Cartography and Navigation in the Time of Champlain: Dead Reckoning

Written by Julia Miller

OVERVIEW

In this series of hands-on activities, students will use the basic instruments that were utilized in the 16th and 17th centuries for navigation and cartography to determine speed, latitude and altitude, and to map a location using these crude instruments.

WHY IS THIS AN IMPORTANT CONCEPT?

Students will use teamwork and basic geometry to answer the following essential questions:

- How difficult was it was for explorers in the 1600’s to know exactly where they were? How accurate were the maps made by Samuel de Champlain?

GRADE LEVEL: 7-12 SOCIAL STUDIES

TIME REQUIRED: 1-3 class periods

OBJECTIVES:

- Draw maps and diagrams that serve as representations of places, physical features, and objects.
- Understand how to develop and use maps and other graphic representations to display geographic issues, problems, and questions.
- Explain how technological change affects people, places and regions

MEDIA RESOURCES:

- Dead Reckoning ~ Champlain in America website - http://www.champlaininamerica.org
• Clip from the Mountain Lake PBS film, *Dead Reckoning ~ Champlain in America*, located at Montréal in the **1603 and 1613 journeys section** of the map in the *Champlain in America* website - [http://www.champlaininamerica.org/thejourney](http://www.champlaininamerica.org/thejourney)

• Google Earth or Google Maps or equivalent source to determine actual latitude and longitude of home location

• Google Maps (satellite view) or other local map or atlas for comparison to maps made in home location

• Map from Champlain’s Journal

• Satellite view of same region as in Champlain’s map

**MATERIALS:**

• Large open space such as an empty parking lot, grassy field, or gymnasium (weather permitting, outdoor location is preferable)

• Child’s wagon, snow saucer, or heavy tarp (outdoor), or large blanket (indoor) (one per group)

• A 5-foot length of rope (one per group)

• Several plastic protractors, drinking straws, tape, 7” pieces of string, and “weights” such as metal gaskets (one of each per group)

• Several small compasses (one per group)

• Several 1-minute egg timers-hourglass type (one per group)

• Several 6-inch rulers (one per group)

• Clipboards, plain white paper, graph paper, pencils (one of each per group)

• 50-foot length of rope or cord – measured and marked with sharpie at one-foot intervals (one per group)

• Astrolabe Silhouette (from [www.pbs.org/classroom/w3astrolabe.html](http://www.pbs.org/classroom/w3astrolabe.html))

• Crew Members Sheet

• Mapping Rubric

**BEFORE THE LESSON:**

• Divide the class into groups of 4-6 students – you will need the materials listed above for each group, so the number of groups (and how many per group) may depend upon the available supplies.

• Copy the Crew Members Sheet and Mapping Rubric

**THE LESSON**

**PART I: LEARNING ACTIVITY**

In the Classroom-

**CONSTRUCT AN ASTROLABE**

1. Using tape, attach the 7” piece of string to the center mark on the straight edge of the protractor.
2. Tape the drinking straw along the top of the straight edge.

3. Tie the weight onto the other end of the string.

On Location:

**CONSTRUCT YOUR “BOAT”**

1. Find a spot where there is plenty of open space – an empty parking lot, a grassy field, or if weather does not allow outside activity, a gymnasium.

2. In this activity, students will be simulating the motion that Champlain would have felt on a boat and using simple tools and will try to map a location while in motion.

3. If outside, use the child’s wagon on hard smooth surface, or the snow saucer or tarp on grassy surface, as your “boat.” One student sits on the boat while one or two other students pull the boat along—a rope may be necessary to pull the saucer or tarp. If inside, use a large blanket on the gym floor as your boat.

**TO DETERMINE SPEED**

4. Students will be using the 50-foot length of cord to determine speed.

_Originally, a member of the crew would cast a floating object, which was attached to a long line of rope, overboard. The line was knotted at regular intervals. Another crew member would use an hourglass-type timer to record the time that it took for a certain number of knots to pass overboard. This is the origin of the nautical measure “knots” for the recording of speed._
5. Using an egg timer, one member of the crew (on shore – as not to tax the pullers with the weight of two students) will say “begin” and the boat will begin to move.

6. While moving, another student will extend the 50-foot cord slowly out of the boat.

7. When the timer has finished, the crew on shore will say “end.” The crew will count how many lengths (or knots) have been extended. This will give the quantity X. The speed can be determined by this formula: \( \text{Speed in feet per minute} = \frac{x}{3} \) (our egg timer was 3-minutes in length)

**TO DETERMINE DISTANCE**

8. Any student will know that \( \text{RATE} \times \text{TIME} = \text{DISTANCE} \), so if the boat now moves across the entire area at approximately the same rate, another crew member can time the travel in order to determine the measurement of the whole area.

9. At this point, students with clipboards on shore can begin to “map” the area—using graph paper will make your map more accurate. Students measure out the distance using the boat, and then map the line in that many squares on the paper.

10. This process can be repeated in another direction in the area to get another marking for the map.

11. Use the compass to mark a “compass rose” on your map.

Be sure to face the rose in the direction of north—not just the top of your page as you are looking at it.

