Lesson Plan for

Navigation Video: "How did Captain Vancouver navigate the oceans?"

Lesson Overview

Learn more about the scientific elements of Captain Vancouver's voyage along the Pacific Northwest coastline. This lesson introduces students to the navigation concepts of longitude and latitude, and how sailors plot a course and create maps.

Resources:

- ➢ Video "How did Captain Vancouver navigate the oceans?"
- ➢ Review questions worksheet for students
- ➢ Chart the Coast Math Activity for practicing longitude and latitude calculations

Lesson Learnings

Inquiry Questions:

- ➢ How did Captain George Vancouver and his crew navigate the oceans?
- ➢ What role did maritime technology play in late 1700s European overseas voyages?

Learning Objectives:

- ➢ Describe the technology that Captain Vancouver and his crew used to navigate and chart the Pacific Northwest Coast.
- ➢ Apply mathematical concepts and equations required to calculate longitude and latitude in the context of early Pacific Northwest exploration.

Key Terms and Figures:

- ➢ Cartography
- ➢ Latitude
- ➢ Longitude
- ➢ Chronometer
- ➢ Navigations
- ➢ Sextant

Activate Prior Knowledge

Use any of the following questions for group discussion or as think-pair-share. Students could draw a mind map to keep track of words and ideas.

- How do you know where you are in the city? How do you find directions to your destination?
- Imagine you found yourself on a small raft in the middle of the ocean with no phone or GPS. How do you know where you are? What kind of clues might you have?
  - Can you see anything to help you determine where you are? (for e.g. the horizon, stars, sun, ocean, clouds)
  - Throughout history, many peoples used stars to navigate. What might be some challenges of using the stars? (if it's cloudy; they move throughout the night; requires a lot of knowledge

Watch *Changing Perspectives* Video

Resource: accompanying review questions worksheet

Watch the video "How did Captain Vancouver navigate the oceans?" as a class.

Video Worksheet

Ask students to answer the following questions, as written answers using the worksheet or as think-pair-share. These questions build from direct recall to active critical thinking.

Possible answers in red.

Imagine you are a crew member of Captain Vancouver's 1791-1795 expedition. Your job is to navigate the ship's route:

1. The distance you are north or south of the Equator is called: latitude
2. The distance you are east or west of the Prime Meridian is called: longitude
3. What could happen if you didn't know your location at sea?
   - Get lost, could sail into dangerous waters, get attacked by pirates or a navy, could sink if hit shallow water or rocks, crew could get mad and mutiny.
4. What technology and knowledge do you need to calculate your ship's latitude and longitude? Fill in the chart:

	Latitude	**Longitude**
Technology	Sextant	Chronometer
Knowledge	Which star is the North Star,	Time in England, time where you are,

	trigonometry, how to use a sextant	Earth moves 15° in one hour, Earth rotates around the sun every day

Analysis Prompts

These additional prompts challenge students to further analyze what they've learned from the video. These questions ask students to reflect on the practice of history and incorporate evidence to justify their claims. In some cases, students may benefit from further resources to explore these questions.

1. What can we learn from looking at navigation artifacts from Captain Vancouver's expedition? Look at the sextant, telescope, and chronometer used by Captain Vancouver's crew, and follow the Close-Looking lesson guide.
2. Compare the two maps in the video at timestamp 4:08. The map on the right was created by Captain Vancouver in the late 1700s, and the map on the left is a Russian map created in the 1700s showing a similar area.
    a. What are the similarities and differences between the two maps?
    b. Why are there differences between the maps?
    c. Can you find these regions on Google Maps or Google Earth? What makes it easy or difficult to locate the region?
        i. Google Maps coordinates
        (Note: Google Maps does not show lines of longitude or latitude, but can show a location's coordinates)
        ii. Google Earth coordinates
        (Note: Google Earth can show lines of longitude and latitude. Go to Menu → Map Style → Turn on Gridlines)

Wrap Up Discussion

Wrap up your lesson with a reflective discussion. Ask students to give answers to the following questions, either as a class, in small groups, or as an independent writing exercise.

- Are these navigation technologies, skills, and knowledge relevant in today's world?

