Geometry Activities from Many Cultures

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Contents

Name ______________________________________

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Some Native American Maps

Long before Columbus, many of the Indian nations of the Americas had developed skills as mapmakers. When Columbus was lost off the coast of Central America, a lone Maya fisherman made a map of the region for the Spaniards. The first English settlers in North America also made use of Native American maps.

Lamhatty's map is a famous example of these mapmaking skills. In 1707, a young Native American named Lamhatty was captured near the Florida Gulf Coast. His captors marched him north through territory unknown to him. They were on their way to sell Lamhatty in the English slave markets. The young man escaped and walked for nine more days. Then he surrendered to the English in Virginia, who enslaved him again. When a British officer asked Lamhatty about his 600-mile forced march, he described his journey and drew a very good map.

The story had a happy ending, because when summer came Lamhatty escaped again and remained free.

Group Project

Reconstruct Lamhatty's map from the following description that he gave of his journey. Refer to an atlas to find the rivers and towns he passed on his travels.

1. Lamhatty was captured in his hometown near the Florida Gulf (probably between Pensacola and Panama City). He described it as "the waves tumble and roar like a sea."

2. He was taken north to Abekas on the Coosa River, in what is now Alabama.

3. Next stop was Tallapoosa, Alabama, where he was forced to work in the fields all summer.

4. He traveled east to Oconee on the Oconee River, in what is now Georgia.

5. Then he crossed the Oconee River and walked through southern Appalachia to the headwaters of the Savannah River, in Northeastern Georgia.

6. Lamhatty was then taken north "along the ledge" of the Blue Ridge mountains, probably north through North Carolina, into Virginia.

7. Lamhatty escaped on a branch of the Rappahannock River, probably the Rapidan, "as the river flows out of the mountains." It was north of present-day Charlottesville.

8. He walked east and surrendered to the English in northern Virginia, not far from the present-day District of Columbia.

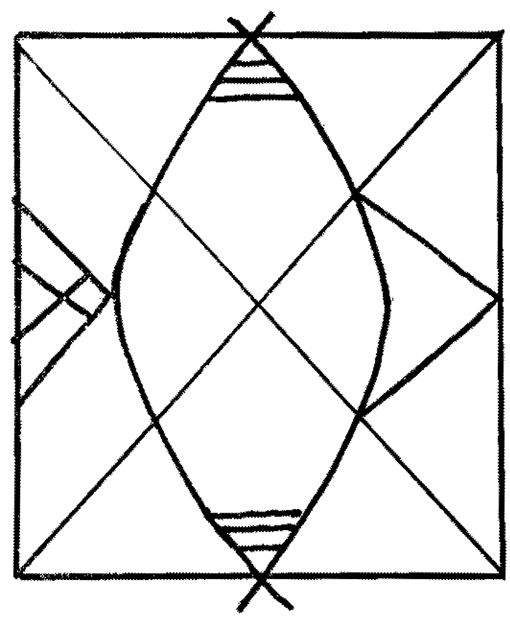
Name ______________________________________

Date ______________________________________

Navigators of the Pacific

Long before Columbus, the Marshall Islanders learned to navigate hundreds of miles of open sea between Pacific Ocean islands. Their science of navigation required knowledge of star altitudes for different locations, and the effect of wind and wave patterns. For example, an island over the horizon can be detected because waves striking the island are reflected. The reflected wave alters ocean swell patterns up to 80 kilometers out at sea. Birds can also serve as guides. When navigators see birds at sea, they know they are close to an island. If the birds are of a species that returns to land at night, the sailors wait until late afternoon to follow the birds to port.

Some of the small coral islands lie low in the water and are not visible from a distance. Often a cloud mass gathers over these small islands. When navigators spot a cloud, they know it may signal land. Sometimes the reflection of the island is visible on the underside of a cloud. The navigators' knowledge is highly valued. Students who attend schools for future navigators are carefully selected. Maps such as the following are used to teach patterns of the ocean swells—those coming in to the island and those reflected from the island. These maps made of sticks are called Meddo charts. The following example, on display at Chicago's Field Museum, shows the waters between Majuro and Jaliut Atolls in the Republic of Marshall Islands.



