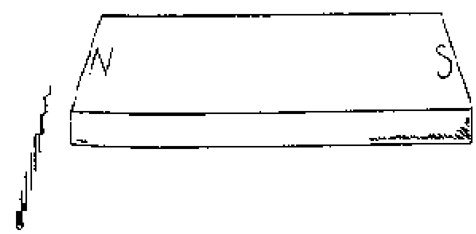
2. If you suspend a bar magnet by a thread tied at its middle point, what will it do?

3. You have seen bar magnets that have one end marked with an N and the other end marked with an S. What do these labels mean?

Science as Inquiry

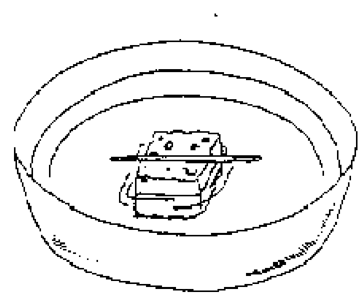
The Floating Needle

Stroke a steel needle along one end of a bar magnet several times. Place a small block of sponge in a water-filled bowl on a nonmetallic tabletop, and not near any metal objects. Then put the needle on the sponge as shown.



1. How is the floating needle oriented in the bowl? In which direction does it point?

2. Does the same end of the needle always end up pointing in the same direction? Why?



3. Describe how you could use the results of this observation to build yourself a device that would tell you which way is north if, in the daytime when you could not find the North Star (or the Southern Cross), you were out camping or hiking in a remote area or if you were boating on a large body of water where you could not see land. What do we call such a device?

Student Sheet

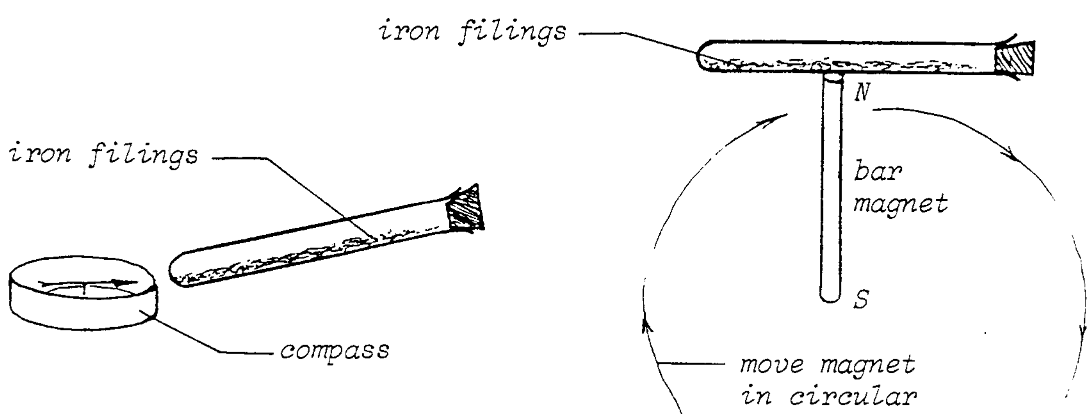
Science as Inquiry

Test Tube Magnet

Place some iron filings in a test tube, cork it, and shake the filings while holding the tube horizontally. Bring the end of the tube close to a magnetic compass. Is the compass needle attracted? Try the other end of the tube.

Now take the bar magnet and magnetize the iron filings in the test tube by stroking the bottom side of the horizontally held tube with one pole of the magnet in a circular motion (see sketch).

After stroking the tube with the magnet about five or six times, move each of the two ends of the tube near the compass. What do you observe?



1. Why is the compass needle attracted to the iron filings before the tube was magnetized?

2. Why does the stroking of the test tube have to be done with a circular motion? Will other patterns of strokes work?

3. How can we know whether the iron filings in the test tube are magnetized or not?

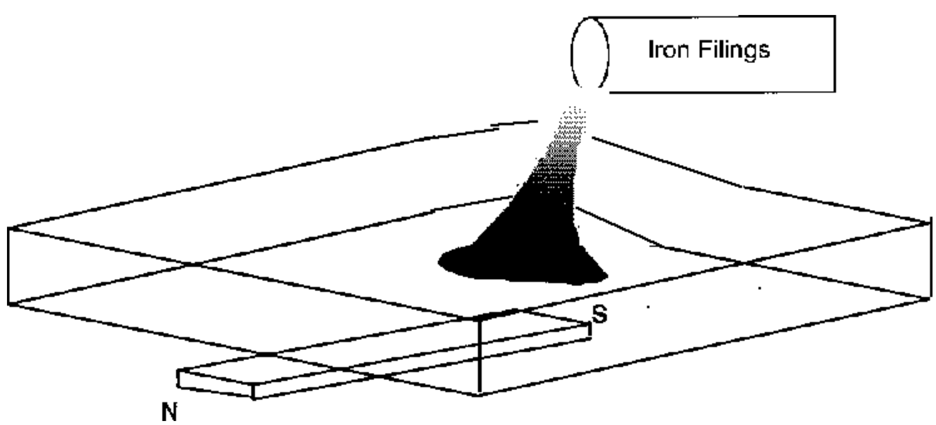
4. How would the compass needle behave if a regular bar magnet approached the compass?

5. What could we use if we did not have a magnetic compass?

Science as Inquiry

Invisible Lines of Force

Fold a large sheet of white paper with small flaps facing up around the perimeter. These flaps will help keep the iron filings in the "paper tray." Lay a magnet underneath the sheet of paper. Carefully pour iron filings onto the paper. Gently tap the paper sheet to equally disperse the iron filings and observe the pattern.



1. What pattern do the iron filings create when exposed to a magnetic field?

2. Are two poles always present in a magnetic field regardless of the magnet type (bar, horseshoe, electromagnet)?

Science as Inquiry

How Do Magnets Interact?

You have seen how a magnet can be made, and you understand now what we mean by the north and south poles of a magnet. What you have not yet investigated is how magnets interact with each other.

To carry out this investigation, you have been given two metal bars. First, see if each metal bar will attract bits of iron. If so, you know that they are both magnets. Now, suspend each magnet by thread tied around the middle of the bar, and observe which end aligns with north. Mark that end as N, and the other end as S. This can be done by writing on masking tape placed on the ends of each magnet. When you finish, leave the thread attached to each magnet so that you may suspend them again for another part of this investigation.

When you have determined in this way the poles of each magnet, you are ready to carry out an important investigation. You will be determining how magnets interact with each other. To do so, hold one magnet by the thread so that the magnet is suspended. Then bring the north pole of the other magnet near the north pole of the suspended magnet. What do you observe? Next bring the south pole of the magnet you are holding next to the south pole of the suspended magnet. What do you observe? Finally, bring the north pole of the magnet in your hand up close to the south pole of the suspended magnet. What do you observe now?

1. Based upon your observations, what rule can you create to describe how poles of magnets interact?

2. Suppose that you have two unmarked iron bars, and that at least one is a magnet. If you are given no magnetic materials, and you can only have the two bars interact with each other, describe how you would determine if these were both magnets, or if only one is a magnet, how you would determine which was the magnet.