Creative & Inquiry Project Ideas

Expand on learning with an inquiry-based or creative project, such as:

- Build a sextant using materials found around the classroom, such as protractors. There are multiple tutorials online, or challenge students to make one without instructions. The finished sextant can be used to locate your latitude using the North Star or pick an object on the ceiling to demonstrate.

Chart the Coast Math Activity

Intended audience: Grades 5-6
Student Resources: Activity Worksheet
Teacher Resources: Activity Background Sheet (below) and Activity Answer Key (below)

Activity Background

If a navigator knows both their latitude and longitude, they can figure out where their ship was in the world.

<u>Latitude</u>

Latitude measures the distance north or south of the Equator, from 0° to 90°. In Captain Vancouver's time, sailors used a sextant to determine their latitude by measuring the angle of a star to the horizon. Demonstrate using a globe and figurine that if you're standing on the North Pole (90°), the North Star appears directly above you (aka 90 degrees from the horizon). If you're standing on the Equator (0°), the North Star appears to be on the horizon (aka 0 degrees from the horizon).

What do you notice about the degree of latitude compared to angle between the horizon and North Star? They are the same degree. (Example: The Equator is 0° latitude, and the horizon at the Equator has an angle of 0° to the North Star). This is how using a sextant could let sailors know how far North or South they were.

Note: Although the North Star in Figure A doesn't look like it's directly above the North Pole, in reality, the North Star is so far away from Earth that it *appears* to be right above.

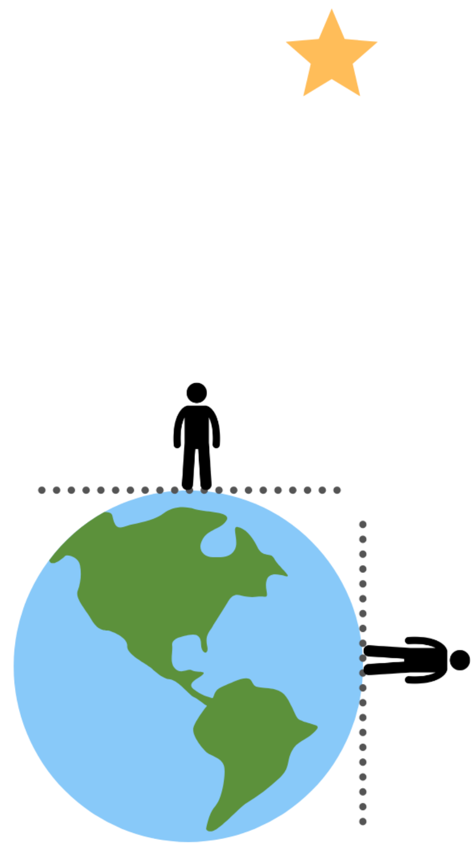


Figure A. Where the North Star is compared to our horizon.

<u>Longitude</u>

Longitude measures your location east or west of the Prime Meridian (0° degrees). Time is the key to calculating longitude. If the world rotates 360° every 24 hours, how many degrees does it rotate every hour? (360/24 = 15° every hour).

Chronometers are clocks that can accurately keep time at sea. Before starting the voyage, the ship's chronometer would be set to the time at the Prime Meridian. To calculate your longitude, you also needed to know what time it was where you are. If you're in the middle of the ocean, how could you know when it's noon? When the sun is at the highest point in the sky. At noon, read the time on the chronometer. Calculate the difference between these two times. Multiply this number by 15 degrees. This will give you your longitude.

Example:

Noon local time	12:00 PM	
Prime Meridian time	07:00 AM	
Difference	**05:00 hours**	5 hours x 15° = **75° west of the Prime Meridian**

Navigate the Coast Math Activity Answers

Can you chart the *HMS Discovery* and *HMS Chatham*'s route along the Pacific Northwest Coast during the summer of 1794? The coordinates are approximated based on maps and journal entries from this voyage.

Latitude

1) Calculate how many degrees of latitude the ship is north of the Equator. The following sextant measurements show the angle of the North Star relative to the horizon on each day.

   (Remember, the North Star is at 90 degrees to the horizon in the North Pole. At the Equator, the North Star is 0 degrees to the horizon).