STAR MAPS OF PACIFIC ISLANDERS

Long before the Europeans came to their islands, Pacific Islanders had developed their own advanced technology and science. The islanders created special maps to teach wind and wave forms. Since the lives of the crew depended on the navigator's knowledge, young navigators were very good students. They learned to steer by the stars, following a star compass which they had memorized. Pacific Islanders found their way across open ocean to islands 700 km away without the aid of a magnetic compass or radio.

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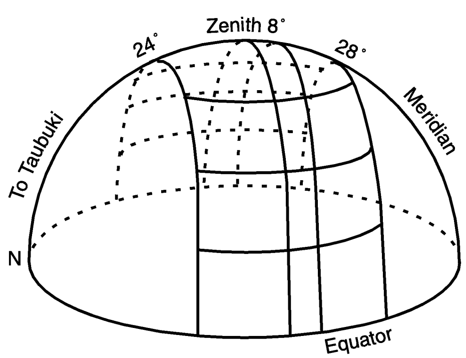
Navigators of the Pacific *(continued)*

Island astronomers remembered which stars rose on the horizon in the direction of islands they wanted to visit. For each island destination, the Pacific Island navigators followed a whole series of stars, since star positions change as the earth turns. In the Caroline Islands, the star compass, or map, showed the horizon as a big circle. Naturally, their own island was at the center. The circle was divided by radii that point to the rise and set positions of 16 bright stars. These star positions were used to locate lands they often visited.

Gilbert Island students also used a study guide made in the form of stone slabs. The islanders called them the Stones for Voyaging, or Stone Canoes. Each pair of stones also lined up with the rising and setting points of some of their guide stars. For example, at sunset in August, the star Regulus rose and lined up with the stone pointing to Tamana, 80 km away. By midnight, Regulus was in a different position and the star Arcturus lined up with the Tamana stone.

To give more exact positions for star locations, Gilbert Islanders created their own coordinate system for the heavens. They mentally sliced the sphere of the skies with four east–west planes. Then they sliced the sphere parallel to the equator and assigned names to each sector. In all, Pacific Island navigation was an intellectual achievement of the highest order.



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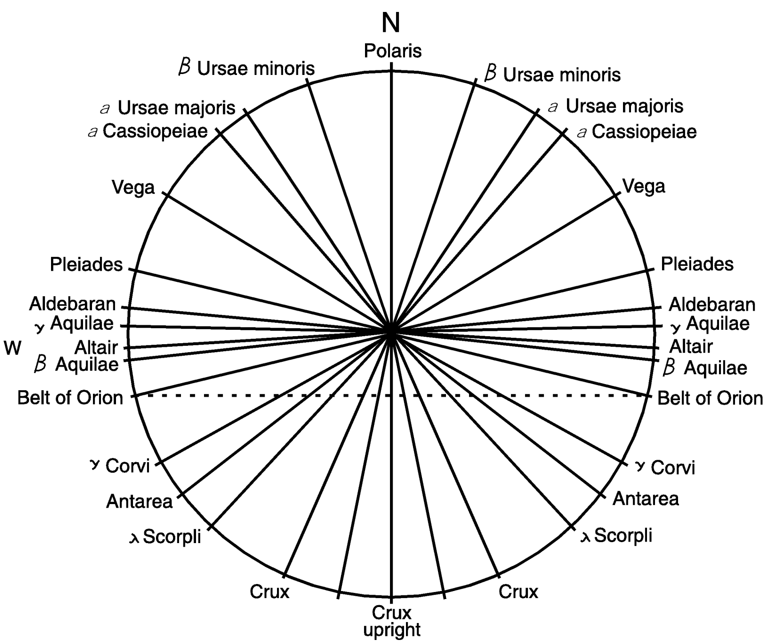

after Goodenough, 1953

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Navigators of the Pacific *(continued)*

Questions for Critical Thinking

1. In what ways was Pacific Island navigation scientific?

2. The skill of the island navigators depended, in part, on the navigator's excellent memory. How important is a good memory in your schoolwork? Do you think it was easy or hard for the islanders to memorize their lessons? Explain.

3. Which of the stars in the Caroline Island map can be seen in your location? *Hint:* "Stars Visible at Dusk" are often listed on the weather page of daily newspapers.

4. Using words only—no numbers—write a description that locates a given object in the classroom. The path to the object can start from the front door of the classroom.

Group Project

Visit a lake, river, or ocean shoreline. Discuss the best way to make a map of several miles of the shoreline. Divide up the sectors to be mapped among group members. Put the map together and submit it to your class for discussion.

