Today: maps! navigation! history!

- Maps: Map projections, types, meanings, etc.
- Navigation: Piloting, dead reckoning, sailing by the stars, finding latitude/longitude, modern navigation
- History: Brief history of ocean exploration and study

Navigation by Piloting & Dead Reckoning

- **Piloting**, earliest method of navigation, judging location by **landmarks** within sight of coastline – Egyptians, 4000 B.C.
- Later mariners also used **direction and speed of travel** to determine approximate position: **Dead Reckoning** had to rely on visibility, instincts, luck

Celestial Navigation

- In 325 B.C., Pytheas (Greek astronomer-geographer), worked out simple method for determining **latitude**:

  *determine the angle between the horizon and the North Star (Polaris)*

Using the North Star to Determine Latitude

- Here in Noho the angle is **42°19’**

  ![Diagram](image)

  *note: can only determine North-South position*
Prior to the late 18th century, explorers had the problem of locating East-West position (longitude). Solution: invention of the chronometer by John Harrison (read Dava Sobel’s *Longitude*). Need to measure time accurately at sea.

Earth rotates from West to East (counterclockwise when looking down on N. Pole)

\[
360^\circ/24 \text{ hours } = 15^\circ/\text{hour}
\]

Record time at noon (Sun at highest point) and compare ship time with Greenwich time (how many hours ahead or behind Greenwich time?)

Navigational methods today:

<table>
<thead>
<tr>
<th>Method</th>
<th>Accuracy</th>
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</thead>
<tbody>
<tr>
<td>1. Celestial navigation</td>
<td>2-10 km</td>
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<tr>
<td><em>position of sun, moon, stars</em></td>
<td></td>
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<tr>
<td>2. Radio navigation systems</td>
<td>0.3-1.0 km</td>
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<tr>
<td><em>land-based signals: Omega, Loran C</em></td>
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<td>3. Satellite navigation</td>
<td>0.1-200m</td>
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<td><em>GPS - Global Positioning System</em></td>
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History of Oceanography:

*ancient explorers*

- 2000 B.C. – 500 B.C.: Polynesians settled Pacific islands covering an ocean area the size of a continent. Used crude but amazing navigation tools, simple canoes. No written language!
**History of Oceanography**

**ancient explorers**

**Phoenicians**
1000 B.C. - 600 B.C.
Explored the Mediterranean Sea

**Greeks and Romans**
450 B.C. – 150 A.D.
- Herodotus – mapped the Mediterranean

**Viking discoveries**

**Erik the Red**
982 A.D.
- Discovered Greenland, Baffin Island in Canada
- Established settlement of Vinland, now part of Newfoundland

**Leif Erikson**
995 A.D.
- Discovered Greenland, Baffin Island in Canada
- Established settlement of Vinland, now part of Newfoundland

**The “Age of Discovery”**

**Christopher Columbus**
1492 A.D.
- Italian but sailed for Spain
- Discovered the West Indies, founded Santo Domingo
- Went to his grave thinking he had sailed to Asia

**Vasco Nunez de Balboa**
1513 A.D.
- Spanish and sailed for Spain
- “Discovered” the Pacific Ocean (though Polynesians had been there for thousands of years)
- Crossed the isthmus of Panama
History of Oceanography

The “Age of Discovery”

Ferdinand Magellan
1519-1522 A.D.

First circumnavigation of the globe
Started out with 5 ships, about 250 officers and crew
Returned with 1 ship, grand total of 18 crewmen, Magellan not among them
Sebastian del Cano completed voyage

History of Oceanography
early scientific expeditions

Captain James Cook
1768, 1772, 1778 A.D.

Sailed for England, 3 voyages to the Pacific Ocean
Took a natural scientist on board; laid groundwork for future scientific expeditions
Discovered Australia, New Zealand, Hawaii
Killed in Hawaii while attempting to recover a large boat

History of Oceanography
early scientific expeditions

Charles Darwin
1831-1836 on HMS Beagle

Original mission was to chart coast of South America
Conducted groundbreaking research on the biology of the Galapagos Islands
Led to the theory of evolution and natural selection
Published *On the Origin of Species* in 1859

History of Oceanography
beginnings of modern oceanography

C. Wyville Thomson
1868, 1869 on HMS Porcupine and HMS Lightning
1872-1876 on HMS Challenger

First major cruises specific to scientific ocean research, commissioned through British Navy
Disproved Forbes’s hypothesis that ocean is lifeless (azoic) below 550 m depth
Also found deepest water colder than 4°C
Challenger expedition a resounding success
History of Oceanography

beginnings of modern oceanography

**The HMS Challenger, 1872**

History of Oceanography

beginnings of modern oceanography

**Fridtjof Nansen**

1893-1897 on R/V Fram

Designed research vessel (R/V Fram) to withstand pressure of polar sea ice

Deliberately froze the Fram in Arctic ice in an effort to attain North Pole

Confirmed circulation patterns in Arctic Ocean and absence of polar continent

Farthest North latitude achieved was 86°14’