"Discovering Geography with Columbus" Teacher's Guide

Please Note When Printing: This Teacher's Guide is formatted for **Legal Paper Size**.

The following Teacher's Guide is designed to help you prepare your students for their upcoming presentation of *Discovering Geography with Columbus* when the Northern Stars Planetarium visits your school. This program is designed as an introduction to many basic principles of geography. Much of the information enclosed in this guide is designed to be background information for you the teacher. There are numerous pages that you may want to copy off for your students, feel free to use or copy whatever parts you like.

Also, because this presentation is given to a variety of age levels, you may find that some of the material enclosed will be either too old or too young for your particular class. Please use only what you feel is appropriate.

Program Outline

I. Who was Christopher Columbus? Where was he from?

II. What did people at that time know about the world?
- A. Was the world generally believed to be flat or round?
- B. What did an early world map look like?
- C. How, in Egypt circa 300 B.C., Eratosthenes had proven the world was round.
- D. Why were sailors sailing around Africa to India & China?
- E. Why were spices so valuable and expensive?

III. Columbus' Solution: Sail west to reach the east?
- A. Columbus' idea of world size
- B. Who sponsored Columbus?

IV. Where did Columbus end up?
- A. "Where he was" versus "where he thought he was."

V. Did Columbus discover America?
- A. Indians & the Bering Land Bridge
- B. Scandinavian explorers
- C. Other possible explorers
  1. English fishermen
  2. Chinese on the American west coast

VI. How did Columbus Navigate?
- A. Compass, Dead Reckoning, simple Celestial Knowledge
- B. Quadrant & how it was used
- C. North Star used to find latitude
- D. Why magnetic north and true north vary & Columbus' explanation.

VII. How these simple tools aided in understanding many common geographic principles.

Bibliography

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Vocabulary

Antarctic Circle An imaginary circle surrounding the south pole 23.5° north of the southern pole (actual latitude is 66.5° south latitude). South of this line the Sun never rises in the summer season.
Arctic Circle An imaginary circle surrounding the north pole 23.5° south of the northern pole (actual latitude is 66.5° north latitude). North of this line the Sun never rises in the winter season.
Caravel The type of small sailing vessels Columbus used during his explorations.
Compass A device with a suspended magnetic needle that aligns with Earth's natural magnetic field, always pointing toward the north magnetic pole. It is used to determine geographic direction.
Compass Declination The amount off from true north that your compass points due to the fact that the magnetic pole is 800 miles south of true north. This declination is measured in degrees. Here in Maine, our average compass declination is approximately 18° west of true north. On the west coast compass declination is measured east of true north. Along a line running from Florida to Wisconsin, magnetic north and true north line up exactly, so the compass declination along that line is 0°.
Degree A measurement of angle, 1/360th of a circle. In other words, a full circle can be divided into 360 equal pie wedges, each with an angle of one degree.
Equator The imaginary line that goes around the Earth exactly halfway between the two poles. The Sun is only *directly overhead* at the equator two days per year: the vernal equinox (the first day of spring) and the autumnal equinox (the first day of autumn). In the summer ,the Sun stays slightly north of the equator; in the winter the Sun stays slightly south of the equator.

Vocabulary Continued:

