AURORAS, MOON ROCKS, AND MAGNETISM

PLANNING THE EXPEDITION

For this activity you will need to gather articles on auroras or the use of moon rocks to study the composition of the moon and the earth. Good sources would be Earth , Science News, Smithsonian, Odyssey, Aviation Week & Space Technology, educational materials supplied by NASA or the Jet Propulsion Laboratory. Encyclopedia articles or explanations from reference books will work equally well.

Once students begin exploring magnetism, they will discover, as will you, that the study of magnets and magnetic fields leads to unexpected links with astronomy, astrogeology, meteorology, and geography. This activity explores two links which will hopefully lead to others. Even if some students are not particularly excited by this unit, there are many ways to connect to subjects that they *are* curious about.

As we look for different ways to engage students in the science classroom, creativity and flexibility become qualities that are vital for both teachers and the students they teach. No connection is too far afield if it makes sense to the person making that link. For example, it might not make sense to you at this point to talk about moon rocks while studying magnets, but some students could easily make the conceptual leap between the magnetic qualities of some moon rocks and theories as to how the moon became our satellite (see CD-ROM for more information on moon creation theories).

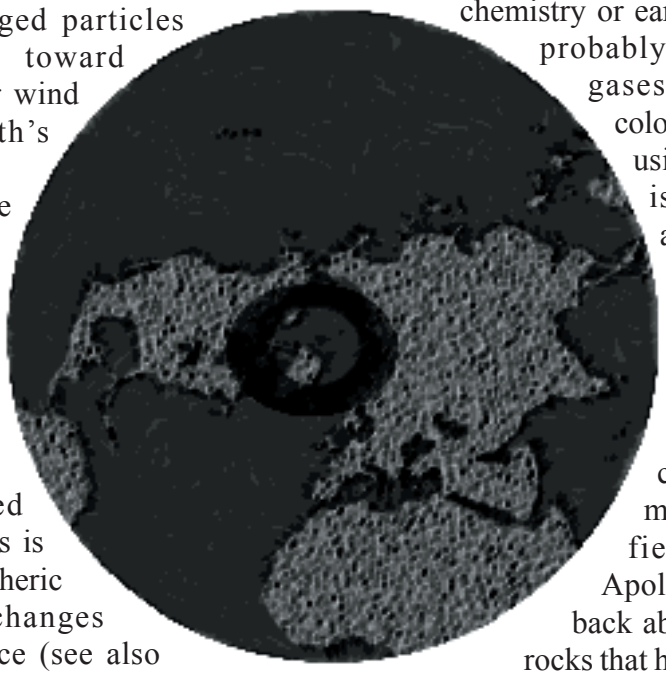
This activity is somewhat different than the others you have used. Rather than a hands-on exploration, it involves reading articles, gathering information, and applying that information to an assessment task of the student's choosing. It is a way for students to showcase their particular talents and utilize the learning style with which they are most comfortable.

Expository reading is required in all science classes but is not often approached separately. Instead, we assume that students can read a science textbook or a science article without providing them with the skills to do so. This activity will rectify this somewhat since you will be requiring the students to read critically several articles or to analyze information from web sites. You may choose to have students do this activity individually rather than in groups depending upon your resources. Whichever option you pick, students should share their information with others as a way of verifying the connections they have made.

1. Before beginning this activity, instruct students to write all they know in their Alpha Logs about auroras.
2. Using the worldwide web or other reference material, students will explore the phenomenon of auroras and/or moon rocks.
3. In their groups, or individually, students maintain a list of web sites visited and reference material consulted, indicating whether or not each is usable for them and indicating why or why not.
4. Hand out articles that you have copied and instruct students to read them for both the amount and quality of information they provide. Encourage students to highlight pertinent information.
5. Students will compare and contrast the use of the worldwide web and written articles. Making a table in their Alpha Logs, students will list advantages and disadvantages of each type of information.
6. Students will share their results with at least two others and answer questions that indicate that they have thought about why they may or may not agree with their classmates. This process indicates that they have critically reviewed the material.

BACKGROUND

Auroras (borealis in the northern hemisphere and australis in the southern hemisphere) are created by charged particles that are blown toward Earth by the solar wind (see "The Earth's Magnetosphere"). Because there is a direct link between auroras and magnetism, they occur only in ovals around the magnetic north and south poles. The area covered by the aurora ovals is affected by atmospheric conditions and changes at the sun's surface (see also "Excursions"). Auroras occur from 40-600 miles above the Earth, becoming most active when there are a lot of sunspots or solar flares.



The aurora borealis, sometimes called northern lights, changes color depending on the chemicals in atmospheric gases. This will make sense to students that have had chemistry or earth science. They are probably already aware that gases exhibit particular colors that can be observed using a spectroscope. It is, in effect, glowing air caused by charged particles from the sun passing through the Earth's magnetic field.

