Chapter Three: Mapping Earth

- 3.1 Position, Coordinates, and Maps
- 3.2 Topographic Maps
- 3.3 Bathymetric Maps

Section 3.1 Learning Goals

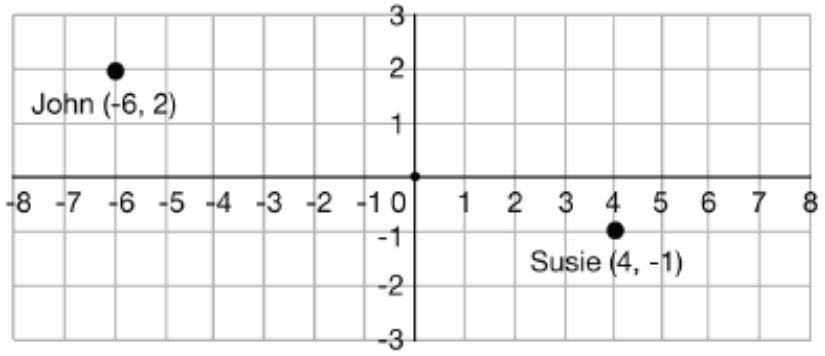
- Describe an object's position relative to a reference point.
- Distinguish between lines of longitude and latitude.
- Analyze a map to determine scale, direction, and specific location.

Investigation 3A

Positive and Negative Position

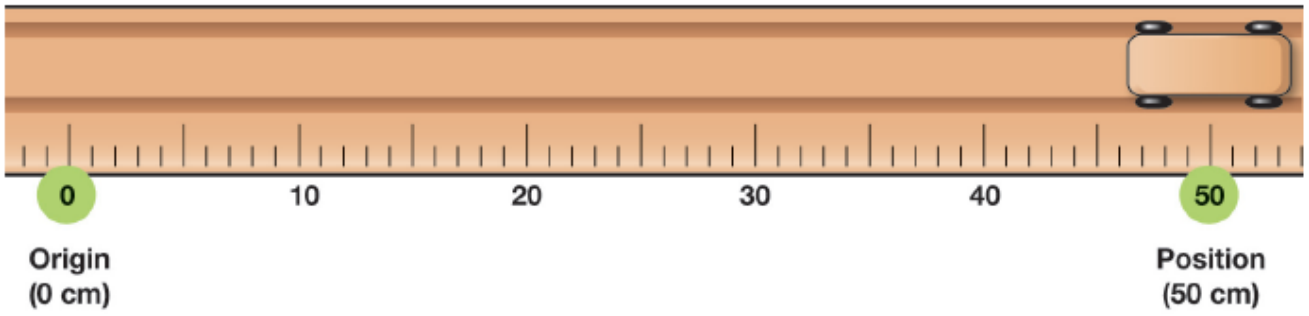
- ***Key Question:***

  How do we measure position in two dimensions?



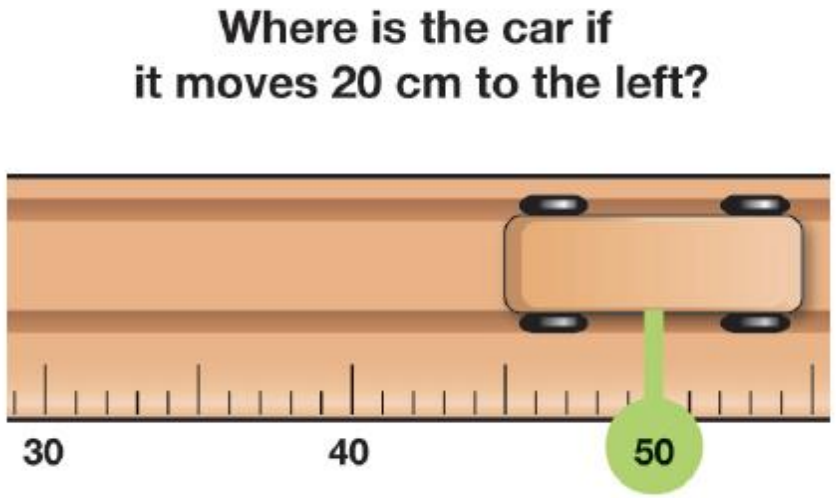
3.1 The position variable

- **Motion is about knowing where things are and how they move.**
- **To understand where things are, we need to understand *position*.**

