BUILD A COMPASS

BEFORE YOU BEGIN

Be sure that the styrofoam pieces you use do not dissolve in water!

You will need to assemble a large number of items. Most of these are found around the home, but you will probably need a little time to accumulate enough for five classes to make compasses. You may wish to put a list of household items (for example, small plastic containers like the ones margarine comes in) on the chalkboard or ask students to copy them down in Alpha Logs and to supply them. Send a letter home indicating that these items are necessary disposables with which the children are going to work.

Students will be keeping their compasses for use in another activity.

Make sure that all magnets are put away. Compasses are affected by magnets!

PLANNING YOUR EXPEDITION

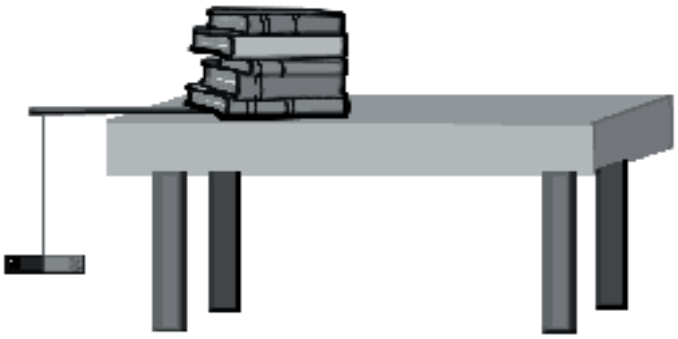
Recreating the work of early scientists and scholars will help students discover that the simplest solution is often the best. Today's compasses are made in much the same way that they were imagined in the 13th century. Some innovation has been made in their manufacture such as adding degrees to the cardinal points to help determine the difference between geographic north and magnetic north, replacing the lodestone with a magnetized needle, or putting the needle on a pivot. However, the basic technology is the same.

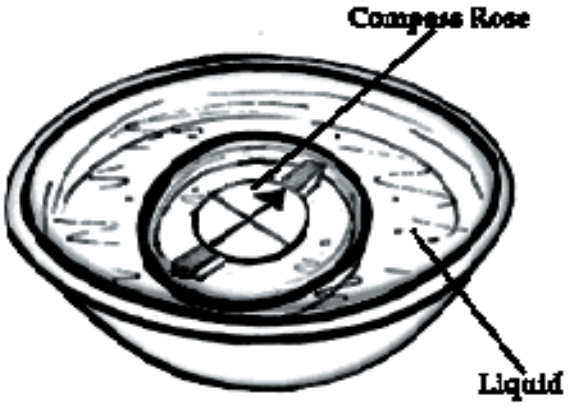
Because students must make a compass without specific directions or a model from which to copy, they will have to ask themselves certain questions before trying each design. Discussing with one another the possibilities for success or failure models what scientists do in the real world. Before scientists undertake a major design or implementation of a design, they anticipate points at which they might run into trouble.

You will be giving your students materials from which they will be asked to build a working compass. Encourage students to bring in other supplies if they need to and, if you are comfortable, devote another class period to refining original designs. Design sketches should be included in the Log since each group will give handwritten instructionsto another group to replicate (repeat exactly) the design. One important lesson taken from this activity is that it is very difficult to write clear instructions for another person (see Excursions).

If students would like to research the "first compass" or early compasses for ideas on how to proceed, encourage them to do so. However, what you want to avoid is your students building a compass from instructions provided for them. The experience of trial and error, putting together different materials, is important.

1. Inform students that they can use any and all of the materials at their disposal to create compasses.
2. Students first discuss in their group which of the group's plans (done for homework) they will adapt for use in this activity. This will require a good deal of discussion.
3. Each group will build their compass and test it to be sure it does what they expect it to do.
4. Each student should draw a labeled diagram in his or her Alpha Log with observations and comments.
5. The group writes a step-by-step instruction sheet for another group to use.
6. Groups exchange written instructions and proceed to build and test another compass.
7. In the Alpha Log students compare and contrast the two compasses.
8. Groups choose one compass to use in the next activity.





BACKGROUND INFORMATION

In the 13th century, Peter Peregrinus, a crusader in Italy, attempted to write down all he knew about lodestones. As he tried to explain the phenomenon that he observed, he devised a compass by shaping a piece of lodestone into a circle and floating it. Not for another 300 years did sailors try to use this idea and manufacture magnetic compasses. (See Hidden Attraction by Gerrit L. Vershuur for a detailed history.) Early explorers took with them compass needles and lodestones (to keep the needles magnetized). Compasses as we know them, encased and easy to carry around, still did not exist.