**MAPPING BY SIGHTLINE from a fixed or anchored position**

12. To map by sightline, students need to be in a fixed spot, “anchored”, and use the clipboard and the ruler.

13. On the map, mark your approximate position at anchor with an x.

14. Then hold the clipboard up to your eye level, and use the ruler flat on the paper to “sight” a point (perhaps another crew member standing far away) in the distance (fig A). Then draw a
line with the ruler that “lines up” with the point. Imagine how hard this would be if you were moving!

15. Change your location of anchor to another point on the map and mark it with another x. Repeat the sighting of the same object, and draw another line with the ruler. Where the lines intersect, draw a dot. This is the location of the object on your map (fig B)

16. Make sure your map has a “legend” on it – to define symbols or marking you might be using.

Look at Champlain’s map and you will notice similar lines.

Here is a satellite version of the same area for comparison- Champlain’s measurements from the sea were more accurate than those of the depth of the landmass — Why do you think that is?
DETERMINE LATITUDE USING AN ASTROLABE

17. At night, when you look through the straw in your astrolabe at Polaris (the brightest star), note the angle marking where the string crosses — this is your latitude.

18. During the day, do not look directly at the sun — hold your hand up a few inches away from the “eye-end” of the straw on your astrolabe and direct the other end toward the sun. When a small circle of light appears on your hand, note the angle the string crosses the protractor — this is your latitude.

THE CONCEPT OF DEAD RECKONING

19. Imagine you are out at sea for several days or weeks — being able to “map” your latitude would help to follow the planned route. Although, the measurements are variable depending on who takes them, how often, how accurately. Any mistakes that are made in the beginning of the process are multiplied as each measurement is based on the last.

DEAD RECKONING is defined as the process of estimating one’s current position based upon a previously determined position, or fix, and advancing that position based upon known or estimated speeds over elapsed time, and course. A disadvantage of dead reckoning is that since new positions are calculated solely from previous positions, the errors of the process are cumulative, so the error in the position fix grows with time.


PART II: ASSESSMENT

20. Students should be able to produce some form of map within one class period. Collect, scan, and share the maps on a projection system the following day in class. Compare the differences in appearance, quality, accuracy, etc. Ask students to discern what variables caused the differences in their maps.

21. Student maps can be assessed using the Mapping Rubric.

RELEVANT STANDARDS:

National Standards for Social Studies

NSS-G.K-12.1 THE WORLD IN SPATIAL TERMS
Understand how to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective.
NSS-G.K-12.6 THE USES OF GEOGRAPHY
Understand how to apply geography to interpret the past.

NYSED Learning Standards for Social Studies

STANDARD 3 KEY IDEA 1
Geography can be divided into six essential elements, which can be used to analyze important historic, geographic, economic, and environmental questions and issues. These six elements include: the world in spatial terms, places and regions, physical settings (including natural resources), human systems, environment and society, and the use of geography. (Adapted from The National Geography Standards, 1994: Geography for Life)

Performance Indicators for specific grade levels can be found at http://www.emsc.nysed.gov/ciai/socst/ssrg.html
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Assessment Rubric for Mapping Project

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neatness of Color and Lines</td>
<td>All straight lines are ruler-drawn; all errors have been neatly corrected.</td>
<td>All straight lines are ruler-drawn; most errors have been neatly corrected.</td>
<td>Most straight lines are ruler-drawn; most errors have been neatly corrected.</td>
<td>Many lines, corrections of errors, and/or features are not neatly done.</td>
</tr>
<tr>
<td>Map Legend/Key</td>
<td>Legend is easy-to-find and contains a complete set of symbols, including a compass rose.</td>
<td>Legend contains a complete set of symbols, including a compass rose.</td>
<td>Legend contains an almost complete set of symbols, including a compass rose.</td>
<td>Legend is absent or lacks several symbols.</td>
</tr>
<tr>
<td>Working with Others</td>
<td>Almost always listens to, shares with, and supports the efforts of others. Tries to keep people working well together.</td>
<td>Usually listens to, shares with, and supports the efforts of others. Does not cause “waves” in the group.</td>
<td>Often listens to, shares with, and supports the efforts of others, but sometimes is not a good team member.</td>
<td>Rarely listens to, shares with, and supports the efforts of others. Often is not a good team player.</td>
</tr>
<tr>
<td>Attitude</td>
<td>Never is publicly critical of the project or the work of others. Always has a positive attitude about the task(s).</td>
<td>Rarely is publicly critical of the project or the work of others. Often has a positive attitude about the task(s).</td>
<td>Occasionally is publicly critical of the project or the work of other members of the group. Usually has a positive attitude about the task(s).</td>
<td>Often is publicly critical of the project or the work of other members of the group. Often has a negative attitude about the task(s).</td>
</tr>
<tr>
<td>Pride</td>
<td>Work reflects this student’s best efforts.</td>
<td>Work reflects a strong effort from this student.</td>
<td>Work reflects some effort from this student.</td>
<td>Work reflects very little effort on the part of this student.</td>
</tr>
</tbody>
</table>

| Score | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|-------|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|---|
| Total | 100| 95 | 90 | 85 | 80 | 75 | 70 | 65 | 60 | 55 | 50 | 45 | 40 | 35 | 30 | 25 | 20 | 15 | 10 | 5 | 0 |
Satellite Map of Canada