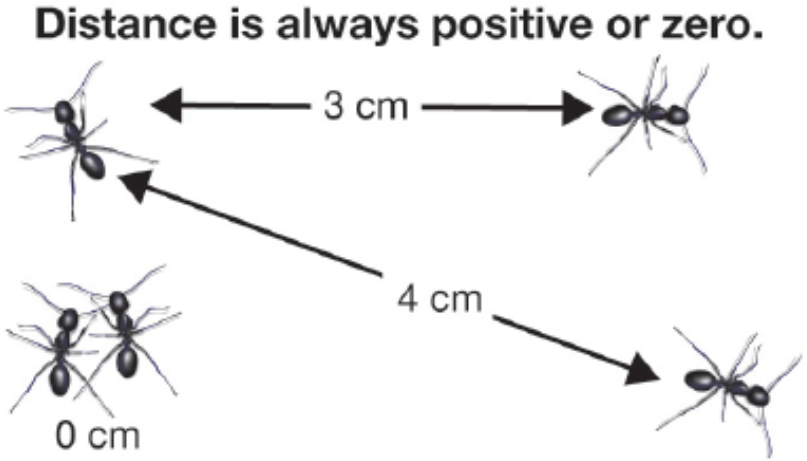


3.1 The position variable

- **Position is a variable and it is always relative to an *origin*, or the place where the object's starting point was zero.**



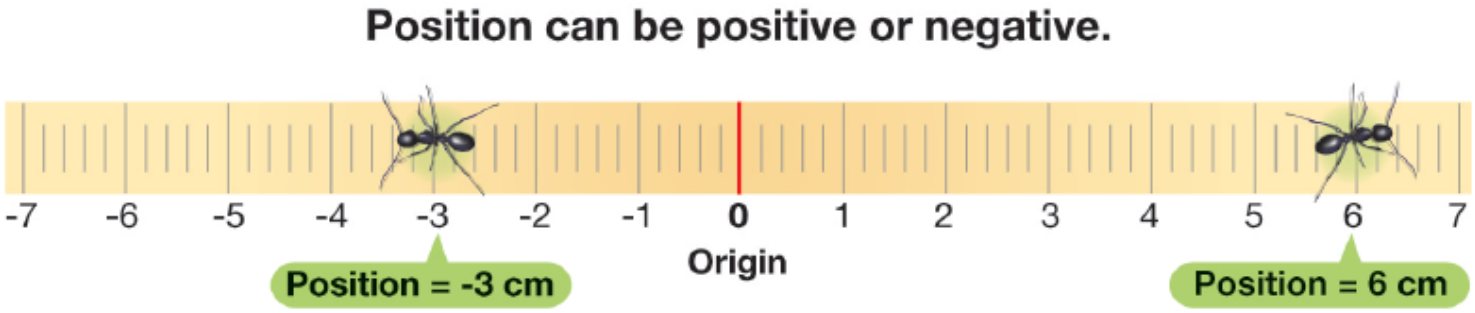
3.1 Forward and backward



- **Position and distance are similar but not the same.**
- **Both use units of length.**
- **Distance can be zero or have positive values.**

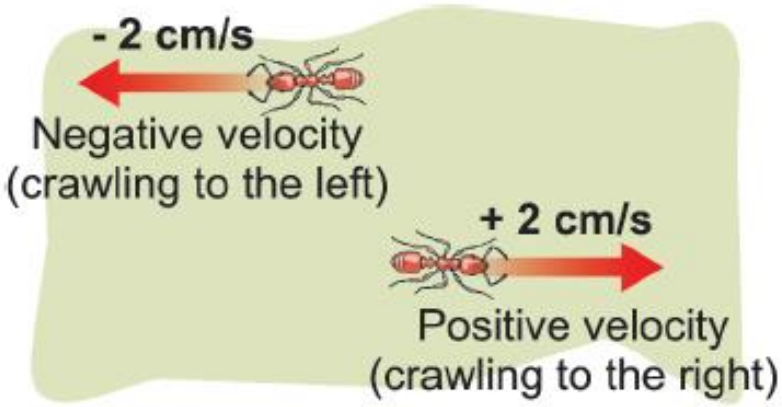
3.1 Forward and backward

- Position uses positive and negative numbers.
- Positive numbers are for positions to the right (in front) of the origin.
- Negative numbers are for positions to the left (or behind) the origin.



