POLE REVERSAL

PLANNING THE EXPLORATION

This exploration lends itself well to making connections with Earth Science: in particular, the study of oceanography, plate tectonics, and continental drift. You can make this connection for the students or simply propose it as a topic for further research. The reversal of present-day pole positions is a difficult concept, one that students may or may not be able to comprehend depending upon their level of sophistication. Since students are designing their own projects, however, they will relate this information to what they already understand in a way that makes sense to each one of them.

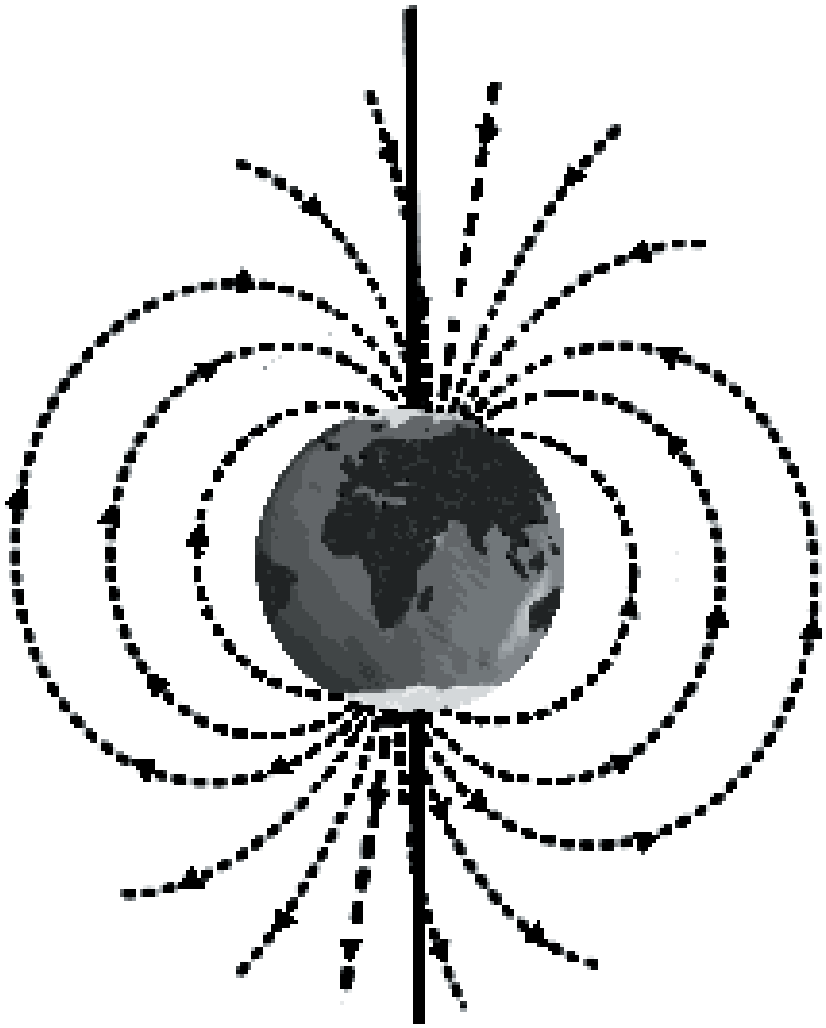
It is important that students design their own research project. Rather than choosing what they perceive as the easiest task, students should be encouraged to tap into their strengths (writing, art, music, computer graphics, or computer usage, for example). Depending upon your particular class, you may wish to contract with each student about their project; or, you may be at a point where you can just assign a project and give guidance only where necessary. Projects can be done individually, in pairs, or in groups. This allows students who are uncomfortable with group work a chance to demonstrate their individual strengths as well as to pursue a subject of personal interest.

This is a good time to revisit your discussion of models and how they are used in science. A model does not have to be what we traditionally think of when we hear that word: car or ship models with pieces that are glued together or papier mache representations. A model can be anything that allows students to look at or demonstrate an idea that is too large (or small) or too complex to observe directly.

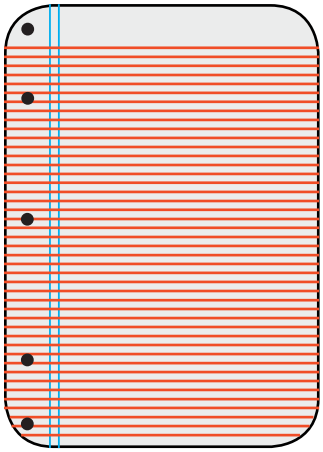
BACKGROUND INFORMATION

Although most of us are familiar with the North Pole and South Pole, the Earth's magnetic poles have switched several times throughout geologic history as is evidenced by magnetic stripes on the ocean floor. Magnetic stripes are indicators of polar wandering because of the iron content in basalt -- the most common rock on the ocean floor. Basalts have a high iron content, and as they are deposited on the ocean floor by volcanic eruptions they cool and freeze and leave a magnetic "fingerprint." Each time there is an eruption new layers of basalts are laid down on the ocean floor resulting in stripes that represent the direction of the magnetic field lines at the time of the eruption.