Geography The study of the Earth, its features, natural resources, and the distribution of life.
Hemisphere Half of a sphere. Earth is often divided into hemispheres such as the northern hemisphere and the southern hemisphere, or the eastern hemisphere (Eurasia, Africa, Australia) and the western hemisphere (the Americas).
Isthmus A narrow strip of land connecting two larger bodies of land.
Latitude Imaginary horizontal lines on a map that are used to measure one's location north or south of the equator. Latitude is measured in degrees; the equator is always 0° latitude, the north pole is 90° north latitude, the south pole is 90° south latitude.
Longitude Imaginary vertical lines on a map that are used to measure one's location east or west of the prime meridian. Longitude is measured in degrees east or west of the prime meridian which runs through Greenwich Observatory in Greenwich, England.
Magnetic North Pole The spot that your compass actually points towards. It is not at the geographic north pole, but is located 800 miles south of the true north pole in the Queen Elizabeth Islands of northern Canada.
Meridian An imaginary line that runs from north to south. Whatever meridian you are standing on would be your present longitude.
Polaris (the North Star) The star that marks the end of the Little Dipper's handle. It is the 48th brightest star in the sky. It is currently within 1/2° of being directly above the true northern pole of Earth. However, because of a very slow wobbling motion of Earth called precession, Polaris has not always been the north star, nor will it always be. In Columbus' day, it was slightly farther from the pole than it is today.
Quadrant A simple instrument used to measure the angular height of a star, planet, or Sun in the sky. This information can then be used to determine latitude but <u>not longitude</u>. Columbus carried a quadrant, but he did not put much faith in it. The Quadrant is the predecessor to the modern sextant.
Tropic of Cancer An imaginary circle surrounding the Earth 23.5° north of the equator. It is the same as the 23.5° parallel of north latitude. This is the farthest north the Sun can actually appear directly overhead, and it only appears directly overhead at this latitude on one day each year, the summer solstice (first day of summer)
Tropic of Capricorn An imaginary circle surrounding the Earth 23.5° south of the equator. It is the same as the 23.5° parallel of south latitude. This is the farthest south the Sun can actually appear directly overhead, and it only appears directly overhead at this latitude on one day each year, the winter solstice (first day of winter).
23.5° This angle represents the tilt of the Earth compared to the plane of the Earth's orbit about the Sun. This 23.5° tilt is what creates the seasons, and also it is what designates the polar and tropical regions of the earth. (Also see: Arctic Circle, Antarctic Circle, Tropic of Cancer, & Tropic of Capricorn.)
Strait A narrow stretch of water between between headlands that connects two larger bodies of water.
Western Hemisphere (the New World) The Americas.
Eastern Hemisphere (the Old World) Europe, Asia, Africa, & Australia.

Study Questions:

1. **Where was Columbus trying to go when he sailed west across the Great Ocean from Spain?** (*Indies, India, southeast Asia, China, & Japan.)*

2. **Why was getting to the (East) Indies so important?** (*Spices--such as cinnamon, cloves, pepper, nutmeg, were more valuable than gold. Also the far east brought jade, porcelain, silk, & gold.)*

3. **How did Europeans get these valuable items before Columbus?** (*Originally they were introduced by Muslim traders in the middle east, but middle eastern trading was very expensive, which led to searching out long and hazardous water routes around Africa.)*

4. **Did everyone in Columbus' day really believe the world was flat?** (*No. It was common knowledge to all educated people that the world was round. It had been proven by Eratosthenes in Egypt around 300 B.C.)*

5. **Did Columbus really discover America?** (*No, and yes. No-- he was definitely not the first person from the old world to visit the Americas. The Vikings explored northeastern North America, a settlement has been discovered at L'anse Aux Meadows, Newfoundland. There is evidence that Scotish fishermen fished off North American shores well before Columbus. On the west coast of America there is evidence of Chinese explorations that predate Columbus. And of course the Native Americans beat everyone here, and they were originally from Asia. Yes, in a way he did discover America for the European nations. Columbus was the one who truly opened up America for European exploration and exploitation.)*

6. **Where does a compass point?** (*It points toward the magnetic north pole, which is 800 miles south of the real north pole.)*

Geography Project Ideas

1. **Imaginary Island** Have your students create their own "Imaginary Island" maps utilizing as many different geographical features as possible.

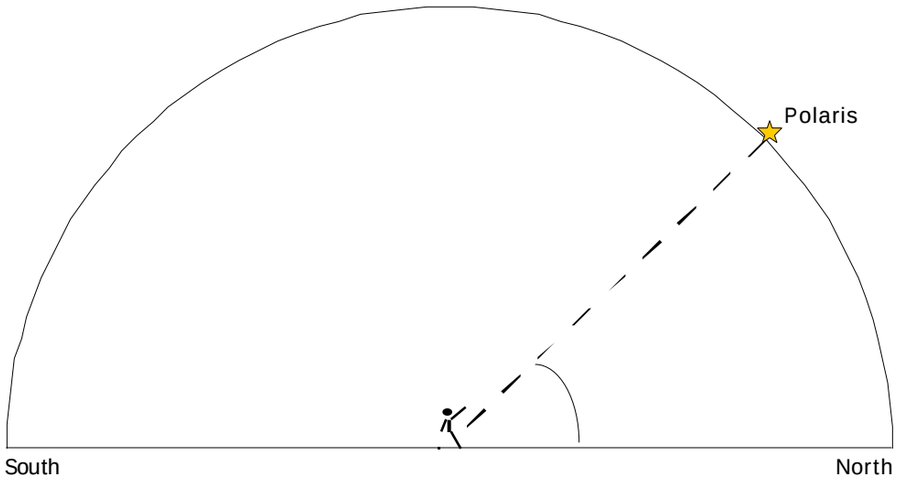
2. **Map & Treasure** Have your students map the school and its grounds. Have them measure distances in paces or by a real foot, or hands, or fingers; this will help them understand why many early distance measurements were so inaccurate. Have them use a compass to set the proper directional layout of the school. Then divide the class into three or four groups, have each group create their own treasure chase by writing up a description of where they want another to go to find their treasure. Have them make the chase more or less difficult depending on age. The description can only contain compass directions and the number of paces necessary to get to the treasure. See if their classmates can find each others treasures.

