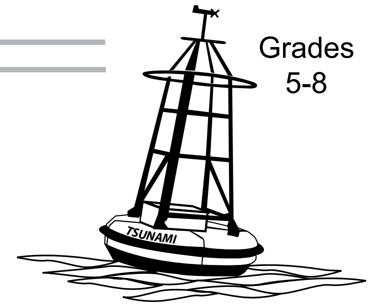
Tsunamis with a Latitude



Grades 5-8

Overview:

Globes, which are spherical maps of Earth, can be useful when learning about tsunamis. All maps, including globes, use a system of lines, including latitude and longitude, prime meridian, and the international date line as a reference for specifying location. During this lesson, students learn the significance of the many lines drawn on globes, and use latitude and longitude lines to learn more about their own community.

Targeted Alaska Grade Level Expectations:

Math

[7] F&R-5 The student demonstrates algebraic thinking by evaluating algebraic expressions.

Objectives:

The student will:

- locate, label, and understand the significance of the equator, prime meridian, international date line, Arctic Circle, Antarctic Circle, tropic of Cancer, and tropic of Capricorn;
- understand the difference between latitude and longitude; and
- use latitude and longitude to locate familiar places on a map and determine the latitude and longitude of his or her community.

Materials:

- Masking Tape
- World globe
- Map of Alaska
- VISUAL AIDS: “Latitude Lines,” “Longitude Lines,” and “International Time Zones” (transparency or CD versions located in the pocket at back of this lesson manual)
- STUDENT WORKSHEET: “Tsunamis with a Latitude”

Science Basics:

The art of marine navigation dates back more than five centuries to a time when trade boats first traveled within sight of the shore and used landmarks to determine their bearings. Early voyages that required several days of open ocean travel were undertaken by the Polynesians, who populated Hawaii about A.D. 300, and by the Vikings, who traveled between Iceland and Greenland beginning around A.D. 900. These voyages required a navigator who could determine their progress north or south based on the height of the sun in its east-west movement across the sky. At night, they determined their bearing based on the North Star and major constellations such as Orion in the Northern Hemisphere and the Southern Cross in the Southern Hemisphere. Progress to the east or west was more difficult to determine and was generally based on the assumed speed of travel and the duration of time spent traveling. One means of determining speed entailed tying knots in a line and weighting the end. The weight was thrown in the water, and speed was calculated by counting how many knots in the rope played out over a set time. It is interesting to note that the speed of a boat is still referred to in knots per hour.

Activity Preparation:

1. Make 4 compass point (North, South, East, West) labels and post them on classroom walls. Use masking tape to draw a grid on the classroom floor. Label the equator and two lines above and below

with 10 and 20 degrees. Label the perpendicular (longitude) lines 0, 10, 20, and 30 degrees.

Activity Procedure:

1. Tell students that to pinpoint any location on a world map or globe without searching randomly, a grid work of imaginary lines has been established from east to west, and from north to south, covering the whole world. This grid work of lines is like a street map, and a system of degrees and directions are used, like a house address or the intersection of two roads, to pinpoint a location anywhere in the world. For students who have used a Global Positioning System (GPS), this system of labeling a location may be familiar.
2. Help students practice using a grid coordinate system by calling out coordinates on the classroom grid and asking students to go to each coordinate.
3. Use a world globe to show how Earth is divided into the Northern Hemisphere and the Southern Hemisphere by a circle around the globe called the equator.
4. Place the VISUAL AID: “Latitude Lines” on the overhead projector. Define lines of latitude, and explain that the North Pole is at 90° north latitude (90° N) while the South Pole is at 90° south latitude (90° S). The equator is at 0° latitude. A hint for remembering latitude is that the lines run horizontally, like a ladder, or “laddertude.”
5. Ask students to locate the Alaska Peninsula on the State of Alaska Map. Ask students: On the globe, what latitude line lies below Akutan Island? What latitude line lies below Lake Clark? (Students should be able to find 54° N below Akutan Island and 60° N below Lake Clark.)
6. Point out the Arctic and Antarctic Circle on the globe (they may appear as dotted lines). Ask students if they know the meaning of these circles. Explain that the circles indicate the highest latitude at which the sun can be seen throughout the year. Beyond this point there is a period of darkness each year when the sun never crests the horizon, and a period of light when the sun does not set. The winter and summer solstice, the days with the shortest period of sunlight and longest period of sunlight respectively, are on or about December 21 and June 21.
7. Use the world globe to explain that Earth also is divided into the Eastern Hemisphere and the Western Hemisphere by two imaginary lines running from the North Pole to the South Pole called the prime meridian and the international date line. The prime meridian runs through Greenwich, England, while the international date line runs through the Bering Strait, north of the Alaska Peninsula. Point these same lines out on the State of Alaska Map.
8. Place the VISUAL AID: “Longitude Lines” on the projector on top of the VISUAL AID: “Latitude Lines.” Define lines of longitude, and point out that Greenwich, England, lies along the prime meridian at 0° longitude, while the western coast of Alaska lies just east of the international date line at 180° latitude.
9. Use the globe to show that locations east of the prime meridian and west of the international date line have an eastern longitude and lie in the Eastern Hemisphere, while locations west of the prime meridian and east of the international date line have a western longitude and lie in the Western Hemisphere.
10. Ask the class in which hemisphere the Alaska Peninsula is located.
11. Project the VISUAL AID: “International Time Zones” in front of the class.
12. Explain that the prime meridian also is the line used to establish time zones around the world. Imaginary lines run from the North Pole to the South Pole to make up 24 time zones around the world. The time zone containing the international date line, which runs through the Bering Strait, represents the first hour in a 24 hour day, while the time zone to the west of the international date line represents the last hour in a 24 hour day. Consequently, on the west side of this line it is 24 hours later than it is on the east side of this line. Point out that the international date line has some bends in it. This was done