3.1 Vectors

- **Position is an example of a kind of variable called a *vector*.**
- **A vector is a variable that tells you a direction as well as an amount.**



Velocity is an example of a vector quantity. It includes both speed and direction.

3.1 Keeping track of where you are

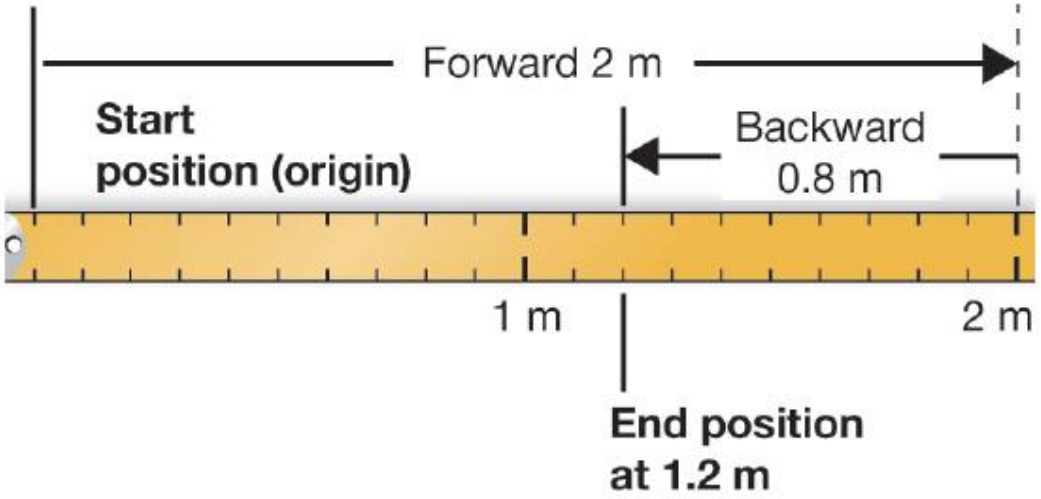
- **Sojourner is a small robotic rover sent to explore Mars on the Pathfinder mission.**

- **Sojourner explores ancient floodplains of Mars.**

Where is Sojourner now?

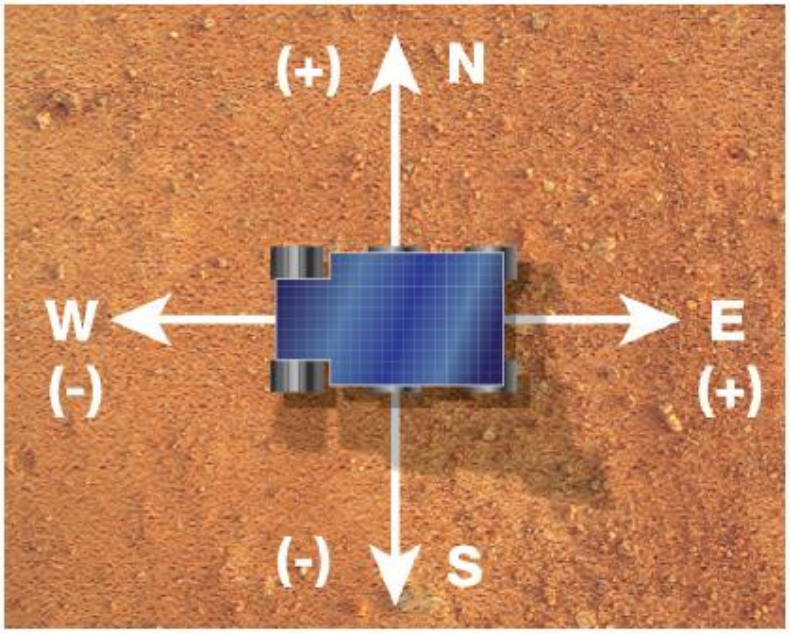
3.1 Keeping track of where you are

- As it moved, *Sojourner* needed to keep track of its position.
- The robot used speed and time data to calculate the position vector, and then added up position vectors to come up with a final position.