The actual reversal takes place relatively quickly (1000 years) once the process begins, although the entire process can take on the average of 500,000 years. The study of paleomagnetism investigates polar wandering by counting back from mid-ocean ridges to determine the relative age of the stripes. Absolute dating can be done using potassium-40/argon-40 . When scientists looked at rocks 1,000,000 years old, they found that the magnetic field at that time was close to today's position but when other rocks were tested, it was apparent that the north and south poles had switched positions. This disparity in rock layers is just one piece of evidence to support Alfred Wegener's theory of continental drift. He proposed that continents moved around on the Earth's surface after observing similar fossil evidence in rock layers from different locations (specifically Africa and South America). This led to the later theory of plate tectonics and the supercontinent of Pangaea which supported Wegener's continental drift (5-10 cm per year) and is confirmed by magnetic rock layers.



FOR YOUR PLANBOOK



Suggested time: 1+ hours

Gear: CD-ROM for reference

National Science Content Standards: A, B, C, D, F, G

Sunshine State Standards Benchmarks: SC.B.2.3.1, SC.C.1.3.1, SC.C.1.4.1, SC.C.2.3.1, SC.C.2.3.2, SC.C.2.3.3, SC.F.2.3.4, SC.H.1.3.1, SC.H.1.3.2, SC.H.1.3.4, SC.H.2.3.1, SC.H.3.3.6, SC.H.3.3.7

Sunshine State Standards Benchmarks -- Language Arts: LA.A.1.3.4, LA.A.2.3.5, LA.A.2.3.7, LA.A.2.3.8 (if Reading and Writing assessment pieces are completed) , LA.B.1.3.1, LA.B.1.3.2, LA.B.1.3.3 (if research report is done), LA.B.2.3.1, LA.B.2.3.3, LA.B.2.3.4, LA.C.3.3.3 (Booktalk and oral presentation), LA.D.2.3.4, LA.D.2.3.5, LA.E.2.3.5, LA.E.2.3.6, LA.E.2.3.7, LA.E.2.3.8

Homework: Have students work on projects at home.

Assessment:

Have students design **a model, map, or other visual aid** that demonstrates how scientists made the connection between magnetic stripes on the ocean floor and the theory of continental drift. The model could compare the fossil evidence with magnetic rock layer evidence that supports Alfred Wegener's theory. Products should show the relationship between magnetic material on the ocean floor and how the continents have moved over the past 400,000,000 years. Encourage students to look for additional information using the CD-ROM, web sites, print material, videos, etc.

The theory of plate tectonics differs somewhat from continental drift theory in that it is not just the continents that are moving but, in fact, the entire tectonic plate floating on the upper part of the mantle. Have students come up with a way to present the difference between continental drift and plate tectonics to the class. Encourage students to use **computer graphics** (quicktime movies from the worldwide web, for example) as a means to present information to a large group. This assessment lends itself well to **artwork** (clay models or other media) that represents continents and the plates upon which they rest. Students may choose to write a **research report** and present it orally.

Have more advanced science students with a chemistry background research and report on the difference between relative and absolute dating: specifically, the difference between carbon-14 dating and the dating done using potassium-40 argon-40. Students will design a **model or activity** that presents the information. The product, in order to be successful, will clarify this information for the class. Encourage the students to include with their product an **evaluation** of some sort so that they can determine whether or not they were successful in explaining the topic to others. This could be in the form of a quiz or short

essay question(s) or a survey that has several student-oriented questions.

Creative writing. Assign a fiction story about how the magnetic stripes on the ocean floor affect an animal that uses magnetoreceptors (see Exploration D: Animal Magnetism) to migrate. This might take the form of an animal that has adventures because he goes off course because of the stripes or animals that exhibit special characteristics because the magnetic fields interfere with one another. In order for this assessment to be completed successfully, students must include information on magnetic fields and magnetic stripes.

Reading and writing. Have students research articles on whales (and other mammals) beaching themselves and ask themselves if there could be some connection between Earth's magnetic field and this phenomenon. Could there be a tie-in with magnetic stripes? Probably the evidence will be inconclusive but this is an area of great interest among marine biologists at this time. An extensive print and website search will yield a great deal of information.