3. **How Many?** Who can find the most different seas? Who can find the most mountain ranges? The most gulfs? The most deserts? The most straits? Peninsulas? Isthmuses? etc., etc., etc. Have them use globes, atlases, almanacs, etc. The point here is to get them using reference books.

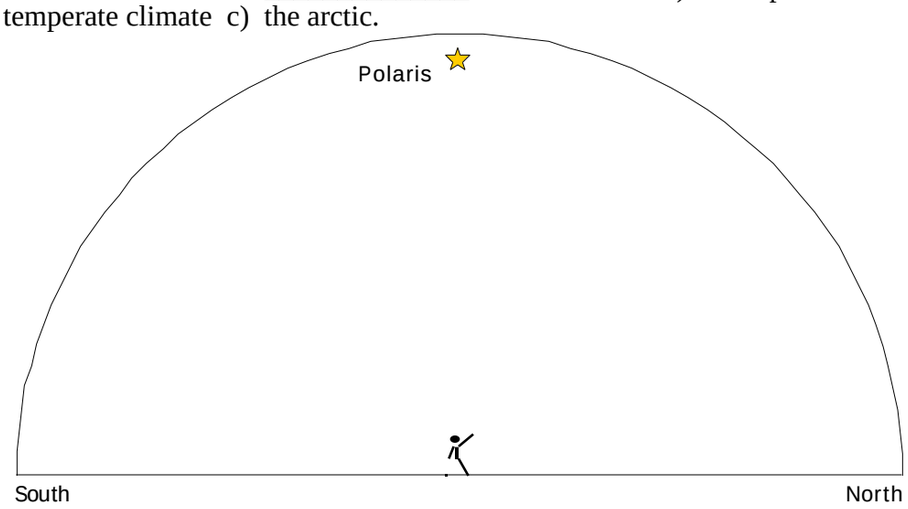
Finding Your Latitude Using the North Star

Polaris, the North Star, is nearly above the north pole. A basic method for determining latitude is measure Polaris' altitude above the north horizon in degrees. Polaris' altitude in degrees equals your approximate latitude.

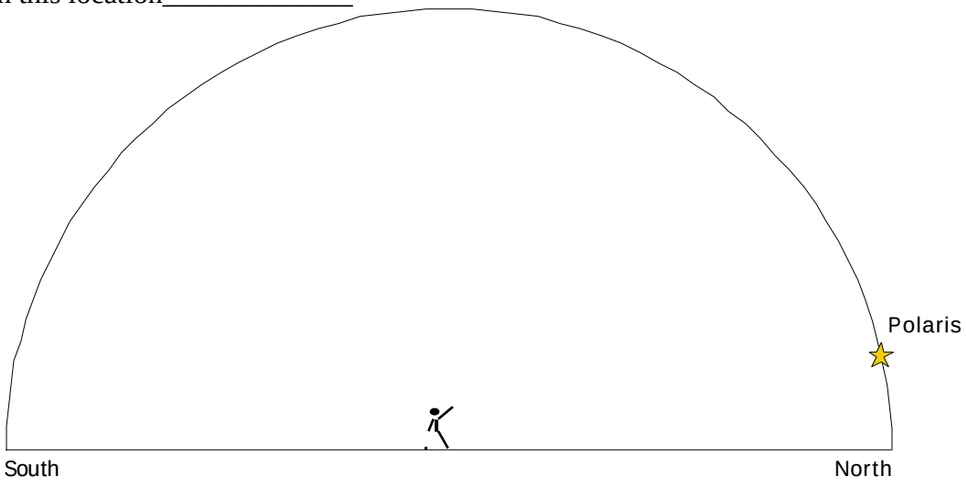
In the three diagrams below, measure Polaris' altitude using a protractor to determine the person's location in latitude. Measure the angle from the man in the center.