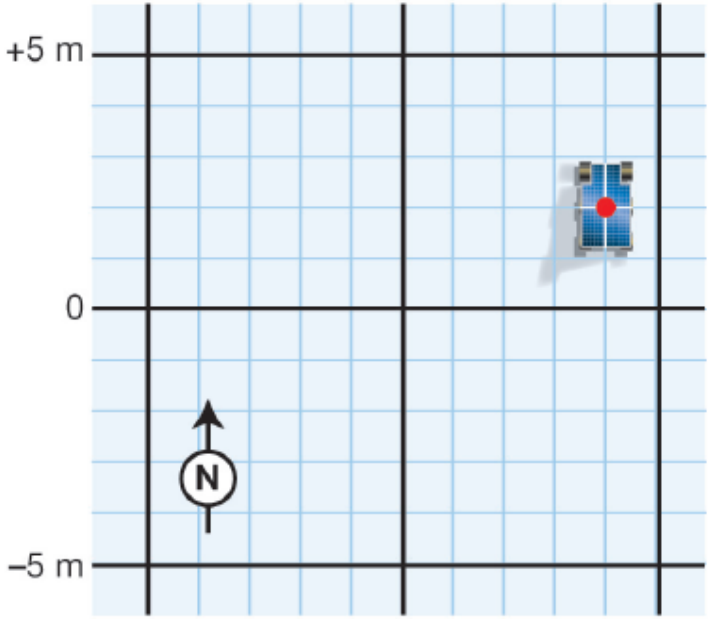
3.1 Maps and coordinates

- If Sojourner was crawling on a straight board, it would have only two choices for direction, forward and reverse.
- Out on the surface of Mars, Sojourner has more choices. The possible directions include north, east, south, and west, and anything in between.



3.1 Maps and coordinates

- Sojourner's exact position can be described with two numbers.
- These numbers are called *coordinates*.



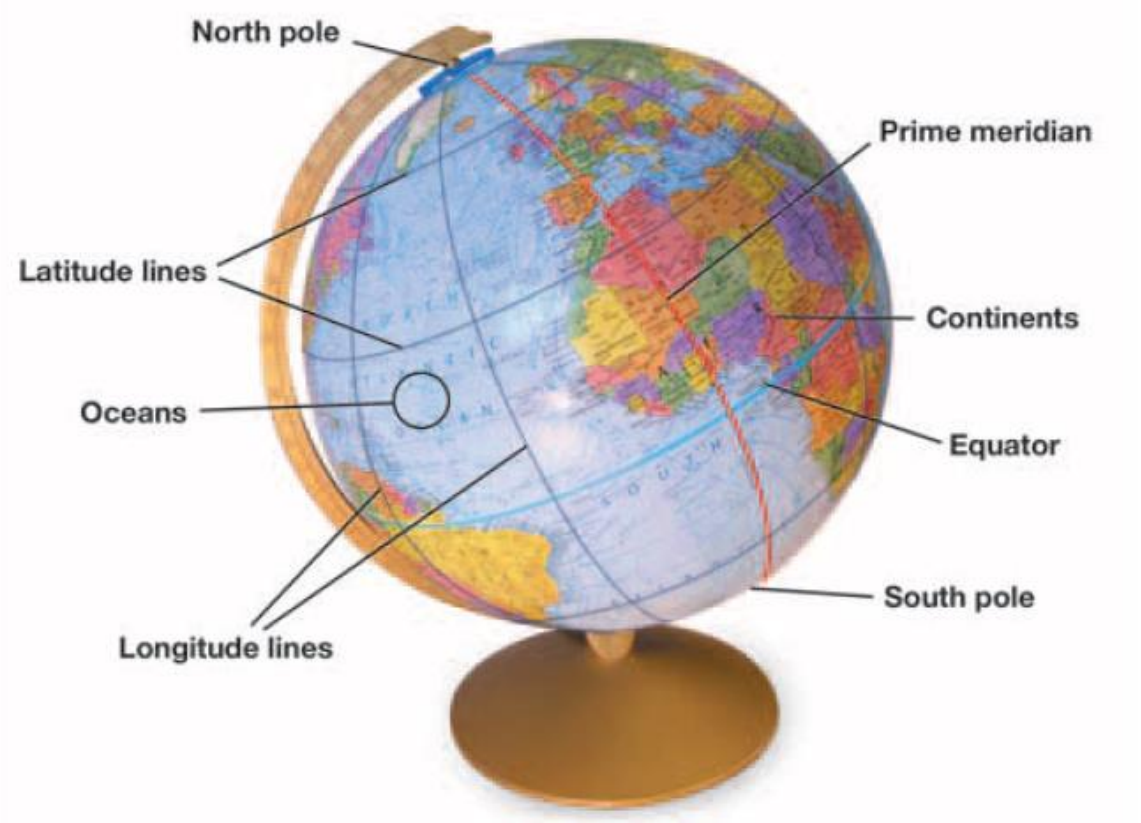
- This graph shows Sojourner at coordinates (+4, +2) m.