EXCURSIONS

For more advanced students: Have students react to the following quotation that is credited to contemporaries of Galileo. If your students keep journals, this would be an appropriate place to make such an entry. "Jupiter's moons are invisible to the naked eye, and therefore can have no influence on the earth, and therefore would be useless, and therefore do not exist." Student responses, at this point, might mention magnetic fields, but should include some synthesis of the idea that we are able to investigate that which we cannot see, that many great scientific theories are developed about things we cannot see. This connection will indicate that students have a grasp of what theory is as opposed to practice and that we can attempt to explain what we cannot see.

SC.H.1.3.1-7, 3.3.5-7

LA.B.1.3.1-3, 2.3.1-4

Instruct students to brainstorm (with another student or a parent) common phrases that include the words magnet, magnetism, or magnetic. For example, magnetic personality, animal magnetism. Students will then draw their interpretation of one of these phrases to share with the class. Drawings will reflect the meaning of the phrase as yet another way for students to demonstrate their fluency with the vocabulary of this unit.

If you are unsure whether or not your students understand how to write directions, you could start with something like: Pretend you are hosting a person from another planet who is unfamiliar with what hamburgers are. Write a description that would enable them, when they return to the home planet, to recreate the hamburger. Or, write out instructions for someone to do a chore like putting dishes in the dishwasher or setting

the dinner table. This exercise requires describing steps and refining instructions by restating those steps.

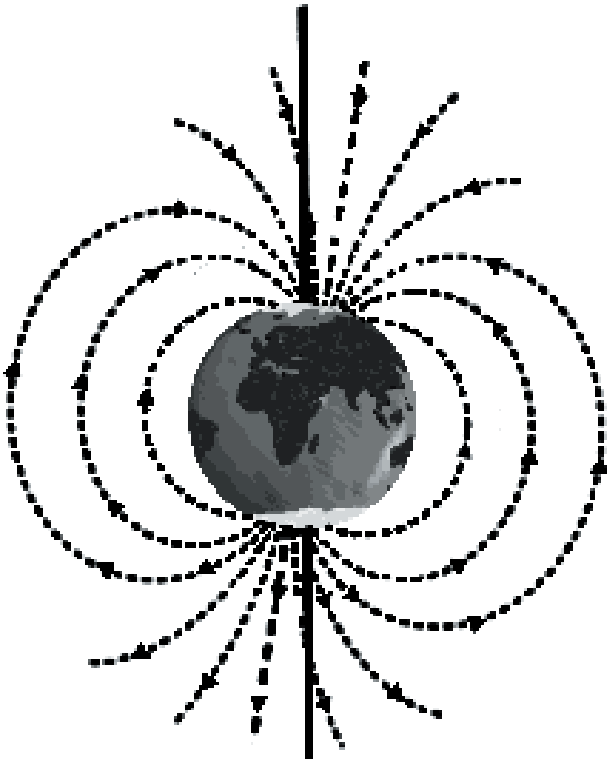
SC.H.3.3.5-7

LA.B.1.3.1-3, 2.3.1-4

On a recent episode of "Star Trek: Deep Space Nine," the chief engineer was asked to find a ship that had crashed. The planet it crashed on was surrounded by satellites that disrupted all instruments. A magnet would detect metal from the downed ship. He created a magnet, found the ship, and all was well. What if it was not a magnet that he needed but a compass? Would this storyline work? Rewrite the story to reflect this idea. Stories should indicate some knowledge that a compass (such as the ones the students made in this activity) would not work in space as a directional device, unless the ship were made of a magnet-attracting material, and the planet did not have a magnetic field. Student stories should explain this and demonstrate that compasses work as they do because of Earth's magnetic north and south pole.

