

# 5

## Geographers' Tools: Location Systems

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Hunter College Geography

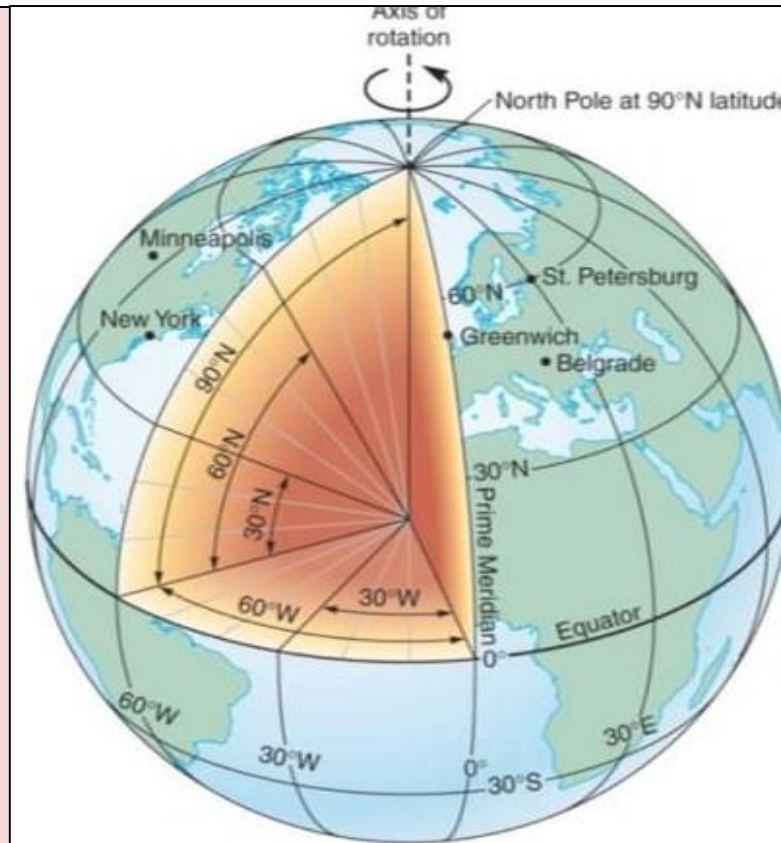
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# Location Systems

❖ **Earth's Grid:** system of points on the surface connected by intersecting lines of latitude and longitude.

To portray data spatially, we need a way to accurately locate places on the earth's surface.

- ❖ This is the **GRID SYSTEM**.
  - Composed of **lines of latitude and longitude**.
    - ✓ Allows us to see **locations, patterns, and interrelationships**.
    - ✓ Allows us to measure **distance**.
    - ✓ Allows us to determine **area**.



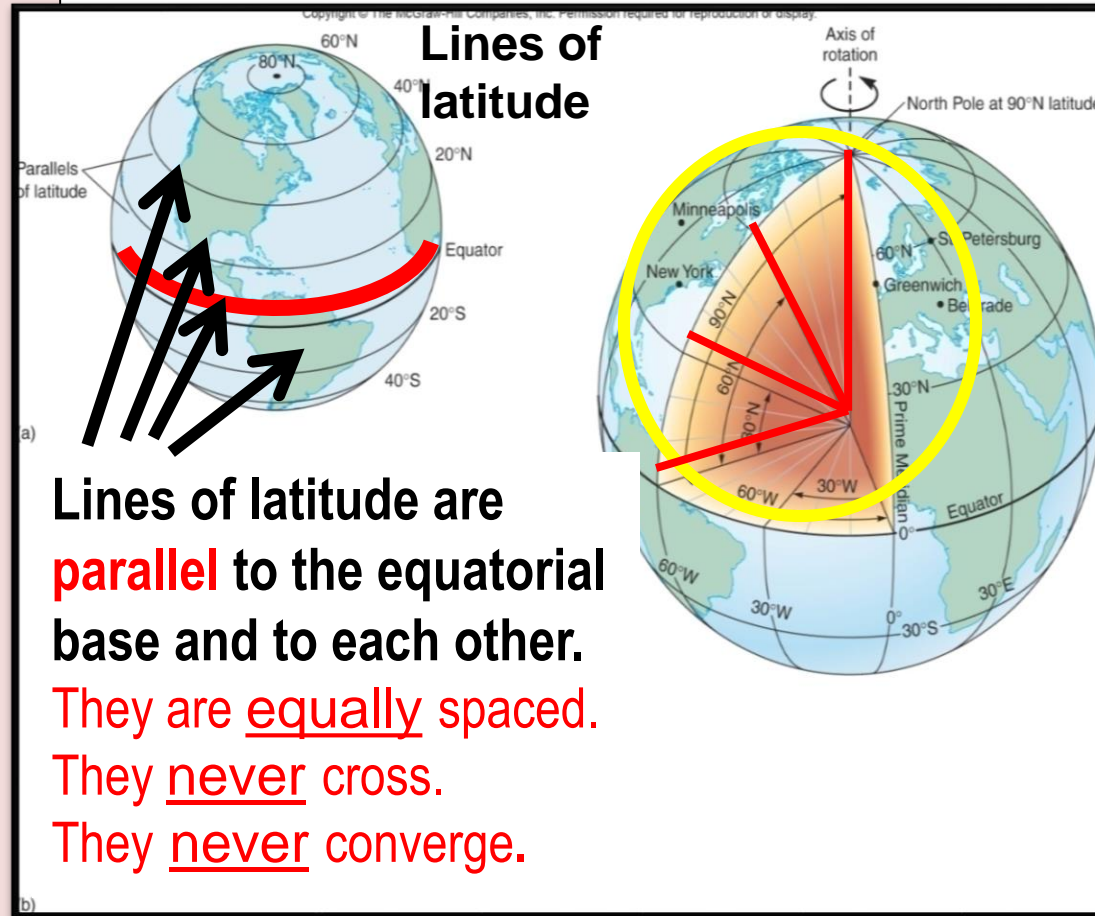
# Latitude

❖ **LATITUDE:** Distance measured in degrees **NORTH** and **SOUTH** of the **EQUATOR**.

It is the result of geometric calculations using the equatorial plane of the earth (equator) as its base.

(The equator is at the center point in the movement of the sun's vertical rays on the earth's surface.)