3.1 Maps and coordinates

- A graph can also show any path Sojourner takes, curved or straight.

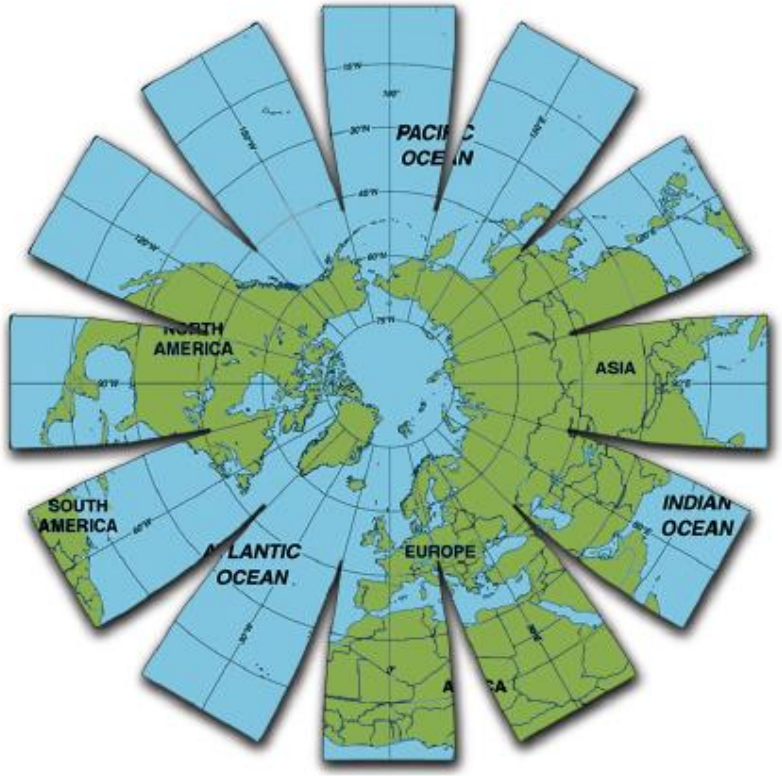
- This kind of graph is called a *map*.
- Street maps often use letters and numbers for coordinates.

3.1 Globe



- A *globe* is a model of Earth.