Another celestial connection to magnetism and magnetic fields is moon rocks. Apollo astronauts brought back about 380 kilograms of rocks that have been used to learn more about the moon and our own planet. That there is a small amount of magnetism present in moon rocks indicates, scientists think, an inner core similar for both bodies.

EXCURSIONS

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.)

SC.A.2.3.3, SC.B.1.3.1-6, 2.3.1, SC.C.2.3.1-3, SC.D.1.3.5, SC.E.1.3.1-4

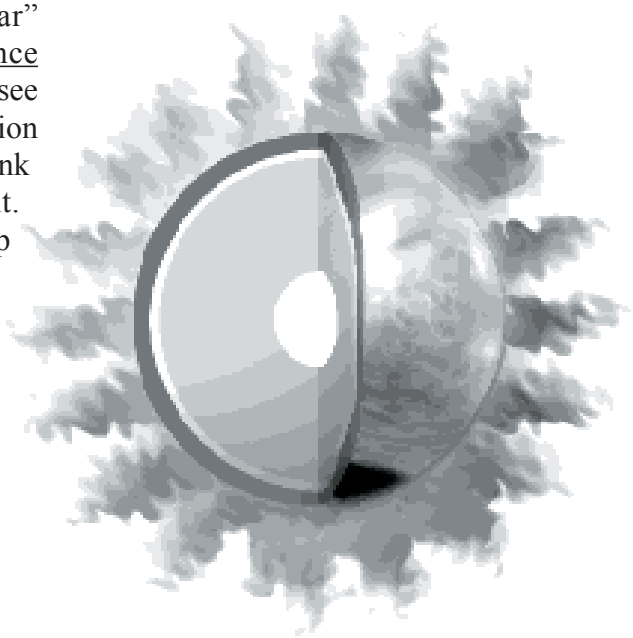
LA.A.2.3.1-8, LA.B.1.3.1-3, LA.D.2.3.1-2

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.

SC.B.1.3.1-6, SC.D.2.3.1-2, SC.E.1.3.1-4, 2.3.1, SC.H.2.3.1, 3.3.5-7

LA.A.2.3.1-8, LA.B.1.3.1-3, LA.E.2.3.1-4, 2.3.5-8

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 done 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.

SC.H.1.3.1-7, 3.3.5-7

LA.A.2.3.1-8, LA.E.2.3.5-8

Students write an article for the school newspaper, literary magazine, or local newspaper that aims at teaching others about the link between magnetism and either auroras or moon rocks (or both). Explaining the information in a clear and concise way requires a solid background. Teaching someone else about the information asks students to make sense of their own ideas.

SC.E.1.3.1-4

LA.A.1.3.1-4, 2.3.1-8, LA.B.1.3.1-3, LA.D.2.3.1-2, 2.3.3-7. LA.E.1.3.1-5

Explore Mike Davidson's National High Magnetic Field Laboratory (http://micro.magnet.fsu.edu).

The photomicroscopy technique that Davidson's group has perfecteduses an optical microscope to photograph slivers of moon rocks. Shavings of these rocks allows scientists to analyze the crystalline structure revealing a great deal about the composition of the moon and characteristics of its crust (including the small amount of magnetism in moon rocks).

SC.H.1.3.1-7

MA.C.1.3.1

LA.B.2.3.4

Investigate other atmospheric phenomena that are observable from Earth, such as "atmospheric elves" (thought to be caused by lightning pulsing upward 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.

SC.B.2.3.1, 1.3.1-6, SC.C.2.3.1-2, SC.D.1.3.5

FOR YOUR PLANBOOK: Auroras, Moon Rocks, and Magnetism

Suggested Time: 1-2 hours

Gear: articles on auroras or moon rocks, www access, Alpha Logs.

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

Sunshine State Standards Benchmarks: SC.B.1.3.3, SC.C.2.3.1, SC.E.1.3.2, SC.E.1.3.3, SC.E.1.3.4, SC.H.1.3.1, SC.H.1.3.2, SC.H.1.3.3, SC.H.1.3.4, SC.H.1.3.6, SC.H.3.3.1, SC.H.3.3.4, SC.H.3.3.6, SC.H.3.3.7

Sunshine State Standards Benchmarks -- Language Arts: LA.A.2.3.1, LA.A.2.3.2, LA.A.2.3.4, LA.A.2.3.5, LA.A.2.3.8, LA.B.2.3.1, LA.B.2.3.4

Homework: Have students respond in writing to the following statement: "Much of the information that we have about the Earth's magnetic field, auroras, the Sun's activity and relationship to Earth's magnetic field, the composition of moon rocks, and the Earth's layers comes from the space program. Many people believe that the United States would be better off spending money elsewhere like on welfare programs, defense, or education, instead of spending many billions of dollars on space shuttles and space probes (not to mention developing a space station, a moon colony, or manned Mars missions)." How do you feel about this issue? Do you support space program expenditures? Do you think this money could be better spent elsewhere? What might we be giving up if we shut down NASA?