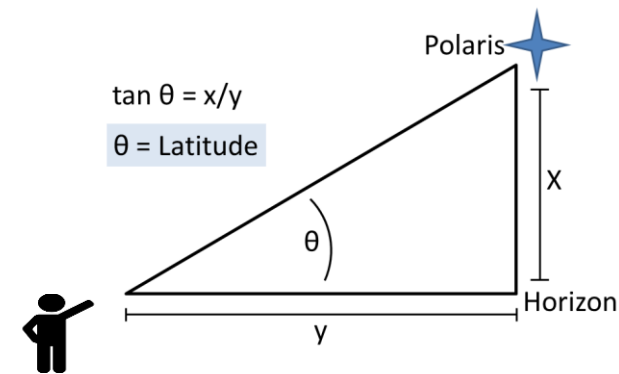
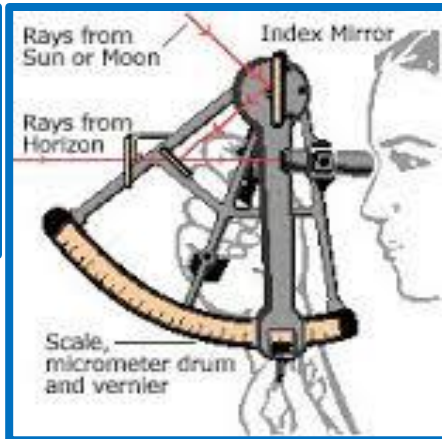
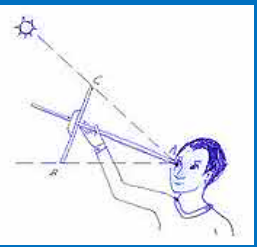
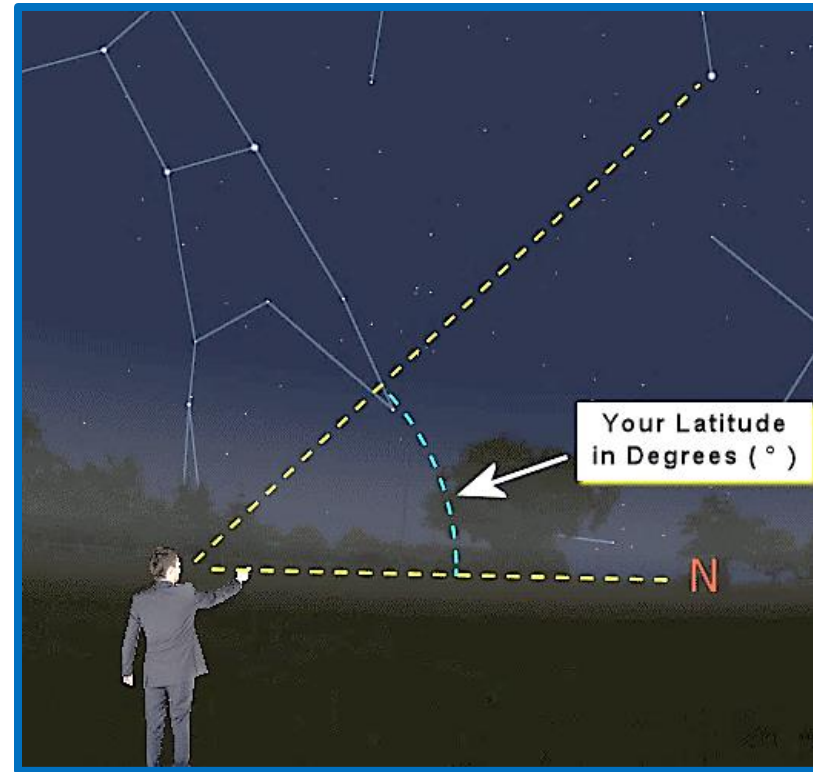
The measured angle of the plumb line from the earth's surface to the center of the equatorial plane equals latitude.



# Latitude

## ❖ Latitude is also astronomical.

You can measure the angle of the sun above the horizon or the height of the North Star at night using a “sextant.” The angle equals latitude.



# Latitude

❖ There are seven lines of latitude we need to know

All are based on astronomical observations.

**90° N = North Pole**

66.5° N = Arctic Circle

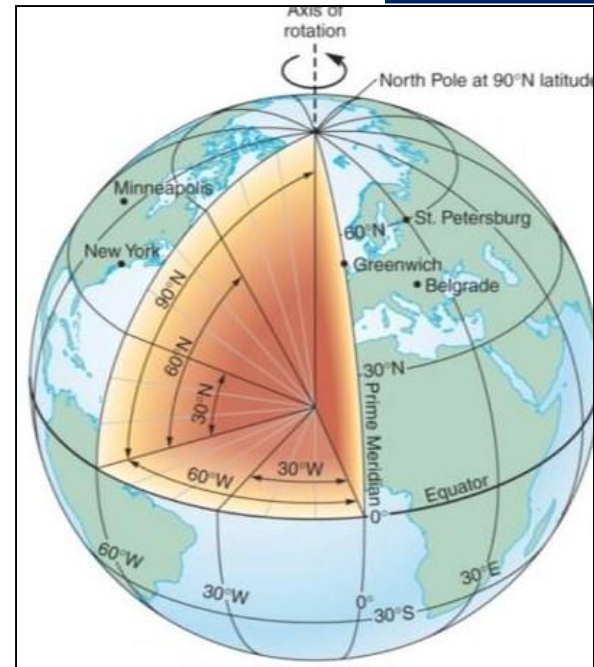
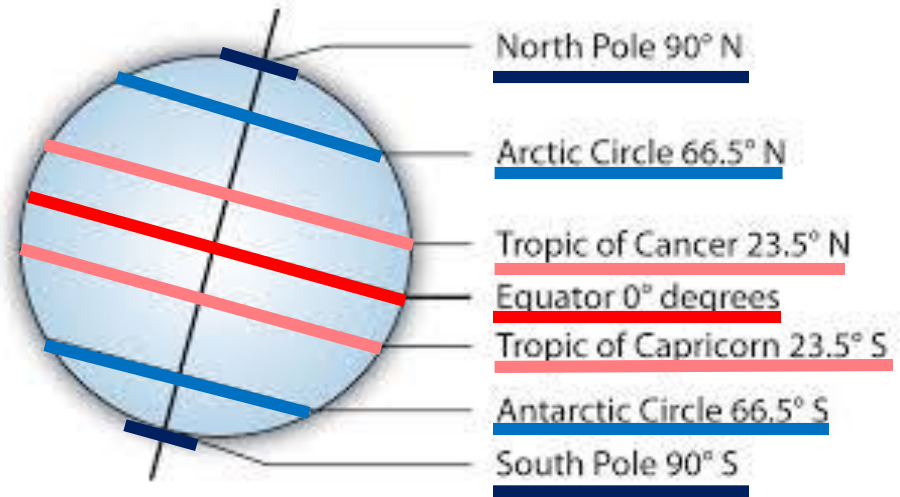
23.5° N = Tropic of Cancer

**0° = Equator**

23.5° S = Tropic of Capricorn

66.5° S = Antarctic Circle

**90° S = South Pole**



# Longitude

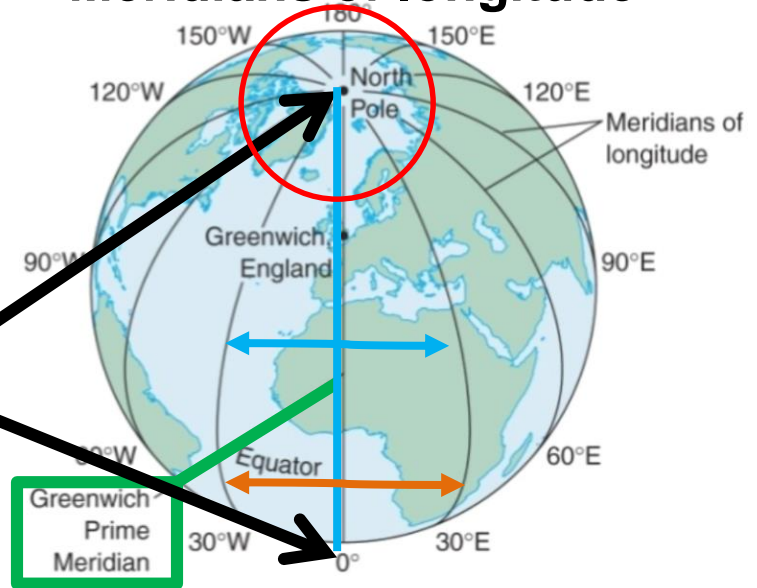
## ❖ LONGITUDE:

Distance measured in degrees **east** and **west** of the 0° line which has been designated the “**Prime Meridian.**”

- All other lines of longitude are called **meridians** and **each one extends from the North Pole to the South Pole.**
- They all **converge** (touch) at the poles.
- Thus, the distance between meridians varies with latitude from the pole to the equator.