to allow all of Alaska to fall within one day, while all of Russia falls within the next day. A similar bend occurs in the Southern Hemisphere.

13. Point out the Diomede Islands off the westernmost tip of the Seward Peninsula. Explain to students that Little Diomede lies on the east side of the international date line, while Big Diomede lies on the west side. However, they lie within the same time zone. Ask students: If it is 2:00 pm on Little Diomede, what time is it on Big Diomede? This is a little tricky. It's the same time, but it's a day later! They lie within the same time zone, but the international date line divides the time into two days.
14. Ask students why this information is important when studying and mapping tsunamis. Ask students to imagine that a tsunami warning is issued in South America for the western coastline of Australia. How would the projected time of the tsunami's arrival be adjusted for the international date line and the time zones? It would be a day later but nine time zones, or hours, earlier (24 – 9 = 15 hours earlier than predicted).

    Distribute the STUDENT WORKSHEET: "Tsunamis with a Latitude." Students will be asked to label the lines on a globe and then determine the latitude and longitude of their community.

Critical Thinking:

The Fish Bowl Method: Hand out one index card to each student. Ask students to write down one question about the classroom lesson. They may ask a question that will help to clarify something they don't understand about the material, or they may ask a broad question about the subject and its real world application. Ask students to place their questions in a fish bowl and at the end of the class period or at the beginning of the next period, draw out several questions for class discussion.

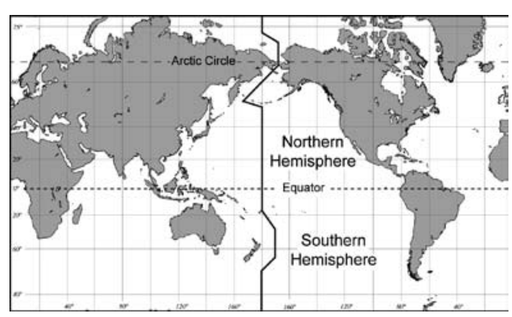
Extension Idea:

Students can gain experience using latitude and longitude lines by playing the game "Battleship" and instead of calling out the existing coordinates of the game, use latitude and longitude coordinates that are taped along the edges of each game board.

Answers:

1.

2.

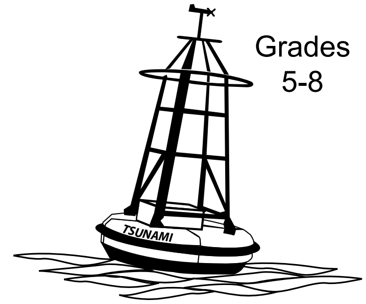


3. *answers will vary*
4. *4591.95*
5. *answers will vary, but should use the same latitude as circled in #3 and demonstrate correct use of mathematical formula*
6. *(Answer to #4) - (Answer to #5)*
7. *15°*

Name:___________________________

Student Worksheet

Tsunamis with a Latitude (page 1 of 4)



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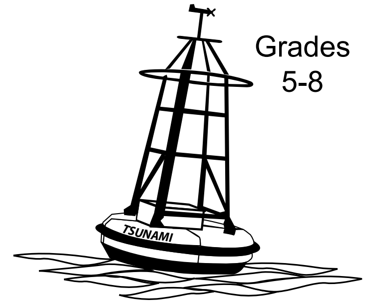
Directions: Label the globe using the words from the box.

equator
prime meridian
Arctic Circle
Antarctic Circle

Name:____________________________

Student Worksheet

Tsunamis with a Latitude (page 2 of 4)



Grades
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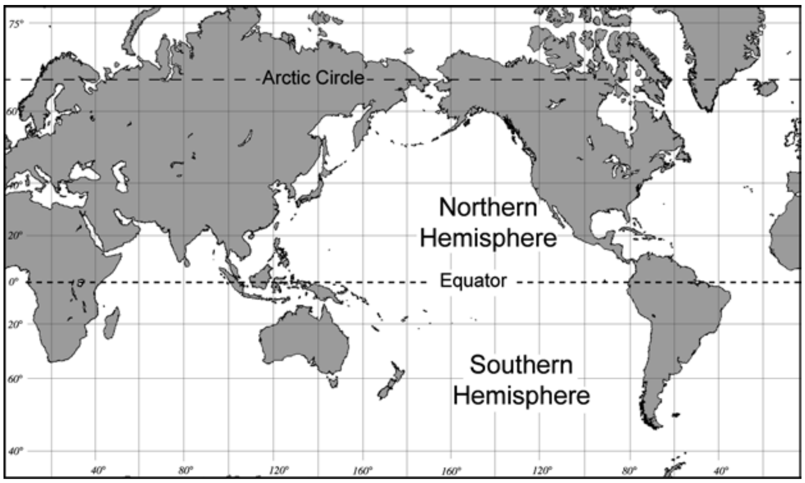
2. Draw the international dateline on the map below.



