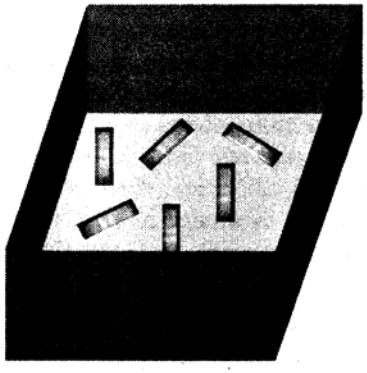
MAGNETISM IN SPACE

PLANNING YOUR EXPEDITION

You will need to prepare shoeboxes before assigning this activity. It will take only a short time if you accumulate small pieces of wood (pencils will do if necessary) and glue.

Directions for making the shoeboxes: In each box, create a pattern with the small pieces of wood. For instance, the pieces of wood could form a triangle or other shape or could just be placed randomly in the box (this would be best). You are not limited to the bottom of the box. Make this a challenge! Glue the wood pieces in place. Put a magnetic marble in the box. Cover the shoebox and tape the top down.

Your students are at a point where they can visualize magnetic fields so it is time to extend this to a larger perspective. Knowing that the same forces that exist on our planet exist elsewhere in the universe, students will begin to investigate things they cannot observe directly. This activity is more about thinking the way scientists do than it is about learning new content material.



Your students have probably asked you time and time again, "How do they know?" This is a difficult problem to tackle, but an introductory activity on indirect observation will help students understand that scientists can infer things and create theories based on the limited knowledge. The fact that we do not have that same depth of knowledge leaves us at a disadvantage, but knowing the process—the way a scientist thinks—might help some students.

How does this tie into space? We cannot see the magnetic field lines in space but because there is a direct relationship between electricity and magnetism, we can see stars, measure light waves, and theorize about black holes and the Big Bang theory of how the universe began.

Several "Excursions" have been used in previous activities. The deeper we get into our study of magnetism, the more interrelated the activities become. Both this activity and "Auroras, Moon Rocks, and Magnetism" deal with magnetic fields in space. The extension activities regarding the Sun are not only meaningful because they deal with a star the students can actually observe and experience, but because activity on the sun's surface affects our lives.

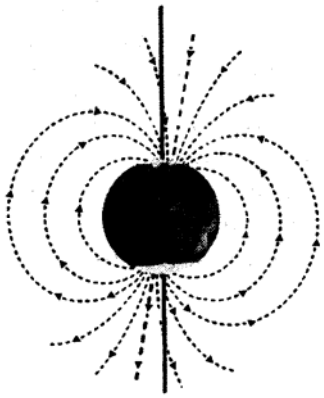
1. Discuss with students ways that we already use information that we know to help us figure out the answer to a question. For example, shaking a present to try to guess what's inside or looking at a puppy's paws to predict how large it will grow. If you know the weight of one object, you can compare it to another and make an estimate of the second object's weight.
2. Instruct students to try to figure out the pattern of the pieces of wood by rolling a magnetic marble around inside the box. By listening, feeling, and using what they know about magnets, they will draw what they think the pattern is, which they will then check by taking the cover off the box.
3. Once they have completed the activity, students will answer in their Alpha Logs some questions about other ways that they could have found the same information. Some examples may have to do with sticking things in the top of the box, shining a light through the box, changing the item in the box from a magnetic marble to something else.

BACKGROUND INFORMATION

Scientists have identified four basic forces in the universe: gravity, weak nuclear force, strong nuclear force, and electromagnetism. Weak nuclear force is a short-range force controlling the rate of radioactive decay. Strong nuclear force (binding energy) is also a short-range force exhibited in the nucleus of an atom. Gravity and electromagnetism are two forces that affect our everyday lives, and are more easily observable. Both can be experienced over enormous distances and exist throughout the universe.

Planets that are large enough to have liquid iron in the core will have magnetic fields. Jupiter, Uranus, and Neptune all have intense magnetic fields many times stronger than Earth's. Many stars also have magnetic fields, some up to a trillion gauss (see "Viewing a Magnetic Field" for a discussion of measuring a magnetic field). Astronomers at observatories can see these fields because of the way they affect light and radio waves that reach Earth. The Sun has a magnetic field of about 1 gauss that reverses every 11 years. Much of the Sun's magnetic force is contained in local magnetic fields caused by sunspots and solar flares.

Both Hidden Attraction by Gerrit L. Verschuur (ISBN 0-19-510655-5) and Driving Force By James D. Livingston (ISBN 0-674-21644-X) are good sources of information on this subject.



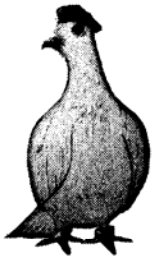
EXCURSIONS*

*Excursions and Standards are the same as in Expedition 11.

Students can investigate the Sun's layers, in particular the corona (the outer atmosphere). A detailed report of the corona will reveal the fact that it has recently been found to have many magnetic loops caused by the charged particles being unable to cross magnetic fields. Sunspots, which are commonly blamed for interrupting communications, are observable phenomena caused by magnetic fields. The Sun has a north and south pole which spin more slowly than the equator, because the Sun is rotating as a fluid, not a solid. The connection between Earth's magnetic poles and magnetic field is one that students should be able to make at this point. (One source of information on this subject is Odyssey magazine, June 1994. Back issues are available from Cobblestone Publishing, 1-800-821-0115.)

Investigate other atmospheric phenomena that are observable from Earth, such as "atmospheric elves" (thought to be caused by lightning pulsing upwards causing an electromagnetic charge above a storm cloud), or "atmospheric sprites" that have also been associated with storm clouds, and have students attempt to explain them. Students will be applying their knowledge of magnetism and magnetic fields to occurrences that *scientists* are still trying to explain. Their explanations will be no less important or correct.

Assign the short story "Bobo's Star" by Glenn Chandler, found in Science Fiction Stories by Edward Blishen (see Appendix C). In a large group discussion ask students if they can make any link between electromagnetism and light. Are



there any theories that back up their ideas (perhaps black holes)? A concept that students will find in this story is that science must be done responsibly because there is danger (implied and otherwise) in scientific experimentation. Student responses should indicate that they realize science is not done in isolation and that much of scientific inquiry affects many people in various ways.

Star Trek fans can explore magnetic confinement beams in the book The Physics of Star Trek by Lawrence M. Krauss. The link between science fiction and science fact is particularly strong here because a great deal of research has been done on Star Trek. Many of the ideas from the original Star Trek series have already come into everyday use (for example, cellular phones and space travel). Although there is much in the various Star Trek series and movies that is indisputably impossible, many of the technological advances are based on present scientific theory and fact.