Meridians are **man-made** phenomena based on the geometry of circles ( $360^\circ$ )

## Meridians of longitude



The 0° line of longitude is known as the “**Greenwich Meridian.**”

# Why Greenwich Meridian?



## The American Meridian

To your left is the hemisphere of the Atlantic, the hemisphere of Europe and Africa, of Roman numerals and Indian script, of the Silk Road and the rising sun.

To your right is the hemisphere of the Pacific and the American West, the hemisphere of Japan and China, of calligraphy and rocketry, of towering volcanoes and the starry night.

Beneath your feet is the line that divides the two.

From 1848 to 1884, the United States of America marked the center of its world at this line. Before it accepted the Meridian at Greenwich, England, as the "Prime Meridian," the United States separated the world into eastern and western hemispheres along the American Meridian, a line that originated at the old U.S. Naval Observatory and passed through this point.

This Meridian was used to survey the western states, and the straight borders of those states are measured in integral degrees from this point.

Wyoming Eastern Border:	29 Degrees (Am.) West
Western Border:	36 Degrees (Am.) West
Colorado Eastern Border:	27 Degrees (Am.) West
Western Border:	34 Degrees (Am.) West
Oregon Eastern Border:	42 Degrees (Am.) West

Also borders of Arizona, California, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North and South Dakota, Utah, and Washington.



Stephen Joel Trachtenberg  
President

June 2000

Meridian

American Eastern Hemisphere | American Western Hemisphere

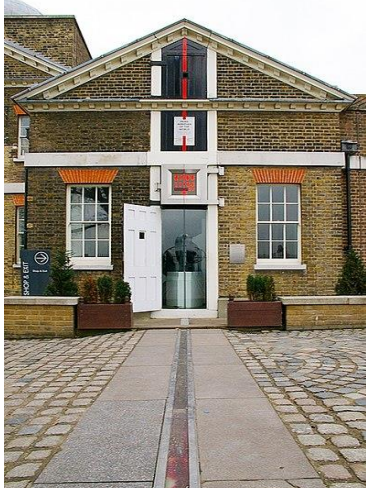


At one time, countries defined their prime meridian by the location of the observatory telescope that was used to gather the astronomical data.

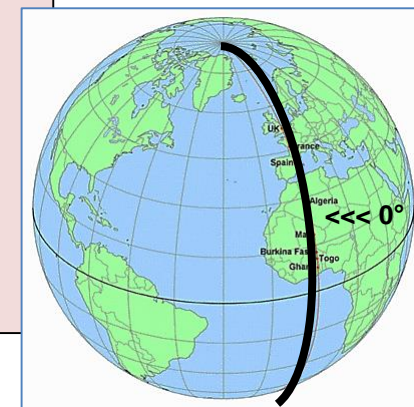
**1766** - Britain published the first nautical almanac. Its detailed maps, charts and tables, all based on the 0° meridian at London, became widely used.

**1870s and 1880s** – a series of international conferences was convened to the address prime meridian issue.

➤ **The result was a worldwide acceptance of the Greenwich Meridian as the Prime Meridian (0°).**



Greenwich Meridian



<<< 0° Prime Meridian

# Drawing Longitude

Meridians of longitude are marked by first dividing the equatorial circle into 360 segments, then dividing every circle of latitude into 360 segments and finally connecting all like-numbered degrees.

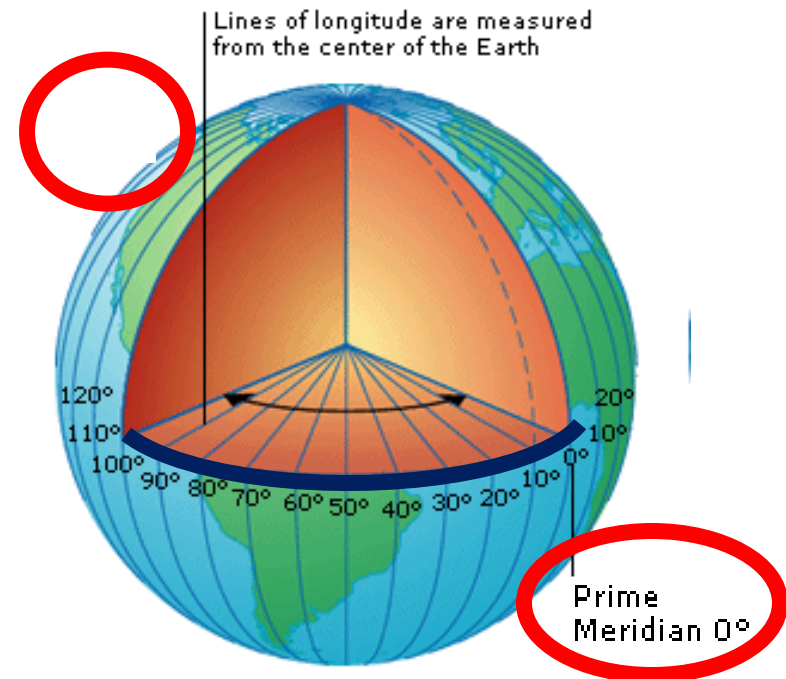
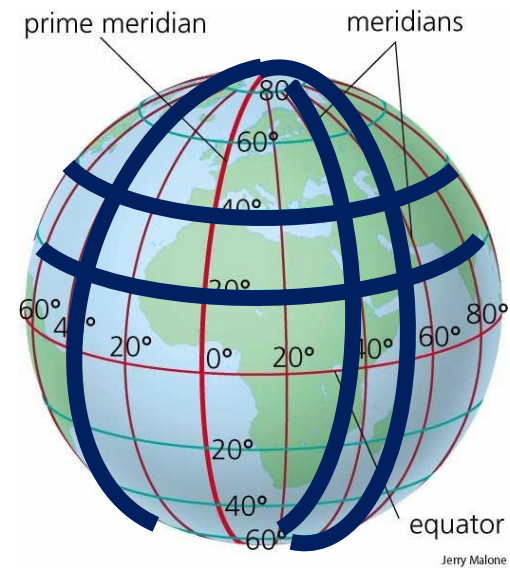
❖ There two meridians we need to know:

**$0^\circ$  = Prime Meridian**

**$180^\circ$  = International Date Line**

(IDL follows along  $180^\circ$  but not exactly.)