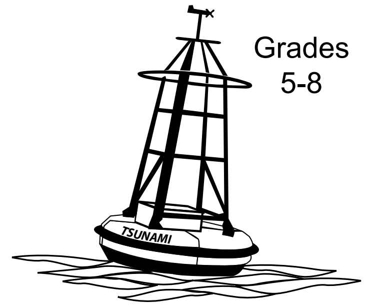
Determining Location using Latitude and Longitude:

3. Latitude and longitude lines cover Earth's surface in an imaginary grid work, like a net covering a ball. These lines make up a coordinate system that can be used to describe any location on Earth's surface. Knowing the exact latitude and longitude for a location can be very important. Global Positioning Systems (GPS) are standard equipment on many boats and aircraft, and can give an exact location in the event of an emergency.

   The latitude and longitude of several communities on the Alaska Peninsula are listed below. Circle the latitude and longitude of your village on the chart below.

Location	Latitude	Longitude
Akhiok	56° 57´ N	154°10´ W
Akutan	54° 8´ N	165°46´ W
Chignik Bay	56° 17´ N	158°24´ W
Chignik Lagoon	56° 20´ N	158°31´ W
Chignik Lake	56° 14´ N	158°45´ W
Chiniak	57° 37´ N	152°11´ W
Cold Bay	55° 11´ N	162°43´ W
False Pass	54° 51´ N	163°25´ W
King Cove	55° 4´ N	162°19´ W
Larsen Bay	57° 32´ N	153°58´ W
Nelson Lagoon	55° 59´ N	161°12´ W
Old Harbor	57° 12´ N	153°18´ W
Ouzinkie	57° 55´ N	152°30´ W
Perryville	55° 54´ N	159° 9´ W
Port Lions	57° 52´ N	152°53´ W
Sand Point	55° 19´ N	160°30´ W

Name:____________________________



Grades
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Student Worksheet

Tsunamis with a Latitude (page 3 of 4)

Using Latitude and Longitude to Determine Distance:

Latitude and longitude can be used to calculate how far the distance is from one place to another. The distance between each latitude line is 111 km or 69 miles. To further pinpoint a location, latitude lines are divided into units of measure called minutes and seconds. A minute is 1.85 km or 1.15 miles, and a second is 30.83 meters or 101.2 feet (see the table below). In the previous chart, only degrees (°) and minutes (´) are given, not seconds (˝). A specific location, like a school, would require that seconds be given as well. Note: Lines of longitude meet at the poles, the distance between lines of longitude is greatest at the equator and decreases as they move north and south toward the poles. Therefore, the distance between lines of longitude will vary depending on location.

Distance between lines of latitude:
1 degree (°) = 111 km or 69 miles
1 minute (´) = 1.85 km or 1.15 miles

Latitude can be used to determine how far your community is from the Arctic Circle. The latitude at the Arctic Circle is given as 66°33' N. Use the latitude of your community (from the chart above) to fill in the missing information and complete the calculation.

4. Start by converting the latitude of the Arctic Circle into miles.

   Arctic Circle latitude = 66°33'

   = (66° x 69 miles) + (33´ x 1.15 miles)

   = 4554 miles + 37.95 miles = ___________ miles

   (Distance from the equator to the Arctic Circle)

5. Next convert the latitude of your community into miles in the same way.

   The latitude for your community is = _____________

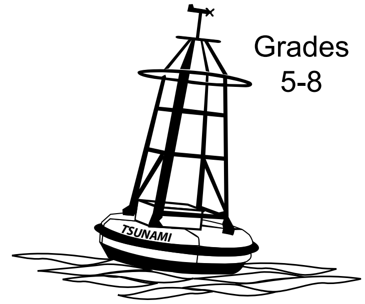
   = (______° x 69 miles) + (________´ x 1.15 miles)

   ______________ + ______________ = __________ miles from the equator

Name:___________________________

Student Worksheet

Tsunamis with a Latitude (page 4 of 4)



Grades 5-8

6. Now subtract the two to find out how far it is from your community to the Arctic Circle:

_________________ - ________________ = _________________
(answer from question 4) (answer from question 5) (miles between your community and the Arctic Circle)

7. Longitude lines are all equal in length. In contrast latitude lines are not. If an explorer were to travel around the world from east to west, would it be farther to travel by following a latitude line at 15° or a latitude line at 60°?

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