Homework Assessment: The students' written answers should be well-thought out as evidenced by a logical sequence of opinion statements. Upper level students might contrast fact and opinion to support their stance. Helping students to articulate their opinions encourages critical thinking and problem solving. A reasonable objective in science class

is for students to become discerning consumers of information considering the rapid rate at which scientific discoveries are being made. Much of the research leading to these discoveries is funded by tax dollars. As responsible, participating citizens, hopefully students will make well-informed decisions based on their ability to distinguish between reliable and unreliable data.

Assessment:

Alpha Logs will include a description of what students already know about auroras or an educated guess. The list will be either confirmed or not at the end of the activity. To demonstrate that students are able to navigate the worldwide web, they will have a list of sites visited. Identifying the one site that they would recommend as one with the best information requires that they analyze the information for accuracy and determine whether or not it suits their needs or is appropriate for a middle school study of magnetism. In doing so, students demonstrate a knowledge of magnetism as it relates to other phenomena, as well as the ability to distinguish between usable and unusable information. Finally, a table listing advantages and disadvantages of information from the websites versus written articles will extend students' thinking to include not just the information itself but the *kind* of information and whether it is of use to middle school students.

Have students write their own myths about auroras, the beautifully colored sky lights. Myths were attempts by early cultures to understand and explain natural phenomena. Ask students to imagine that they have no science knowledge other than that gained by experiencing natural occurrences in their lives (e.g., rain, cold, stars, or eclipses). As students assume this role they are forced to put into words ideas, impressions, and theories about how things work. As long as the final written product is focused on the subject of auroras, because it is the student's own explanation, accept all reasonable stories.

Students can draw their conception of an aurora or, instead of writing a myth, they can choose to illustrate one. Drawings should indicate some kind of wave-like pattern and might show Earth's surface to orient the height of the aurora (which occur anywhere from 40-600 miles above the Earth).

Instruct students to prepare their data to share with the class. This can be in the form of a media presentation, a written or oral report, a reenactment of a myth about auroras, a reference list of sources for information about auroras or moon rocks, or a visual presentation (poster or drawing) that explains how either of these subjects relates to magnetism or Earth's magnetic field. Evidence of successful completion of this assignment would be that the product demonstrates knowledge of the shape of the Earth's magnetic field and how that shape is affected by activity on the Sun's surface; or knowledge that one of the reasons for studying the moon is to understand more about our own planet.

Notes:

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Itinerary

Auroras (borealis in the northern hemisphere and australis in the southern hemisphere) are created by charged particles that are blown toward Earth by the solar wind (see "The Earth's Magnetosphere"). Because there is a direct link between auroras and magnetism they occur only in ovals around the magnetic north and south poles. The area covered by the auroral ovals is affected by atmospheric conditions and changes at the sun's surface. Auroras occur from 40-600 miles above the Earth, becoming most active when there are a lot of sunspots or solar flares.

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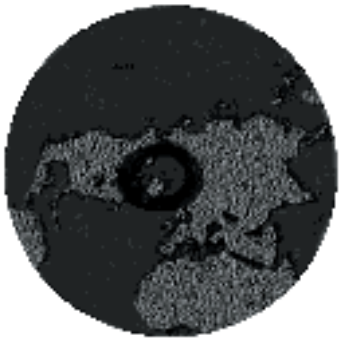

1. In your Alpha Log write everything you know about auroras. If this is the first time that you have even heard or seen the word, take an educated guess and record it in your Log.
2. Use the worldwide web to find and look at information about auroras or moon rocks (your choice). As you reach each site, record the location in your Log so that someone else can find it. Also make a note as to whether or not you think this is an appropriate site for use by middle school students and if you were able to use this information.

3. In your Log note the source (name of the newspaper or magazine, date, and page numbers) of each article that your teacher gives you. Read the articles and, with a highlighter, note the information that you would need if you were doing a research report. Again, in your Log indicate if this information is suitable (in your opinion) for middle school students and if it would be helpful in completing a research report. Another option would be to write an outline in your Alpha Log as you are reading the article. A third choice is to highlight and outline as you read.
4. Create a table in your Alpha Log that lists the different types of information you used and the advantages and disadvantages of each. Leave two columns, one for your opinion about suitability for middle school students and the other for your determination as to the value of the information for a research paper. Choose the one site or article that you found most useful and highlight it in your table.
5. Share what you have learned (your table and any notes that you might have made) with at least two other people. Answer the following in your Log: Did you all come to the same conclusion? If you answer "yes," why do you think this happened? If you answer "no," why do you think this happened?