**FYI:  $0^\circ$  and  $180^\circ$  are neither E or W**





# Finding Longitude

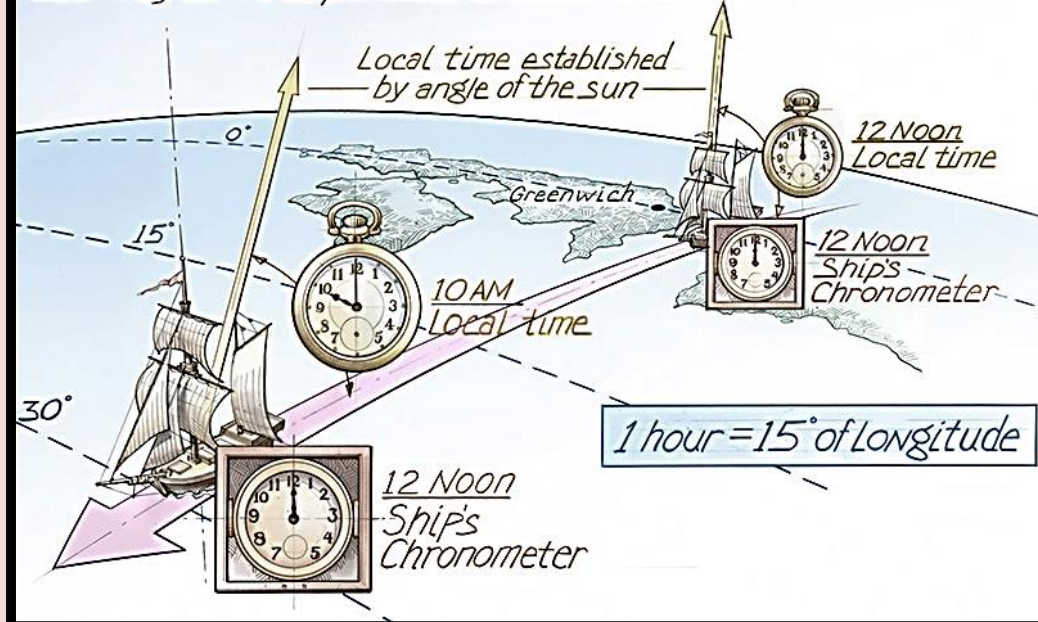
To determine your longitude on the earth's surface you need two accurate clocks.

One clock (chronometer) set for the time at  $0^\circ$  (the Prime Meridian or GMT) and **one set locally by the angle of the sun.**

*The difference in time between them indicates distance from the Prime Meridian.*

## USING A MARINE CHRONOMETER

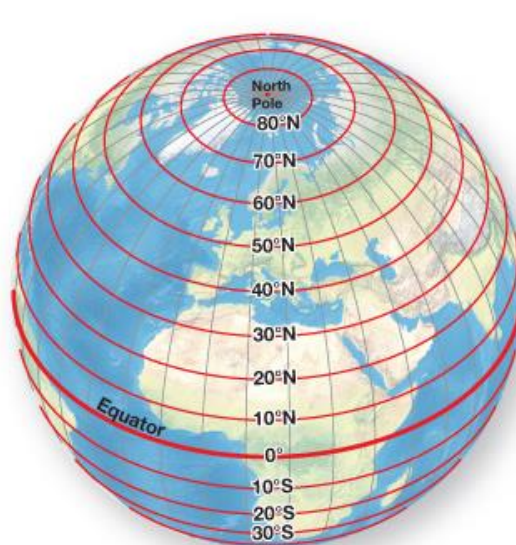
*Marine chronometers are precise, specialized clocks for finding longitude at sea. They serve as portable time standards.*



Each 60 min =  $15^\circ$  of longitude.  
Each 30 min =  $7.5^\circ$  of longitude.  
Each 15 min =  $3.75^\circ$  of longitude.  
Each 4 min =  $1^\circ$  of longitude.

# Latitude and Longitude

## L A T I T U D E

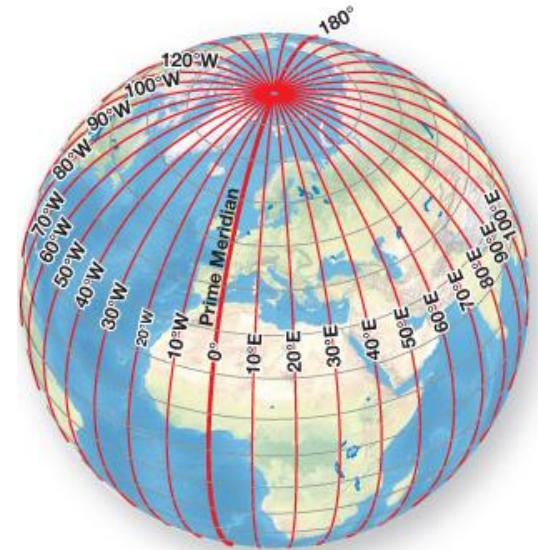


**Latitude** locates points north and south of the Equator

**Longitude** locates points east and west of the Prime Meridian

# Latitude and Longitude

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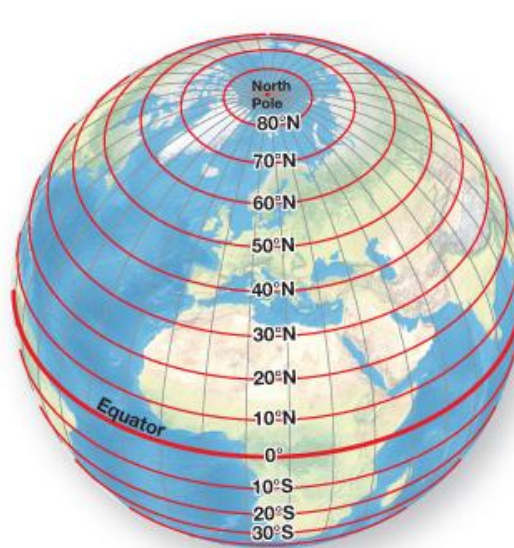


**Latitude** locates points north and south of the Equator

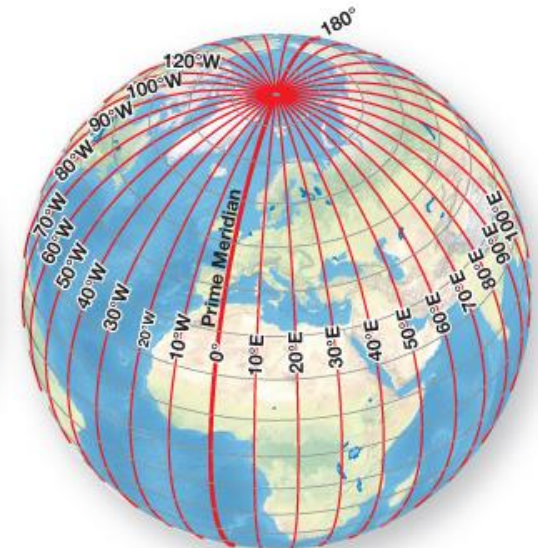
**Longitude** locates points east and west of the Prime Meridian

# Latitude and Longitude

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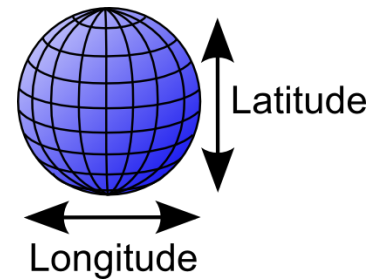