What is our hero's latitude?_____ Is our hero in: a) the tropics b) a temperate climate c) the arctic.

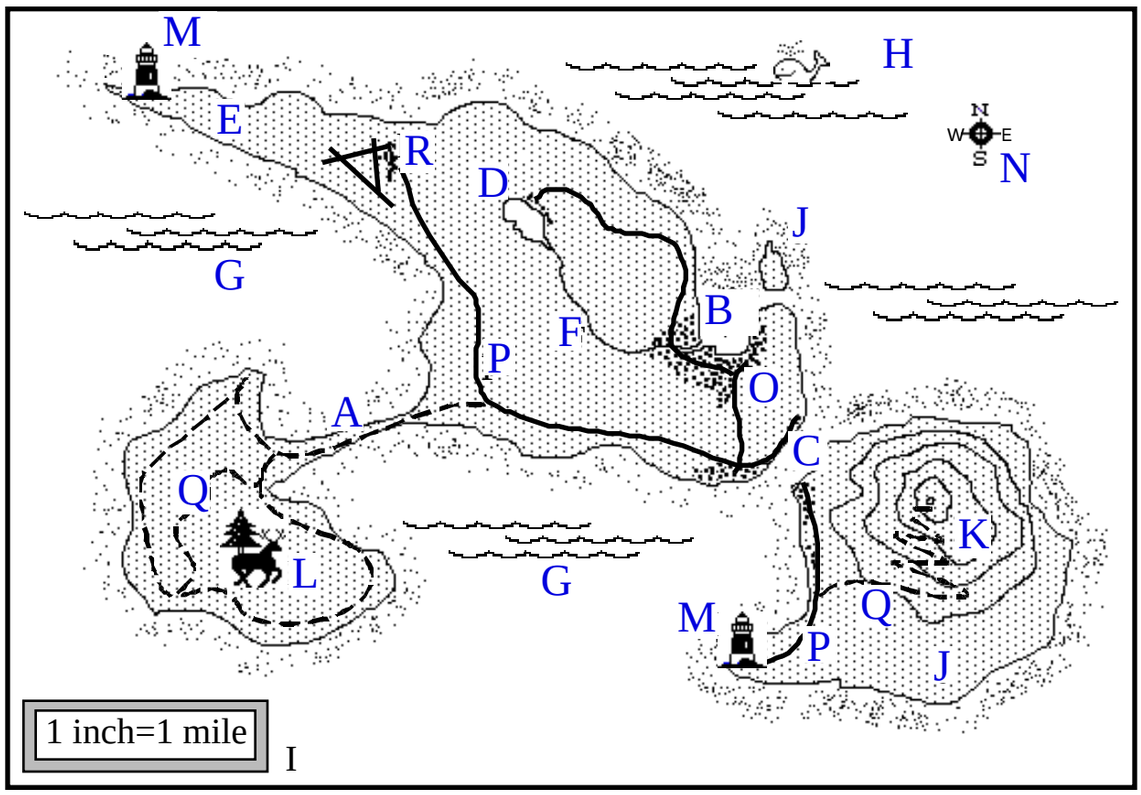


What is our hero's latitude?_____ Is it likely to be very hot or very cold in this location_____



What is our hero's latitude?_____ Would you more likely find polar bears or lizards at this latitude? _____

