BLOCKING THE FIELD

PLANNING YOUR EXPEDITION

Students at this point have an understanding that the shape of a magnetic field can be predicted by the size and shape of a magnet, and the arrangement of its poles. In experimenting with various magnets and objects that are attracted to them, students will also have found that magnetic properties go through things. For instance, in "Viewing a Magnetic Field," there was some discussion of this phenomenon, and students probably tested this by placing a piece of paper between two magnets or putting a paper clip on the desk and a magnet underneath to make the paper clip move around. In doing this activity, students will answer the question "Can you block the magnetic field of a magnet?"

This activity is best when used shortly after completing Expedition 3, "Viewing a Magnetic Field," but it could be used on its own. It is fun for students to use the magnetic marbles. Also, they will be exposed to yet another magnet shape. Introducing this activity with a discussion of the magnetic marble as a model of the Earth and predicting the shape of the field will tie in nicely with the previous Expedition, "Earth's Magnetosphere."

Up to this point the activities have been structured to provide basic information on magnetism and magnetic fields. Now it is time for students to extend their thinking to phenomena that are not easily observable. Science requires the use of models to help scientists, teachers, and students form theories about objects or phenomena that are too large or too abstract to see. Putting these into concrete form that can be manipulated aids us in using what we already know to help us understand what we do not know. It is important for students to understand that this is a real world strategy; for example, models of hurricanes and tornadoes help scientists determine how these storms are formed and why they form sometimes and not other times even though conditions seem to be the same. Other models that could be used to help students answer the question, "Why do we use models in science?" are maps and globes, solar system models that represent planet sizes and distances from the sun, and cross-sectional models that allow us to look "inside" of things.

1. Using a ruler with a groove in the middle, students will place a magnet at one end of the "track" and a magnetic marble at the other.
2. Slowly pushing the marble with a pencil or a wooden dowel, and stopping when the marble is attracted to the magnet, students will determine an average distance from the magnet that the marble travels before the attraction is felt.
3. Then, students will attempt to "block the field" by placing a number of items from around the classroom in the way of the magnetic marble. This will determine whether or not they are capable of blocking the magnetic field (or distorting it).
4. All observations, conclusions, and answers to questions will be written in the Alpha Log.
5. Students will discuss their findings with other students and keep a written record of the results of these conversations in their Logs.

BACKGROUND INFORMATION

Magnetic fields are treated separately from magnets and magnetism by scientists. The discovery of magnetic fields, by James Clerk Maxwell (and the fact that they had properties distinct from those of magnets) were based the work of Michael Faraday. Maxwell (1831-1879) linked the study of magnetic fields with that of electrical fields which became the basis for Field Theory. Field Theory states that fields can be mathematically manipulated and treated as separate entities. With this in mind, it is not necessary to know what is causing the magnetic field in order to study its effects. This theory, however, did not explain how forces can act at great distances and, until Richard Feynman proposed quantum electrodynamics (QED) in the 1950s (for which he won the Nobel Prize), it was the predominant theory in explaining magnetic fields.

The magnetic field lines that your students are producing with iron filings in the magnetic field viewer illustrate that magnetic field lines are one way of determining how strong a field is being generated. The closer lines are, the stronger the magnetic field is; the further apart, the weaker the magnetis field is. Scientists use lines in many ways (see Excursions) and this can help you incorporate other facets of science instruction.

EXCURSIONS

Richard Feynman is an interesting biographical study for students. His influence transcended science and his many and varied interests demonstrate for students that scientists are not one-dimensional characters in lab coats working with test tubes in a sterile environment. Students could create a timeline of Feynman's accomplishments; could role-play an incident from Feynman's life; or could create a poster after researching his life on the worldwide web or in print media. There are several biographies, three autobiographical works currently in print, and CDs of some of his Cal Tech lectures available.

SC.D.2.3.1, SC.H.1.3.1-3, 6-7, 3.3.5-6

LA.A.2.3.5-7, LA.B.2.3.4, LA.D.2.3.2-5

SS.A.1.3.1-2

Lines are used to display a great variety of scientific information. Isobars (lines that connect areas of equal barometric pressure), isotherms (lines that connect areas of equal temperature), contour lines (that connect areas of equal elevation), and magnetic field lines are examples. How close or far apart these lines are represent important information to meteorologists, map makers, geologists, and physicists. Students could investigate the use of lines by obtaining sample maps from various sources that are then shared with the class. (The U.S. Geological Survey, local weather stations or television meteorology departments, the public library, university departments, and departments of transportation are some sources.)