**Latitude** locates points north and south of the Equator

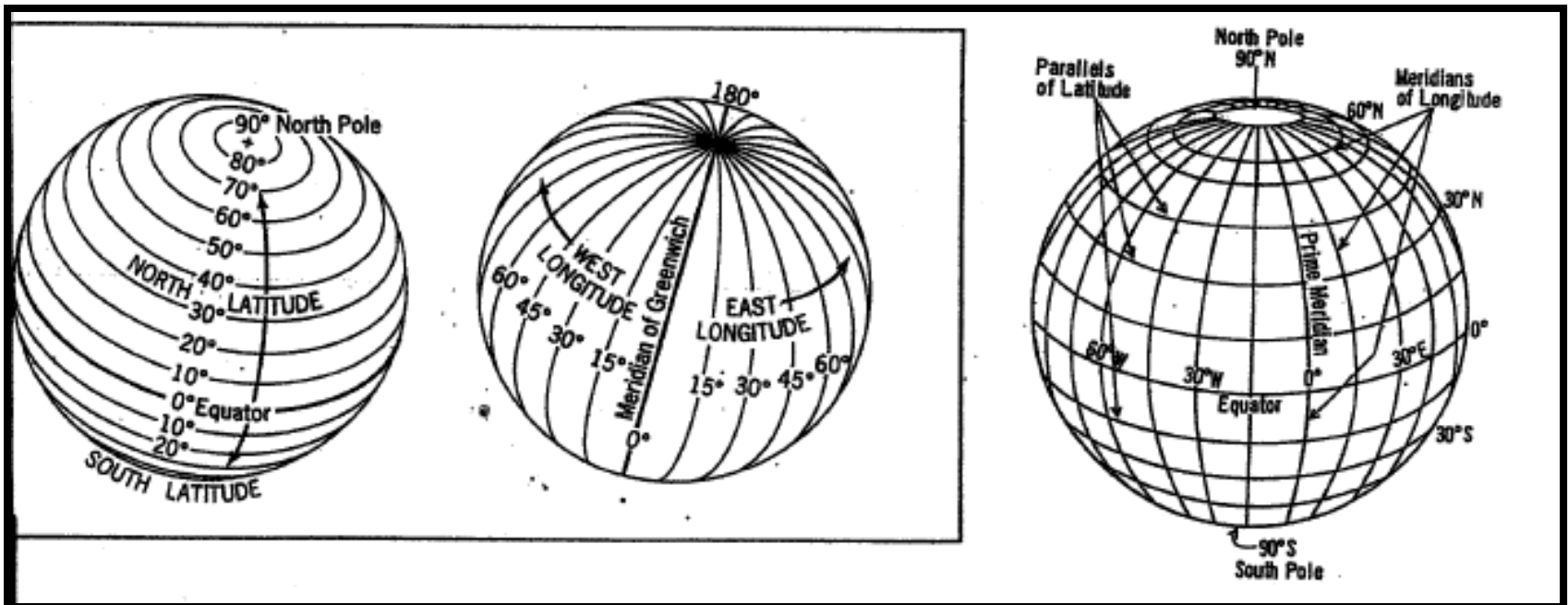


**Longitude** locates points east and west of the Prime Meridian

# Latitude and Longitude



Latitude + Longitude = Earth's Grid



<https://www.youtube.com/watch?v=swKBi6hHHMA> –  
3.5 min summary video

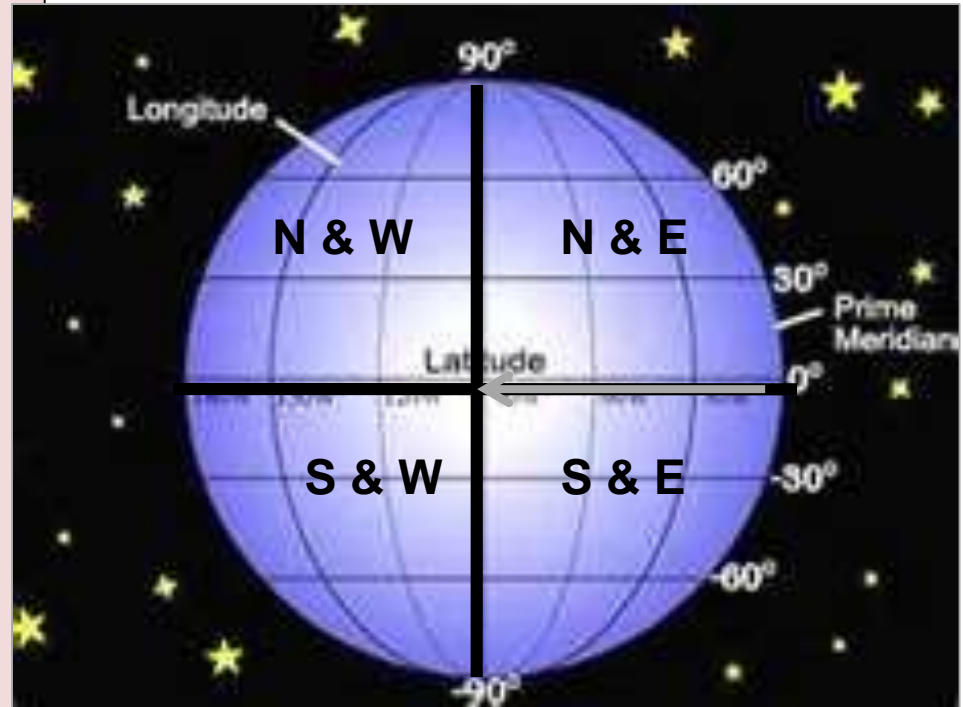
# Latitude and Longitude

We can divide the earth's grid into four quadrants:

north+west | north+east  
-----  
south+west | south+east

❖ **REMEMBER:**

- Latitude is only designated **NORTH** or **SOUTH**.
- Longitude is only designated **EAST** or **WEST**.