IMAGINARY ISLAND. . . .
somewhere in the ocean blue

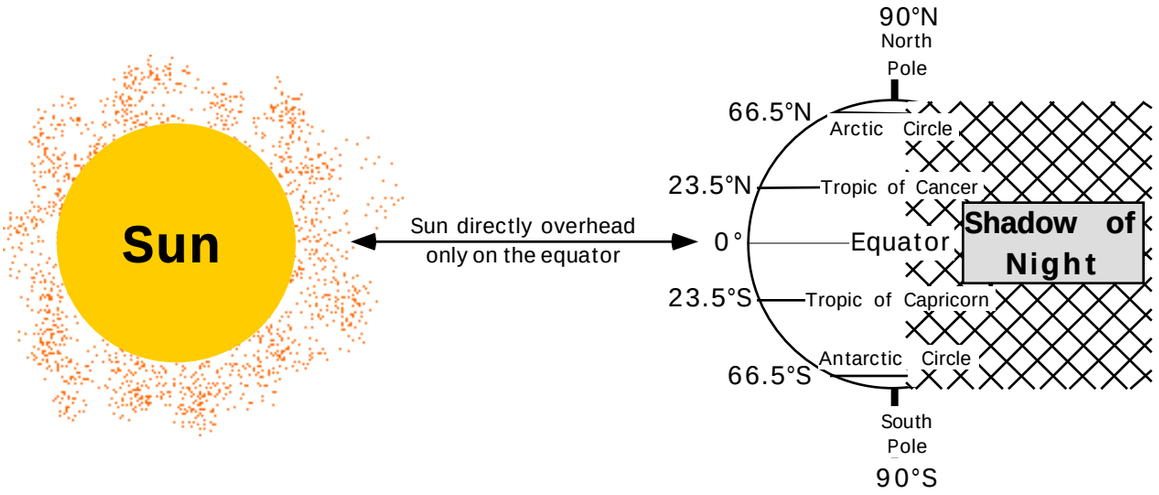


Match the Features on the Map with those Listed Below:

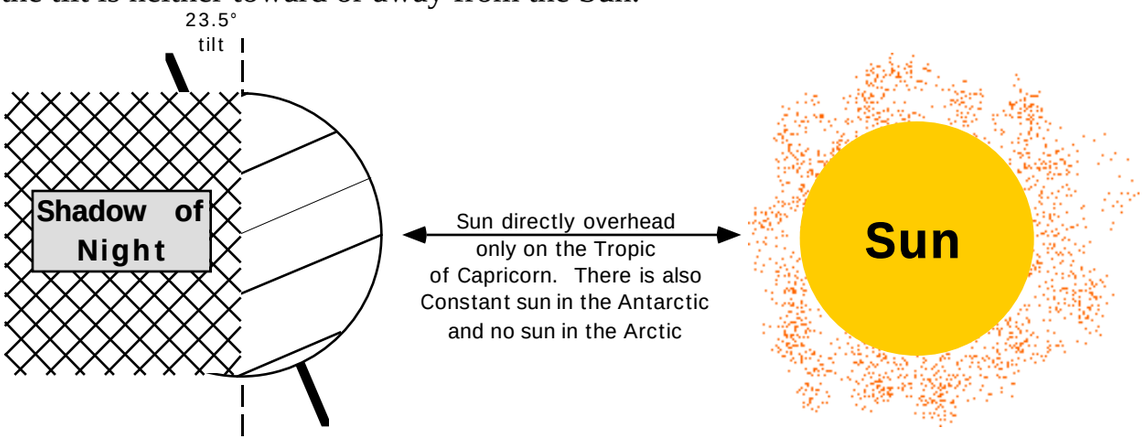
Airport, Bay, City, Compass Rose, Footpath, Harbor, Island, Isthmus, Lake, Lighthouse, Mountain, Ocean, Peninsula, River, Road, Scale Indicator, Strait, Wildlife Sanctuary

A:_____B:_____
C:_____D:_____
E._____ F:_____
G:_____H:_____
I: _____J:_____
K:_____L:_____
M_____N:_____
O:_____P:_____
Q:_____R:_____

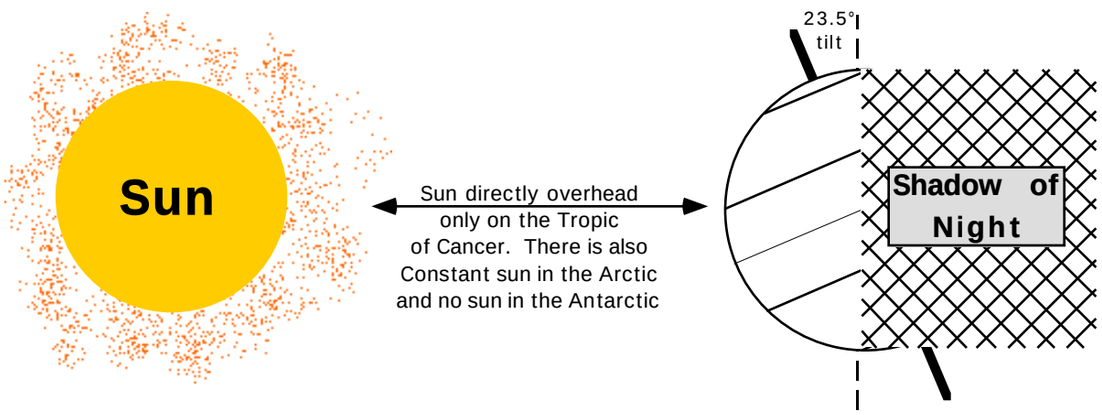
How the Earth's Tilt of 23.5° creates the Tropics, the Arctic, & the Antarctic regions



Earth and Sun Relationship on the Vernal (Spring) & Autumnal Equinoxes when the tilt is neither toward or away from the Sun.