SC.H.2.3.1

MA.A.1.3.1, 3-4, MA.E.1.3.1, 3

SS.B.1.3.1

FOR YOUR PLANBOOK: Blocking the Field

Suggested Time: 1 hour

Gear: ruler (with groove down the middle), magnetic marbles, wooden stick (or pencil), Alpha Log, other items from around the classroom

National Science Content Standards: A, B, D, E, G

Sunshine State Standards Benchmarks: SC.A.2.3.1, SC.A.2.3.2, SC.B.1.3.6, SC.B.2.3.2, SC.C.1.3.2, SC.C.2.3.1, SC.C.2.3.3, SC.C.2.3.4, SC.C.2.3.5, SC.C.2.3.6, SC.H.1.3.1, SC.H.1.3.2, SC.H.1.3.4., SC.H.1.3.5, SC.H.1.3.7, SC.H.3.3.4, SC.H.3.3.5, SC.H.3.3.6, SC.H.3.3.7

Sunshine State Standards Benchmarks—Math: MA.A.3.3.2, MA.A.3.3.3, MA.B.4.3.2, MA.E.1.3.3

Sunshine State Standards Benchmarks—Language Arts: LA.A.2.3.2, LA.A.2.3.4, LA.A.2.3.5, LA.A.2.3.6, LA.B.1.3.2, LA.B.1.3.3, LA.B.2.3.3, LA.E.2.3.8

Assessment: Check Alpha Logs for evidence of student conversations that include statements about whether or not it is possible to block a magnetic field. If students' comments reflect the fact that they are speaking of "fields" as phenomena apart from magnets, this will indicate a great deal of sophistication in their knowledge of magnets and magnetism. This is the level of understanding you want your students to reach.

Have students answer the following questions: Did any of your tests of classroom objects indicate that you had changed the shape of the field? If so, how did you test this? If not, how could we test for this? In answering these questions, students will indicate that they can use information from their Logs to form hypotheses and use the data that they have collected to support them. Answers will also demonstrate students' knowledge of variables and manipulating variables.

As a large group brainstorm models that are used in science and in the classroom. Then have students use the information from the brainstorming session to create a concept map, cluster, or other visual tool to display what they have learned about models. These should indicate that students are able to distinguish between models used to explain an abstract idea (for instance, the protons, electrons, and neutrons in an atom) and models that are created to understand something that is otherwise too large to observe (solar system model, ocean floor model).

BLOCKING THE FIELD

Itinerary

Magnetic fields are treated separately from magnets and magnetism by scientists. The discovery, by James Clerk Maxwell, of magnetic fields and the fact that they had properties distinct from those of magnets were based on the work of Michael Faraday. Maxwell (1831-1879) linked the study of magnetic fields to that of electrical fields.

This activity will be a fun way to "see" if you can block the magnetic field of a magnet. You will have the opportunity to investigate a magnetic field to see if placing different objects in a field will block it.

1. The Materials Manager should collect the following: a ruler with a groove in the middle, one magnetic marble, magnets, a piece of paper, a wooden dowel or pencil. Other items that you will identify later can be found in and around your classroom. All students should have Alpha Logs to record work.
2. Place the ruler on the table on top of the paper. Put the magnet on one end of the ruler and a magnetic marble on the other end of the "track."
3. Slowly push the marble with a wooden dowel or a pencil along the track until it is attracted by the magnet. Mark this distance on the paper and record it in your Log.
4. Repeat this five times. Record the distance measurement for each of the five trials. Find the average distance and record it in your Log.
5. Try to block the magnetic field by testing five objects (one at a time) from around your classroom. Place an object in the groove of the ruler or across the ruler between the magnet and the point you determined to be the average distance in #4 above. Push the marble down the ruler and record where it now feels the attraction to the magnet. Record in your Log the results for each item that you use to try to block the magnetic field.
6. In your Log, answer the following questions: What happens to the magnetic field when you block it? Where does it go?
7. Discuss your results with another group of students and record this conversation in your

Alpha Log paying particular attention to areas where you disagree. If you disagree, find a

way to reach an understanding with which the whole group is satisfied. You may need to retest certain items or check the accuracy of your notes.

8. Answer the following in your Log: Does placing an object into the magnetic field of the magnet block or distort the field?