Day	Sextant measurement	Latitude
July 30, 1794	56.5 degrees	56.5°
August 24, 1794	55.5 degrees	55.5°
September 1, 1794	50.75 degrees	50.75°
September 2, 1794	49.5 degrees	49.5°

2) Is the ship travelling north or south? South

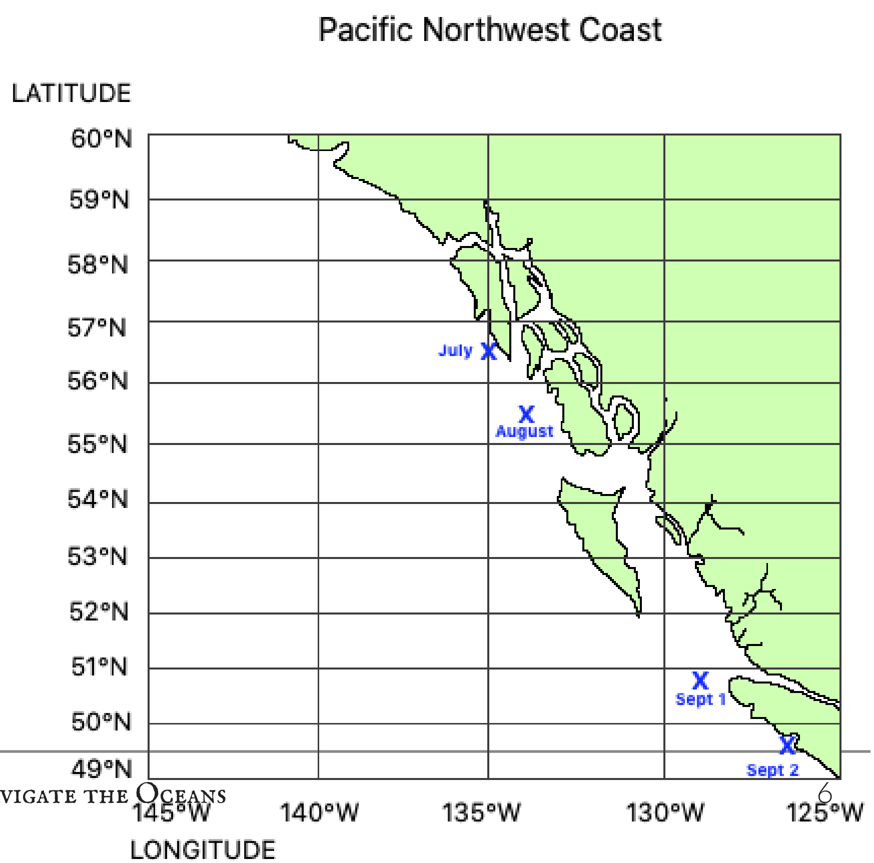
Longitude

1) How many degrees does the Earth rotate every hour?
   360° ÷ 24 hours = 15° every hour
2) How many degrees does the Earth rotate every minute?
   15° ÷ 60 minutes = 0.25°
3) How long does it take for the Earth to rotate 1°?
   60 minutes ÷ 15° = 4 minutes
4) A chronometer aboard the *HMS Discovery* and *HMS Chatham* kept track of the time back in Greenwich, England at 0 degrees longitude. Using the chronometer, calculate the ship's position for the following readings:

Day	**When it is 12:00pm where the ship is, the chronometer reads the time in Greenwich is:**	**Longitude**
July 30, 1794	9:00 PM	(9hr x 15°)=135°
August 24, 1794	8:56 PM	(8hr x 15°)+(56m/4°)=134°
September 1, 1794	8:36 PM	(8hr x 15°)+(36m/4°)=129°
September 2, 1794	8:24 PM	(8hr x 15°)+(24m/4°)=126°

<u>Chart the Coordinates</u>

Using the longitude and latitude coordinates you have calculated, plot the ship's location for each of the four days.



Extra Problem Solving Question:

Captain Vancouver's expedition sailed far north in the spring and summer of 1794 to chart the Pacific Northwest Coast. According to their expedition maps, on June 29 1794, the ship's coordinates were 59.75°N latitude and 142°W longitude. When it was noon local time on the ship, what time was it in Greenwich?

> There are many ways to get to the answer 9:28 PM
>
> It takes one hour for the Earth to rotate 15°. 15° fits into 142° nine times. Therefore it is at least 9 PM. But, there are 7 degrees remaining.
>
> It takes 4 minutes for the Earth to rotate 1°. 7° x 4 minutes = 28 minutes