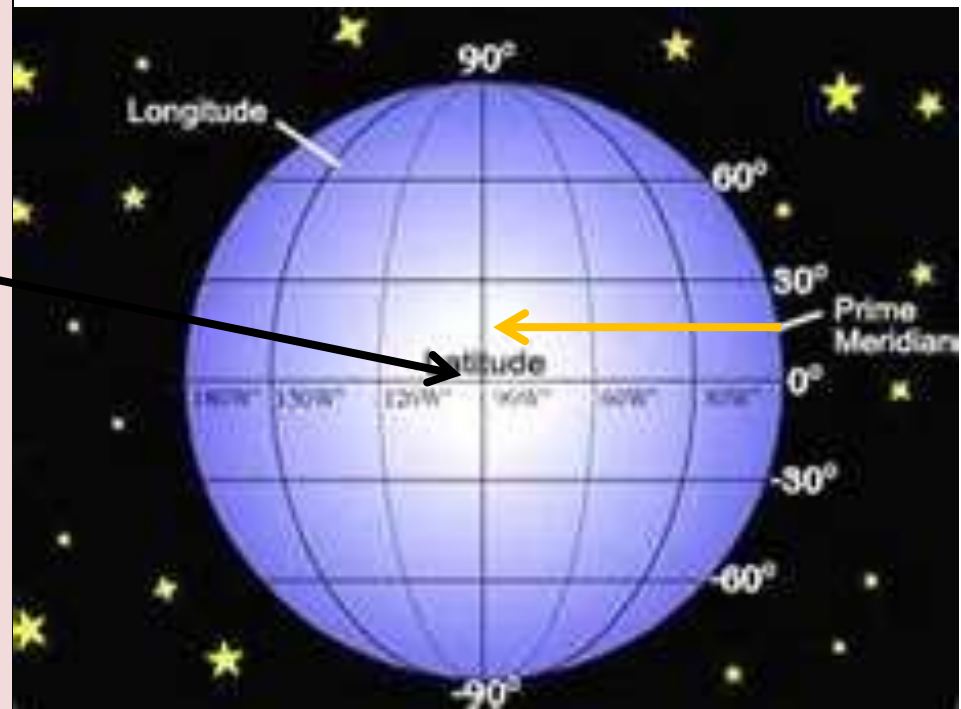


# Reading Latitude and Longitude

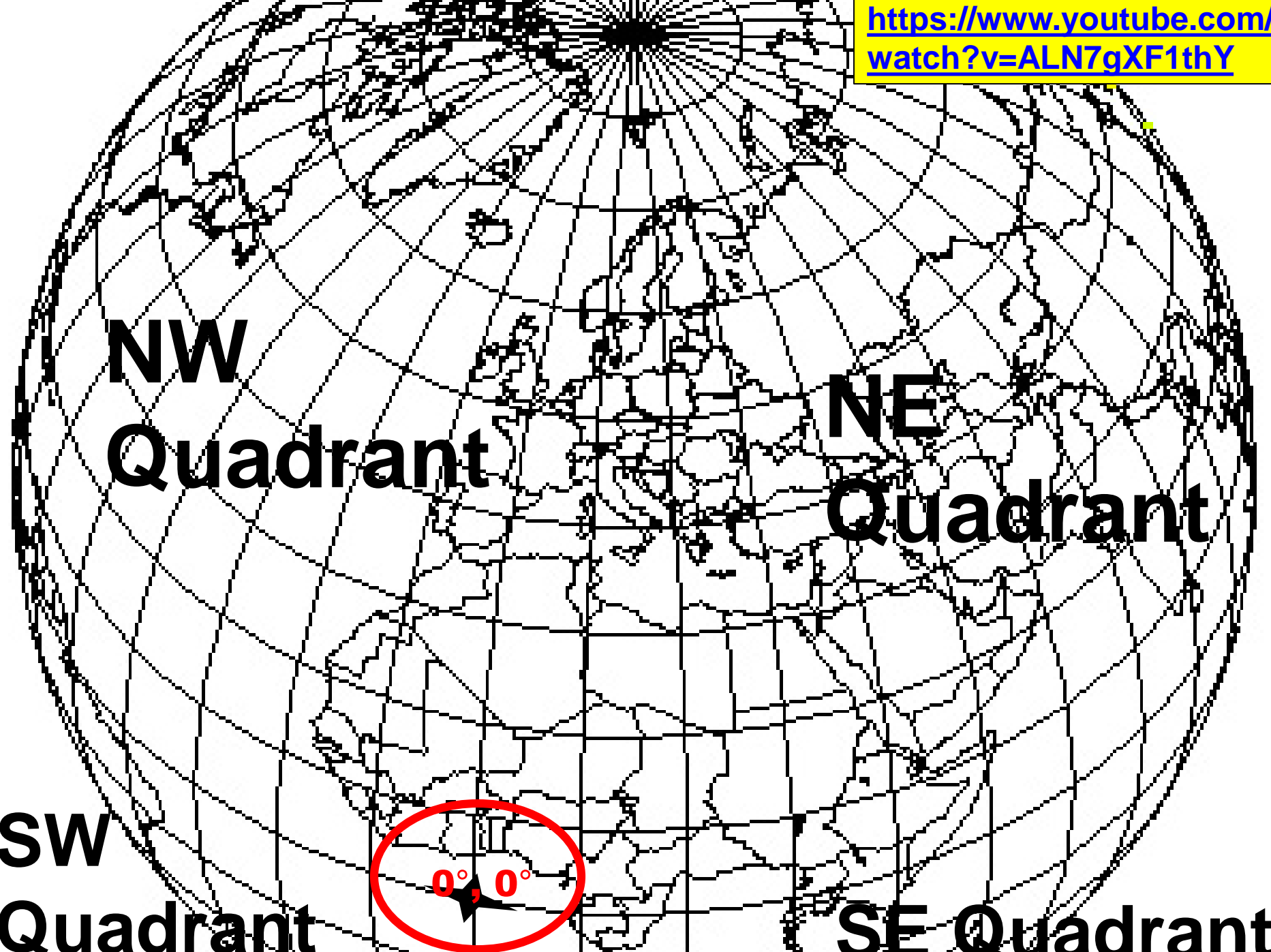
When locating places on the earth, we start where the base lines of latitude and longitude cross:

$0^{\circ}, 0^{\circ}$

- First we count lines north or south of the **equator**.
- Then we count lines east or west of the **prime meridian**.



<https://www.youtube.com/watch?v=ALN7gXF1thY>



**NW  
Quadrant**

**NE  
Quadrant**

**SW  
Quadrant**

**SE  
Quadrant**





# TIME

❖ **The longitude of a location is determined by time differential.**

You need to know the difference between “local” or “sun” time and “prime meridian time (GMT).”

NOTE: It is the same time (hour of the day) along any meridian from the North Pole to the South Pole.

# TIME ZONES

❖ **Standard Time Zone:** an area of the earth that is **15° of longitude wide** ( $360^\circ \div 24 \text{ hrs of one rotation} = 15^\circ/\text{hr}$ ), where all clocks are set when **solar noon** occurs at the zone's central meridian.

❖ **Each 15° of longitude = 1 hour (60 min) of time.**

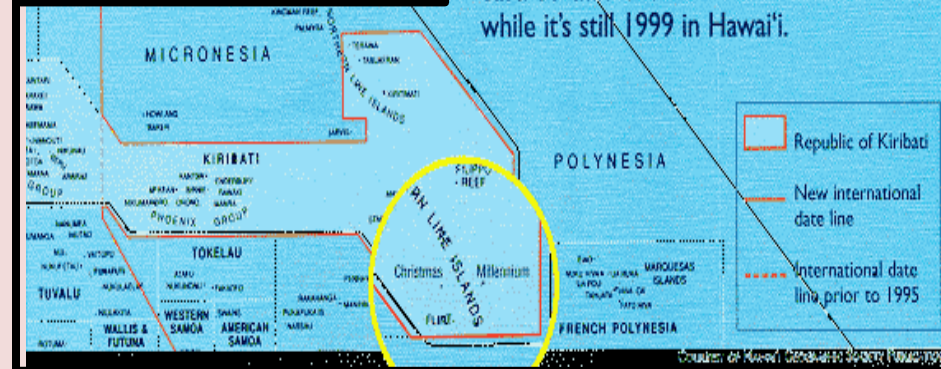
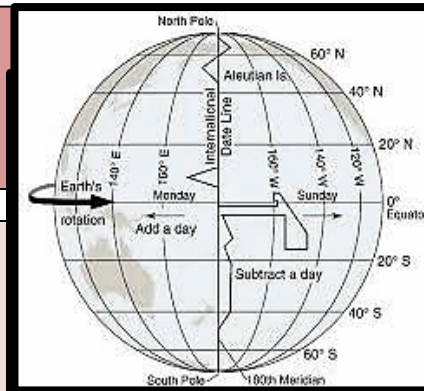
- Each 7.5° of longitude = 30 minutes.
- Each 3.75° of longitude = 15 minutes.
- Each 1° of longitude = 4 minutes.