Earth and Sun Relationship on Winter Solstice (1st day of winter).



Earth and Sun Relationship on Summer Solstice (1st day of summer).

Study Questions:

1. Can the Sun ever pass directly overhead north of the Tropic of Cancer?
2. Do the arctic and antarctic regions ever have sunlight at the same time?
3. When it is summer in the north, what season is it in the south? Vice-versa?
4. If the Earth were not tilted, the Sun would always be directly above where?
5. If the Earth were not tilted, what would happen to the seasons? Why?

Alexandria, Egypt, 300 B.C.: Eratosthenes Proves that the World is Round!

On the summer solstice (the first day of summer) in about the year 300 B.C., a man named Eratosthenes did an experiment in Egypt that not only proved the world was round, but also enabled him to make a fairly accurate estimate as to the Earth's size.

Eratosthenes was a librarian at the great library of Alexandria, Eygpt. One day he came across a papyrus (an ancient writing on a scroll of paper) that told of the southern town of Syene. In Syene on the summer solstice each year at precisely noon-time, and only at that time each year, the Sun shown all the way to the bottom of a well. Also, at the same time, vertical posts cast no shadows. This meant that the Sun was directly overhead. This made Eratosthenes wonder if the same thing would happen in Alexandria on the solstice. When the solstice came he placed a post in the ground. At noon-time the post cast a sizeable shadow with an angle of 7°. Eratosthenes was also a good mathematician. He knew that the angle cast by the shadow would equal the angle created at the center of the Earth between Syene and Alexandria (In Fig.2: angle A = angle B). He also knew that a circle has 360°; therefore, if you divide 360° by the 7° angle of the shadow, it will tell you how many of those angles would have to be put together to equal a full earth: $360 \div 7 = 51.43$

