True North, Magnetic North

Topic: Nautical Science

Grade Level: 4-8

Summary: This activity will help students understand why compass angles need to be corrected for regional magnetic variation..

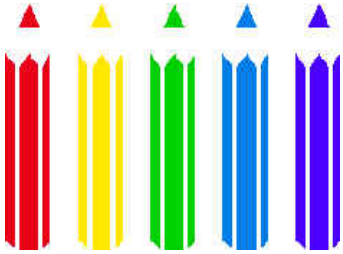
Introduction: Many centuries ago, mariners oriented themselves by the sun's place or rising and setting, or by the direction of the prevailing winds. This was less than precise, especially on windless or cloudy days. The magnetic compass, perfected slowly over years of experimentation, trial and scientific endeavor, became the sailor's most common and most reliable direction-indicating aid.

In principle, the magnetic compass remains as simple as it was when it was invented in medieval times. It is a magnet, balanced so it can pivot freely in a horizontal plane. The magnet -- as any magnet will, given the opportunity -- aligns itself with the earth's magnetic field. A pointer attached to the magnet will point the way toward the north magnetic pole.

The north magnetic pole is near, but not the same as, the earth's true north pole, or axis of spin. The magnetic pole wanders somewhat over many years, and is located in far northern Canada.

What to Expect: Students will observe the difference between magnetic and true north. Each student will measure the angle of variation for a town in a different state. This activity should follow an introduction to the globe, latitude, and longitude. Students can then use a globe to find the North Pole and the magnetic north pole. As an introduction to this activity, explain to students that the earth has a magnetic field with a north and south pole. Compasses align with this field from anywhere on the globe. However, the field is oriented to the north and south magnetic poles, which are not in the same location as the central axis of earth's rotation, the north and south poles.

The resizing and drawing of a large map outdoors is an excellent math/social studies project which should be completed first to provide the outdoor map for this activity.



Materials:

- Map of North America with latitude, longitude, and magnetic north
- Chalk
- Twine, string, or thin rope
- Large protractor
- World atlas

Procedure:

1. Have students use map and scale skills to draw a large (5 - 10 m) map North America outdoors on pavement using chalk. Include lines of latitude and longitude to help orient students toward the North Pole.
2. Mark magnetic north and true north.
3. Have students stand on different states or places.
4. Put one student at magnetic north and one at true north.
5. Have MN and TN students each hold the end of a piece of thin line, twine, or string.
6. Have each student (one at a time) grab the middle of the line between MN and TN.
7. Have the students use a large protractor to measure the angle that is formed to determine the magnetic variation at that point.
8. Have students verify their variation using maps.

Evaluation: These questions can be asked during the activity. Students should record results and hand in the answers:

1. Where in the U.S. is the variation 0° ?
2. Where in the U.S. is the variation the most?
3. What is the difference between an east and west variation?
4. Give the name and variation for a city in China, Africa, and New Zealand (use the world atlas).
5. Compare the variation you measured to the one on a map.

Extensions:

1. Reversals in magnetic polarity have occurred periodically throughout earth's history. Many of these magnetic reversals are recorded in sequence along mid-ocean ridges, areas of long-term ocean basin expansion. See the Mid Ocean Magnetism activity.
2. Ask permission to have students use paint to draw a permanent map of North America outdoors. Other students can use it for history, geography, and social studies.

Resources: Latitude & Longitude
Source: Rick Butler, SEA Experience 1998

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