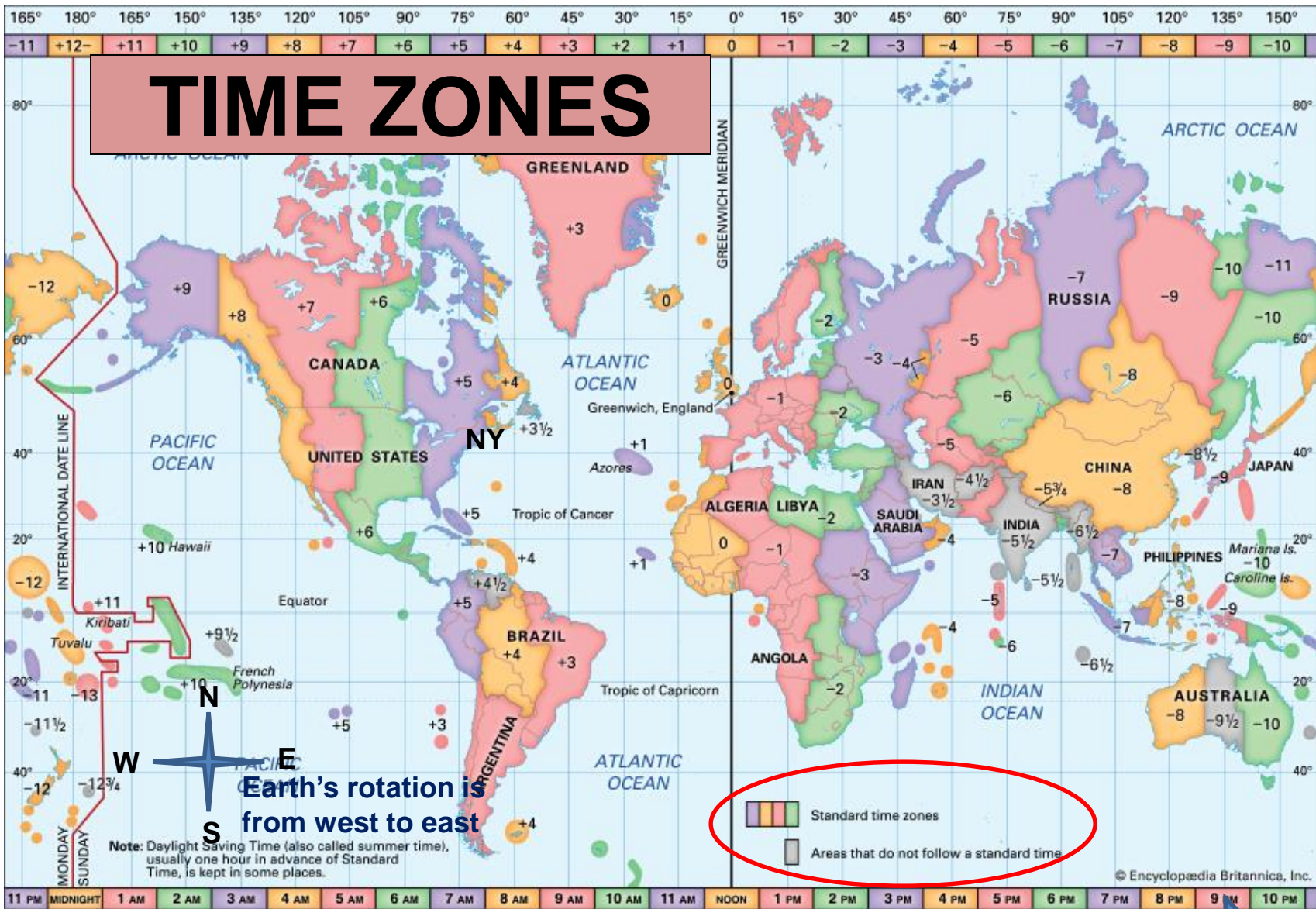
- ✓ **Time zones are based on calculating longitude.**
- ✓ Concept created in 1883 by US railroad companies for scheduling purposes.
- ✓ Linked to International Meridian Conference of 1884
- ✓ Officially adopted by countries starting in the 1920s.

# TIME ZONES

- ❖ There are 24 world standard time zones, each 15° wide and equal to one hour.
- Numerous off-standard zones (half hour, multi-hour, sun) created by governments.
- Over 30 irregular-shaped zones due to political borders.

- ❖ The International Date Line generally follows the 180° meridian – but not exactly in order to keep political units in the same date. **When the line is crossed the date changes, e.g., 3 PM Tuesday becomes 3 PM Wednesday, or vice versa, depending on direction of movement.**



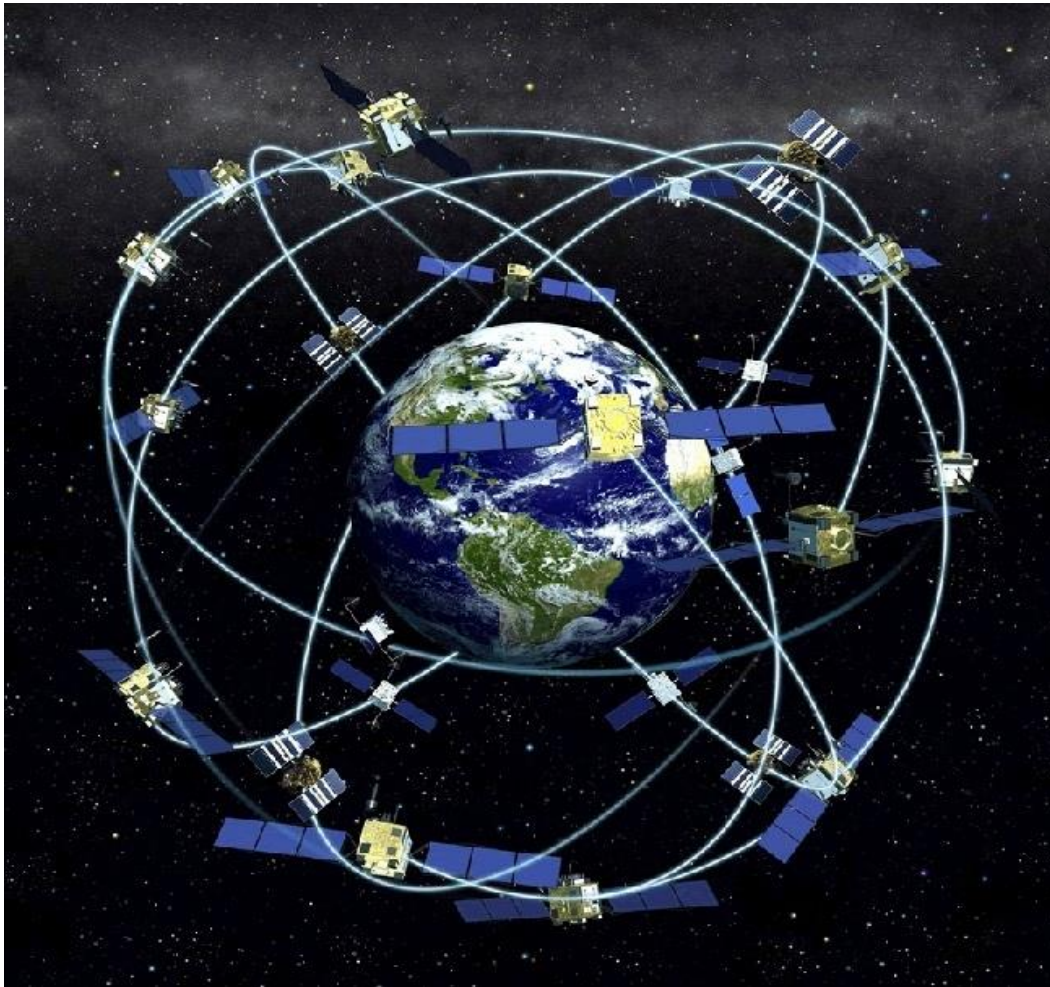


**← EARLIER**

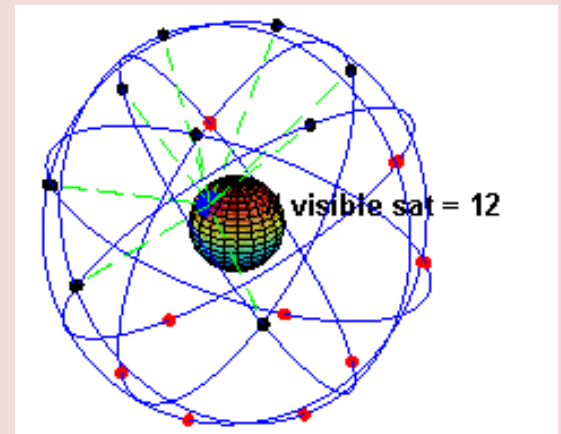
Add or subtract the number of zones between current location and area in question.