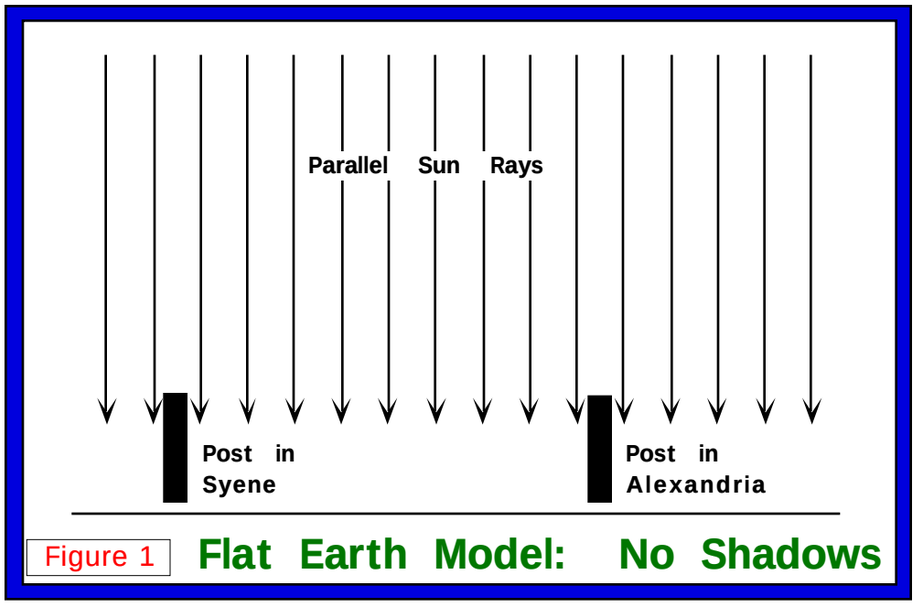


Figure 1 **Flat Earth Model: No Shadows**

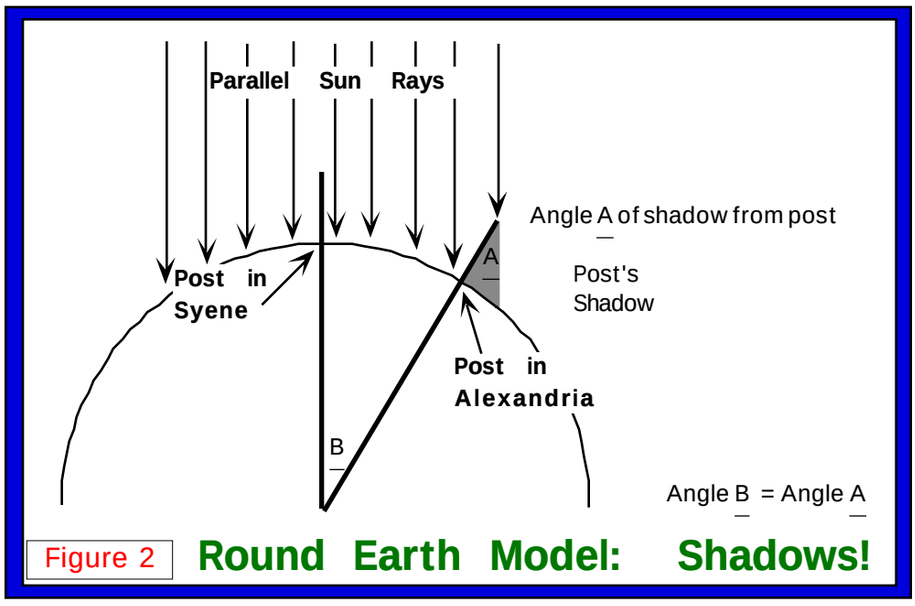
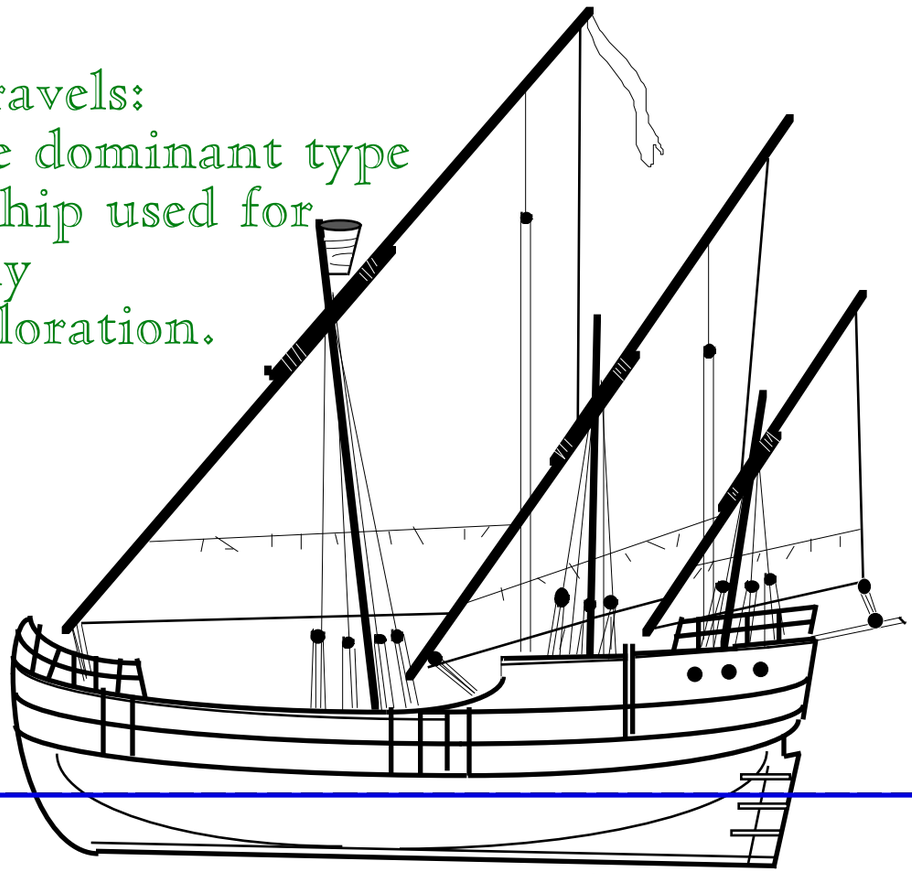


