Title: Construction and Use of a Simple Sextant for Determining Position
(Historical Perspectives)

Grade Level(s): 6-8

Introduction: Today, with the advent of GPS (Global Positioning Systems), navigators and sailors can determine their position on anywhere on the earth within moments. However, before the invention of the GPS, LORAN, and other radio signaling devices, sailors and navigators used the celestial sky for determining position. For many years the sextant was the instrument of choice, where position was determined by measuring the altitudes of celestial bodies. Experienced navigators could determine the position using a sextant in less than ten minutes.

A simple sextant can easily be constructed and a latitude calculation can easily be determined using the North Star, or Polaris, and the celestial body of reference. Longitude cannot be determined using the simple sextant.

Learner Objectives:
• The student will be able to construct and use a simple sextant to determine latitude.
• The student will be able to understand the use of stars and their positions in the celestial sky for navigation purposes.

Sunshine State Standards: Science: Sci.E.2.3.0 Math: MA.B.3.3.1
Competency-Based Curriculum: Science: M/J O-I A2 Math: M/J-1-III-5-A, M/J-3-II-13-C

Materials:
Protractors - one for each student (a compass rose can also be used)
Ice cream sticks (or pencils) - 3 per student
Rubber bands or string

Activity Procedures:
1. Give each student 3 ice cream sticks and rubber bands or string.
**Activity Procedures (Cont’d):**

2. Instruct the students to attach the three sticks into a triangle, using the rubber bands or string to fasten the sticks together.

3. Each student will then hold the triangle to their eye. They will sight the horizon with one stick, and the other will be aimed at Polaris.

4. Move the upper stick of the triangle so that the student can sight Polaris along one stick, and without moving their heads, also sight the horizon.

5. The student will then measure the angle created by the sticks sighting the horizon, and Polaris, using the protractor or compass rose.

6. The resulting angle will be the latitude (in degrees) of where the students are performing the exercise.

**Student Assessment:**

Allow students to answer critical thinking skills questions assigned by the teacher.

1. Using a GPS, determine a position assigned by the teacher. Then, compass the latitude reading from the GPS to the latitude reading calculated using the simple sextant that was constructed. How do the two latitudes compare? How close were the estimations using the simple sextant?

2. Explain different sources of error that may have caused the latitude reading determined using the simple sextant to be different from the latitude obtained from the GPS?

3. How can the model of the simple sextant be modified to be more effective?

**Activity Extensions:**

Before the advent of GPS, Loran, and the sextant, ancient mariners such as Magellan, Drake and Columbus used a cross-staff to determine position during their voyages. Discuss how accurate their determination of position was using the rudimentary instruments that they used. Furthermore, discuss how their original voyages across the oceans could have been more effective if they had such technology and advances in science during their era. (Social Studies, Technology)

**Home Learning Activity:**

Research the web, or other sources for instructions on how to construct other simple instruments to determine position.

**Vocabulary:** GPS, celestial bodies, sextant, latitude, longitude
References/Related Links:
www.northernlight.com
http://celestaire.com
http://home.earthlink.net/~nbrass1/cardart.htm
http://trimble.com/gps/index.html

Conversion Table for FCAT Questions:

<table>
<thead>
<tr>
<th>Imperial</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch (in)</td>
<td>2.54 cm</td>
</tr>
<tr>
<td>1 foot (ft)</td>
<td>12 in</td>
</tr>
<tr>
<td>1 yard</td>
<td>3 ft</td>
</tr>
<tr>
<td>1 mile</td>
<td>1760 yd</td>
</tr>
<tr>
<td>1 nautical mile</td>
<td>2025.4 yd</td>
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</tbody>
</table>
Determining latitude is another matter entirely. To do so, the navigator equates arc with time. Each of the 360 degrees of the earth’s circular belt is divided into sixty minutes of arc. Each minute is one nautical mile-6076 feet. Since the earth spins once every twenty-four hours, the heavenly bodies pass over fifteen degrees of longitude every hour, or fifteen minutes of longitude every minute. Some astronomers in Greenwich, England, began and ended their demarcation of the globe by running the longitude line of zero degrees through their little town. Longitude can be calculated by comparing the time when a heavenly body appears overhead to the time when it would be over Greenwich. Not until the advent of accurate timepieces was it possible to fix longitude.

Captain Cook was one of the first to utilize the breakthrough invention called the chronometer. Until then, mariners commonly sailed north or south until they reached the latitude on which their port of destination lay. Then they would sail directly east or west. Latitude sailing, as it is called figured on the altitude of the North Star, combined with any approximate speed and drift, which I have been keeping running track of, will give me a better idea of my position in this expanse of terrain barren of signposts and landmarks.
Construction and Use of a Simple Sextant for Determining Position

FCAT Questions

Directions: Read the passage, then answer all the questions below. Answer multiple-choice question by circling the letter of the answer that you select. Write your answer to “Read, Think, and Explain” questions in the lines provided.

1. Each minute of each of the 360 degrees of the earth's longitude lines is how long in meters?
   A. 1500 meters
   B. 1609 meters
   C. 1815 meters
   D. 1841 meters

Answer: D

2. If each minute of each of the 360 degrees of the earth's longitude lines is 1 nautical mile, what is the circumference of the earth along the equator?
   A. 24,000 miles
   B. 21,600 miles
   C. 18,600 miles
   D. 26,100 miles

Answer: B

3. How many degrees of longitude does a heavenly body cover in 15 minutes?
   A. 15.5 degree
   B. 3.75 degree
   C. 5.05 degree
   D. 15.0 degree

Answer: B

4. Why was it important for the author to determine longitude?

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   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________

I-A-10