**LATER →**

# Global Positioning System



- ❖ An array of 29 (24 active) satellites orbits 12,500 miles above the earth.
- Need to be in contact with 3 to 4 satellites to get a fix on a location: latitude, longitude and elevation.



# GPS Dependence

MUTTS

By PATRICK McDONNELL

PROCEED  
TO THE  
ASSIGNED  
ROUTE

TURN  
RIGHT...

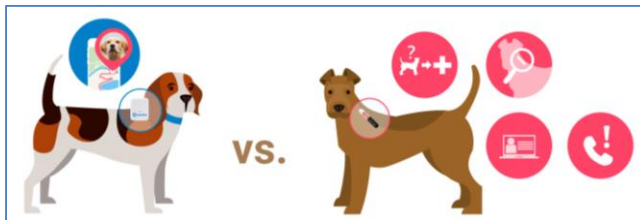
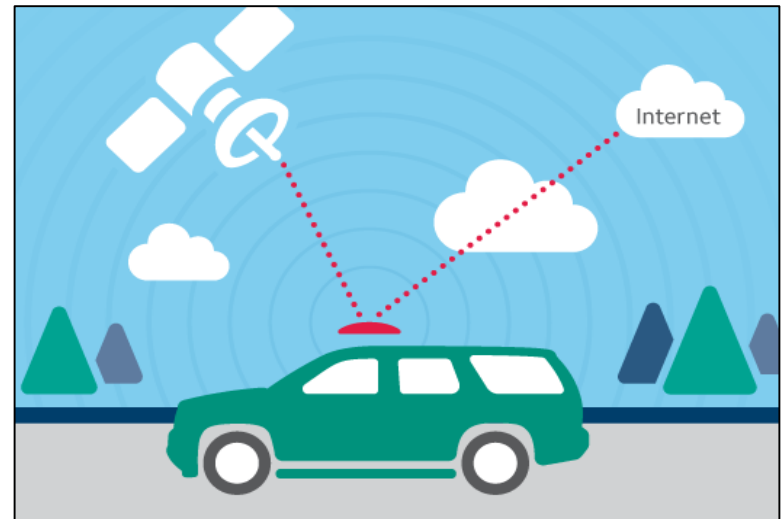
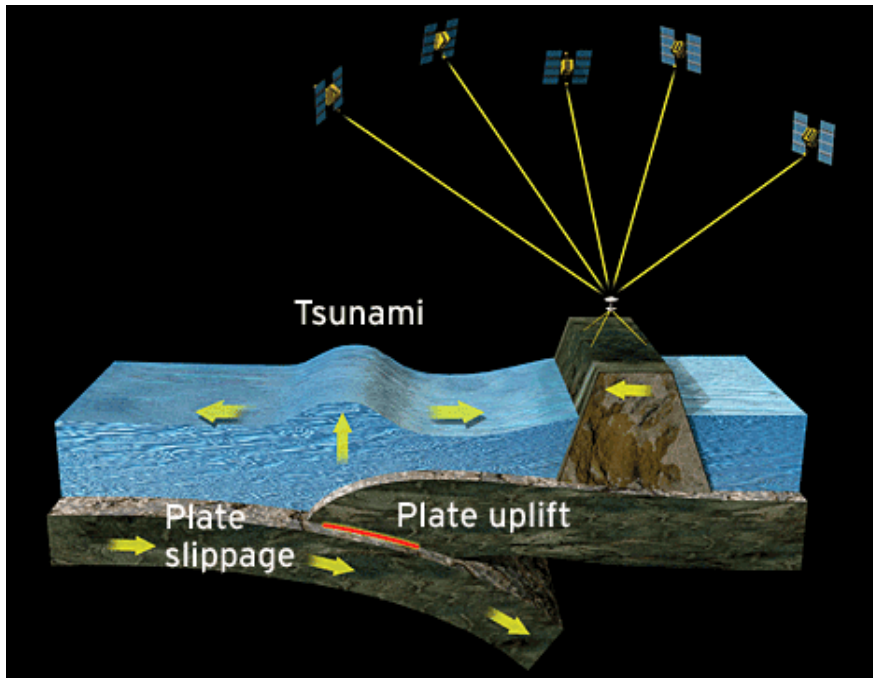
CONTINUE  
SOUTH FOR THE  
NEXT 1,275 MILES

YOU  
HAVE  
ARRIVED

HOW DID  
WE EVER  
DO THIS  
BEFORE  
G.P.S.!

# Using GPS

- Location – positioning things in space
- Navigation – getting from point a to point b
- Tracking - monitoring movements
- Mapping – creating maps based on those positions
- Timing – precision global timing



<https://www.novatel.com/industries/agriculture/> 2 min GPS ad

# Using GPS-enabled Apps to Track Your Location

- Location – positioning things in space
- Navigation – getting from point a to point b
- Tracking - monitoring movements
- Mapping – creating maps based on those positions
- Timing – precision global timing



Data reviewed by the NYTimes shows over 235 million locations captured from more than 1.2 million unique devices during a three-day period in 2017.

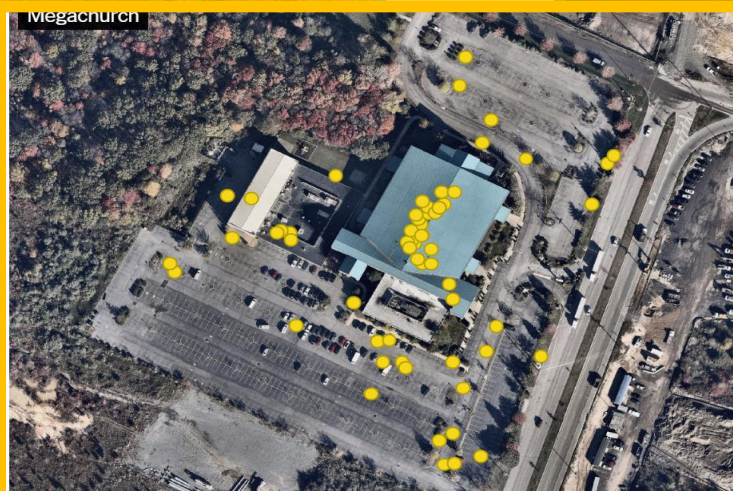
<https://www.nytimes.com/interactive/2018/12/10/business/location-data-privacy-apps.html?module=inline>



# Tracking GPS-enabled Devices: aka, Tracking People

In about four months' of data reviewed by The Times, her location was recorded over 8,600 times — on average, once every 21 minutes.

The mayor's staff, New York City



The information from one Sunday included more than 800 data points from over 60 unique devices inside and around a church in New Jersey. By Michael H. Keller | Satellite imagery by Mapbox and DigitalGlobe

# EXTRA CREDIT

**Extra Credit Atlas Exercise  
for Exam I is available  
on the Course Home Page.  
Submit answers using the blue  
Scantron sheet by **Sept. 26, 2019.****



**Once you have completed the exercise,  
transfer your answers to the blue Scantron  
sheet using a #2 pencil.  
Completely erase all mistakes and stray marks.  
LATE answer sheets will NOT be accepted.**

**N E X T**

# Parts of Maps