Name ______________________________________

Date ______________________________________

Benjamin Banneker: District of Columbia Surveyor

Benjamin Banneker was one of the earliest practicing mathematicians in the United States. As a child in the 1730's, he attended a country school in Maryland. Everything else—algebra, trigonometry, and astronomy—he had to learn on his own. Banneker's genius led to his appointment as astronomer for the survey team to plan the city of Washington, D.C. He is also famous for his almanacs. Local almanacs gave the time of sunrise and sunset, moonrise and moonset, planetary positions, times of eclipses, tides, and so on. The time for these events depended on the city's latitude and longitude.

Longitude and Latitude

The longitude and latitude of Baltimore entered all of Banneker's calculations for his almanac. Longitude and latitude are the coordinates used to locate a point on the surface of the Earth's globe. The axes on the globe are the equator and the Greenwich prime meridian. Latitude is measured north or south from the equator. Longitude is measured east or west from the Greenwich meridian, which goes through London. Meridians appear like vertical lines on the globe but are actually great circles connecting the North and South Poles.

The longitude of Baltimore is 76.6° West. When it is sunrise in London, it is still night in Baltimore. How much later will the sun rise in Baltimore? That depends on how long it takes the Earth to turn 76.6°. Since the Earth turns 360° in 24 hours, it will take (76.6/360)24 hours = 5.1 hours. An adjustment is also needed for latitude because Baltimore is 39.3° north of the equator, while London is 51.3° north of the equator. Banneker completed thousands of calculations, like these, for each almanac.

Questions for Critical Thinking

1. Remember that the Earth turns from West to East. If it is sunrise in London, at that moment is it light or dark:

   (a) in New York? __________ (b) in Chicago? __________ (c) in Rome? __________

2. Sacramento, California is about the same latitude north of the Equator as Baltimore. But Baltimore is at longitude 76.6° West and Sacramento is a longitude 121.5° West. When the sun has just begun to rise in Baltimore, it is still night in Sacramento. How much later will the sun rise in Sacramento?

3. The Earth's globe is divided into 24 equal time zones. How many degrees of longitude are there to each time zone?

Name ____

Date ____

Latitude and Longitude Measure

Project

MATERIALS

meterstick, white or light-colored sphere with smooth surface (could be plastic sphere, snowball Christmas tree ornament), world globe for reference, string, lettering line-tape or pen and pencil

Check off each step as you complete it.

- ❑ 1. Study the globe of the earth to observe the longitude and latitude circles. These are imaginary circles people use to locate points on the surface of the earth.
- ❑ 2. With line-tape or a pen, mark a great circle on a blank globe or sphere to represent the equator. Great circles are the largest circles that go around the globe. Their center is the center of the earth. Mark points not on the equator as north or south of the equator.
- ❑ 3. At any point on the equator, draw a second great circle perpendicular to the equator. This represents the zero meridian that goes through Greenwich and both poles of the globe. Points not on this meridian will be marked as east or west of Greenwich.
- ❑ 4. With a flexible tape or string, measure the length of the equator. If you are using a string, use a meterstick to find the length of the string.
- ❑ 5. Divide the length of the equator into 24 equal parts. Starting with the zero meridian, lightly mark the division points on the equator.
- ❑ 6. Draw great circles at each of the points marked on the equator, perpendicular to the equator. These circles must pass through both the North and the South Poles. The circles you have just drawn represent the meridians.
- ❑ 7. On a meridian, mark a point about 23.5° north of the equator, which is about $\frac{1}{4}$ of the distance from the equator to the North Pole. Through this point, draw a circle parallel to the equator. This is not a great circle. This line represents the tropic of Capricorn, the most northerly latitude in which the sun is directly overhead at noon on June 21.
- ❑ 8. Repeat step 7 but mark a point about 23.5° south of the equator, about $\frac{1}{4}$ of the distance from the equator to the South Pole. Through this point, draw a circle parallel to the equator. This line represents the tropic of Cancer, the most southerly latitude in which the sun is directly overhead at noon on December 21.

Class Discussion

1. Are the meridians parallel? Why or why not?
2. Are all the meridians the same length? Are all of the circles of latitude the same length?
3. What are the latitudes of the equator, the North Pole, and the South Pole?