Figure 2 **Round Earth Model: Shadows!**

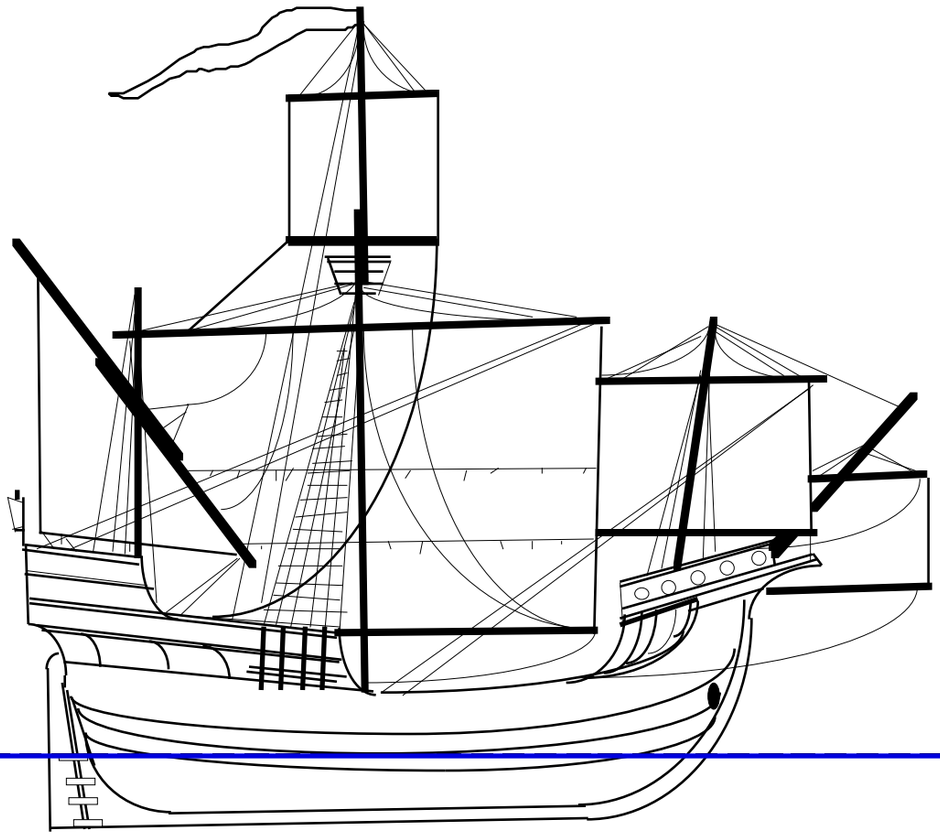
Eratosthenes then hired a man to pace out the distance from Alexandria to Syene. The distance was measured to be 500 miles. Eratosthenes reasoned that 7° of Earth's circumference is thus 500 miles; therefore: 51.43 X 500 miles = distance around Earth, or 25,715 miles.

Eratosthenes not only proved that the Earth was round, but also estimated Earth's circumference as just over 25,000 miles. The actual circumference is 24,901.55 miles. A very close estimate. Where do you suppose the error came from?

Caravels: The dominant type of ship used for early exploration.



Nina with a lateen sailing rig. Columbus later refitted her with a similar rig to the *Santa Maria* below. *Nina* was Columbus' favorite ship of the three.



Santa Maria, Columbus' largest ship in 1492.

Planetarium Program Evaluation

After the Northern Stars Planetarium has visited your class, please take a moment to fill out this evaluation. Your suggestions are very valuable to us!

Mail the completed evaluation to :.....Northern Stars Planetarium
15 Western Ave.
Fairfield, Maine 04937
Or Email To :.....info@northern-stars.com

1. Show Name: _____

2.Group grade/age level:_____

3. Was the material presented at an appropriate level for your class? _____

_____

4. Was the amount of material discussed: Enough Overwhelming Not Enough

5. Should any parts of the presentation be developed further? _____. If so, which parts?

6. Was there sufficient time for questions and answers? Yes No

7. Were you studying astronomy or another related subject at the time of the planetarium's visit?
Yes No
If so, was the planetarium visit helpful? _____

8. Was the Teacher's Guide helpful in preparing your class for the planetarium visit? Yes No
Which parts were most helpful? _____
Which parts were least helpful? _____

9. Did the presenter present the material in a clear and understandable fashion? _____

10. How would you rate the overall program given to your class in the planetarium? _____

_____

_____

11. (Optional) Your name & school:_____

Please feel free to write any *further comments* on the back.

Thank you for your time! Your Comments Make a Difference!