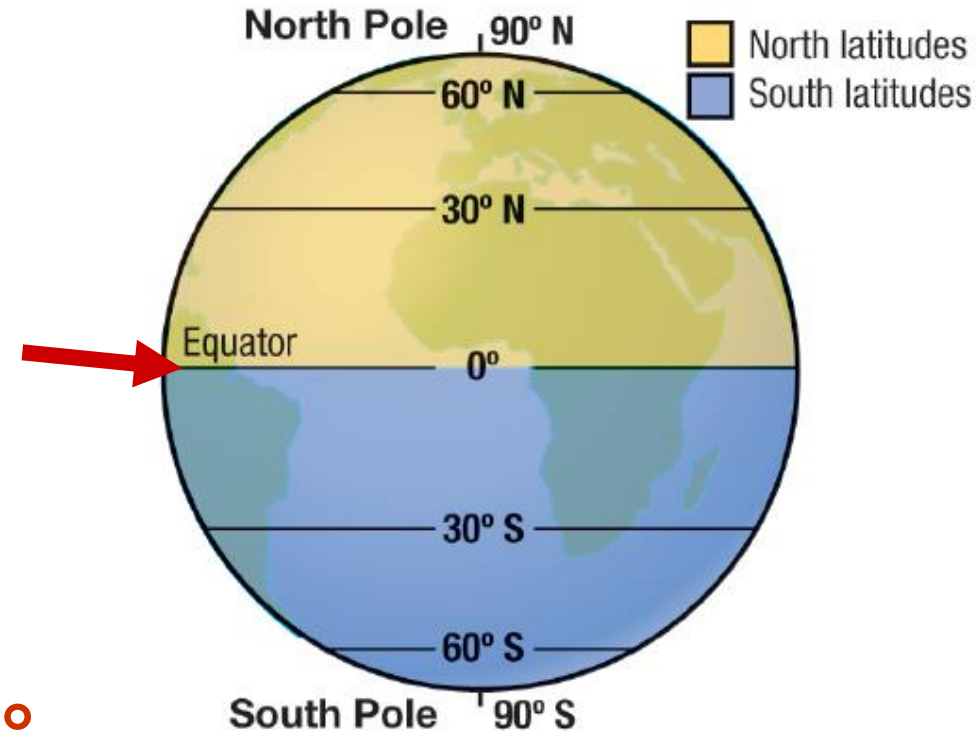
3.1 Making globes



- You can cut a flat paper map to form it into a hemisphere for a globe.

3.1 The equator

- The *equator* is an imaginary line around Earth's middle that lies between the north and south poles.
- The equator is at 0° latitude.

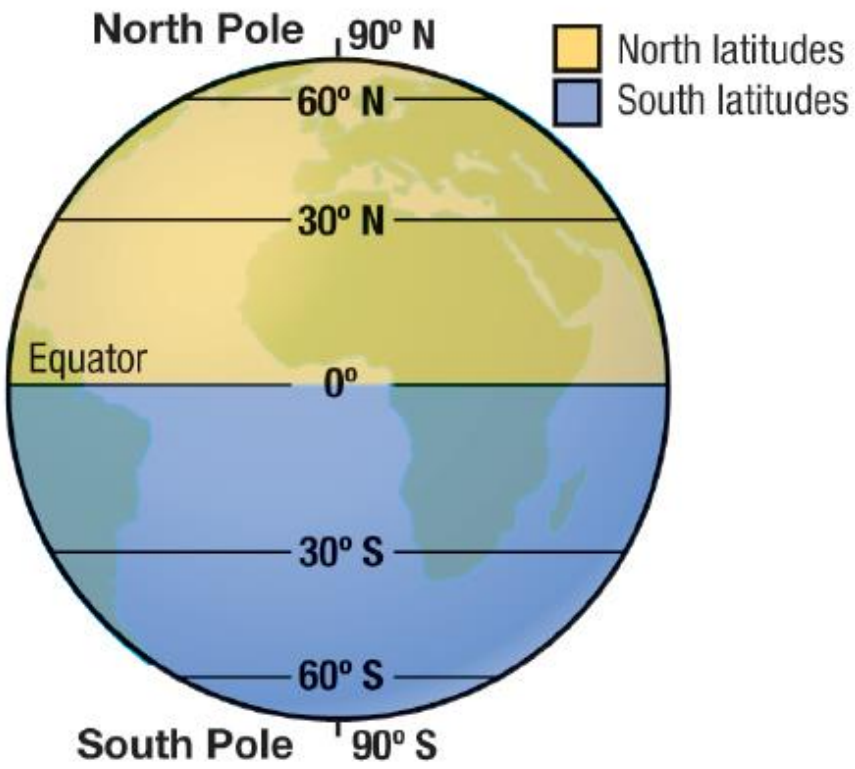


3.1 Latitude

- ***Latitude lines*** **are the horizontal lines on a map.**
- **They are lines that run east to west above and below the equator.**
- **Some latitude lines have special names.**