SC.H.1.3.1-7, 2.3.1, 3.3.5-7

LA.B.1.3.1-3, 2.3.1-4



FOR YOUR PLANBOOK: Build A Compass

Suggested Time: 2 hours

Gear: paper clips, pins, needles, paper, masking tape, petri dishes (or other small containers), aluminum foil, pie plates, corks, pieces of wood, jars, cardboard, mineral oil (if possible), styrofoam, water, bottle caps, permanent marker, thread, a variety of magnets

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

Sunshine State Standards Benchmarks: SC.C.1.3.1, SC.C.2.3.1, SC.C.2.3.2, SC.E.1.3.1, SC.E.1.3.2, SC.E.2.3.1, SC.H.1.3.1, SC.H.1.3.2, SC.H.1.3.3, SC.H.1.3.4, SC.H.1.3.5, SC.H.1.3.6, SC.H.1.3.7, SC.H.3.3.4, SC.H.3.3.5, SC.H.3.3.6

Sunshine State Standards Benchmarks -- Language Arts: LA.B.1.3.1-3, 2.3.1,4

Homework: This homework assignment must be done before the activity. Have each student create a plan for building a compass. Tell students that they must include only materials that will be available in the classroom, and the plan must include a labeled drawing, with step-by-step instructions.

Homework Assessment: The assignment should include a list of materials, a labeled diagram, and step-by-step instructions. If all are included, then the student has successfully completed the assignment. Whether the plan is actually one that will work will be determined during the Expedition and should not be part of the homework assessment.

Assessment: Students have built a compass that consistently indicates a north-south orientation. Look for clear, easy to understand step-by-step directions that were followed by another group of students to replicate the original model. Completion of these two steps demonstrates that students are able to state explanations for why the compass points north-south and can communicate their observations through a clearly written set of instructions.

Students successfully construct a second compass using another group's set of instructions. By doing so, students demonstrate the ability to apply what they have learned to a new set of ideas. Then they will list similarities and differences between the two compasses. Identifying the relationship between the two methods requires analysis of how compasses work. Students determine which compass is the "better" of the two and explain the choice, predicting which compass will work best in a practical application.

Have students find a way to communicate answers to the following questions: How did the group decide which model to make? How did they test their compass? What problems did they have replicating someone else's model? If there were no problems, why was the plan a successful one? What are the features of a good model drawing and set of instructions? By answering these questions (and any others that you believe are pertinent), students articulate beliefs about tools they needed to successfully complete an activity. Students identify alternate ways to be successful with a task (drawing, writing instructions, verbally communicating information).

Have students create a concept map or other visual tool to explain what a compass is, how it is made, and how it is used. Visual tools allow students to construct their own meaning because they design a personal way of organizing information. Be flexible about grading this product since it represents the student's ideas, not yours or anyone else's. It should contain the basic vocabulary that you think is necessary for understanding the idea of compasses as directional tools related to the Earth's magnetic field. For example, if the visual tool is one that you can interpret (or another student can interpret) without help, then it will receive the highest grade (A); if it has all the right words, but you need the student to show you how they relate to one another, then it would get a B; if the student has clustered words without any connections, then it receives a C; and, if the student has put only some of the words and no connections, it would receive a D; not completing the assignment would be the only way to fail.

BUILD A COMPASS

Itinerary

In the 13th century, Peter Peregrinus, a crusader in Italy, attempted to write down all he knew about lodestones. As he tried to explain the phenomenon that he observed, he devised a compass by shaping a piece of lodestone into a circle and floating it. Not for another 300 years did sailors try to use this idea and manufacture magnetic compasses. Early explorers took with them compass needles and lodestones (to keep the needles magnetized). Compasses as we know them, encased and easy to carry around, still did not exist.

This activity will allow you to construct your own compass based on what you know about magnetism. You will be using your homework design in this activity as a model from which to work. Remember to write down all observations and comments in your Alpha Log. This will help you reconstruct your design and construction process at the end of the activity.

1. Discuss the compass designs that you created for homework. Talk about the advantages and disadvantages of each, making a list of the most desirable features of each in your Alpha Log. Decide which plan your group will use.
2. The Materials Manager should now pick up all necessary supplies to create and test your compass.
3. Build your compass. When you have finished, use your knowledge of magnetism and geography to test it. Write the results in your Log and include a labeled diagram of your compass.
4. As a group, write up instructions for another group so that they can replicate your model. Keep in mind the characteristics of easy to follow instructions that you have had experience with. Assume that the group assembling this compass knows nothing!

5. When you have completed your **written** (not drawn) instructions, exchange them with another group and build and test the second compass.
6. In your Logs, compare and contrast the two compasses, listing advantages and disadvantages of each one.
7. Choose the compass that you will use for Expedition #19 " Make a Map Using a Compass".