ED 5661 Mathematics & Navigation Teacher Institute

Lesson: Plotting a course through the school

Target Grade: 11th grade Trigonometry

Lesson Overview: The overall goal of this lesson is for students to plot a course through the school from one end to the other using navigational techniques. The students will use a blueprint of the school as a map for planning the course. The First day will be spent learning about plotting a course. The second day will be spent actually plotting the course through the school and then testing the course by going through the school.

Sources Consulted:


Terms (http://www.marineinstitute.org/nautical%20terms.htm#B)

Materials: Keweenaw Water Ways Map, Dividers, Parallel Rulers, Map of School, Compass, GPS, Tape Measure

Vocabulary: Heading, Bearing, Vector, Polar Coordinates, Latitude, Longitude, Nautical mile

Focus Question: Can we make a course that we could follow to make our way through the school building? How can we use vectors in navigation?

Learning Objective

At the end of this unit students will be able to

1. Plot a course, expressing legs of the course as vectors.
2. Represent the ends/starts of legs as polar coordinates.
3. Use latitude and longitudinal lines to find lengths on a chart.

State Objectives:

Michigan Merit Curriculum:

P9.1 Convert between polar and rectangular coordinates. Graph functions given in polar coordinates.

L1.2.3 Use vectors to represent quantities that have magnitude and direction, interpret direction and magnitude of a vector numerically and calculate the sum and difference of two vectors

A3.7.2 Use the relationship between degree and radian measures to solve problems.
**Day 1**

1. Introduce students to navigation using the Keweenaw Water Ways maps. At this time we will discuss how to read the chart; this includes latitude and longitude lines as well as the compass rose.
2. Plot a course from MTU to south entry.
3. Demonstrate how to get headings and lengths of legs using parallel rulers and dividers. After the process has been demonstrated, students will find the headings and lengths of each of the legs.
4. We will end the day talking about vectors (magnitude and direction) and will discuss how we can refer to each leg as a vector.

**Day’s Focus:** Introduce students to the use of nautical maps along with nautical vocabulary. By the end of the day students should be able to get both the magnitude and direction of each leg of a course and then be able to write the leg as a vector.

**Day 2**

1. We will start with the headings and lengths that students found on day one and reintroduce the idea of describing each of the legs as a vector [magnitude, direction].
2. Discuss how to name each of the start/stop points of the legs as a polar coordinate (with the starting location as [0,0]).
3. After the discussion the students will be given a chart of the school with a compass rose and latitude and longitude lines. The chart will also have a course marked out on it.
4. The students will have to find both the length and heading of each leg of the course.
5. After the students have completed the table with their headings and lengths, they will use a compass (GPS unit) and a tape measure to follow their course.
6. Following the activity we will have a class discussion on error and reasons for error. After the discussion the students will work individually on their assessment.

**Day’s Focus:** Students will use the knowledge from the previous day to make a test a course through the school. At the end of the day there will be a discussion about accuracy and the factors that would affect accuracy.
School Chart

Assessment on next page:
**Group Member Names:**

**Directions:** In each box include both your measurement and the work for the process of obtaining the measurement.

<table>
<thead>
<tr>
<th>Heading</th>
<th>Distance</th>
<th>Coordinate of End point (Polar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEG 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEG 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEG 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEG 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEG 5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Questions

(1) What is the total distance you traveled on your course through the school?

(2) How far “as the crow flies” is your ending point from your starting point?

(3) If you were to travel through the school at 8 miles an hour how long would it take you to travel your course?

(4) Describe the process of using Latitude and longitudinal coordinates to find the length of a leg of a course.

(5) Explain the process of using latitude and longitudinal coordinates to find the polar coordinates of endpoints.