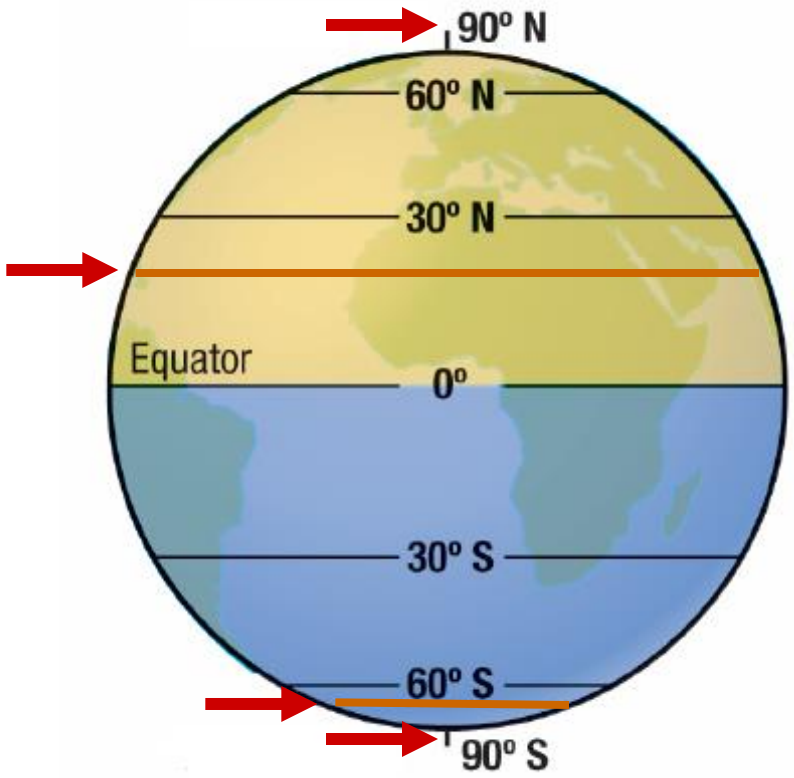
Name of Latitude Line	Approximate Location
Arctic Circle	66.5° N
Tropic of Cancer	23.5° N
Tropic of Capricorn	23.5° S
Antarctic Circle	66.5° S

3.1 Latitude



- Each line of latitude represents one degree on Earth's surface.
- Each degree is divided into 60 minutes and each minute is divided into 60 seconds.

3.1 Latitude

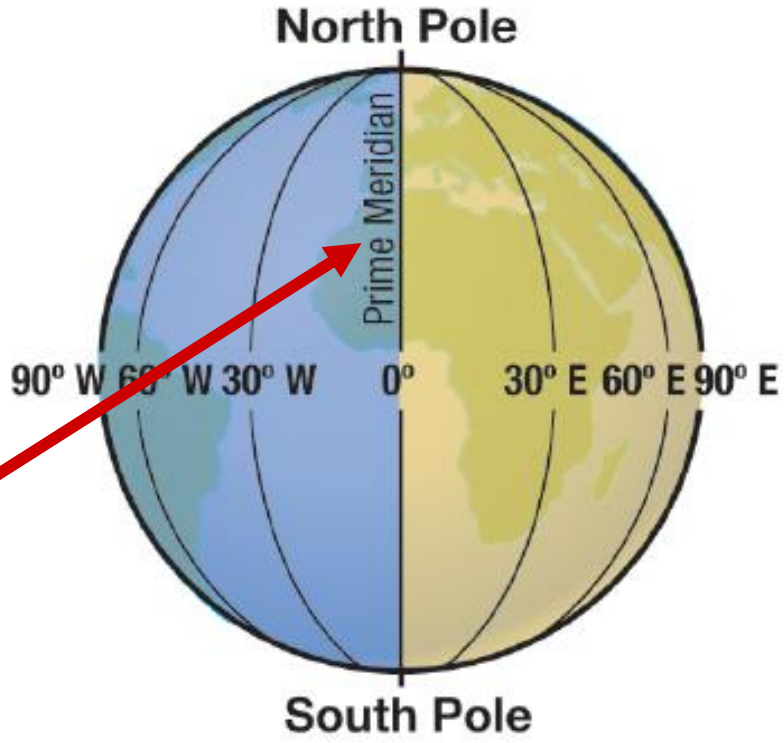


- **Minutes and seconds on maps represent distances, not time!**

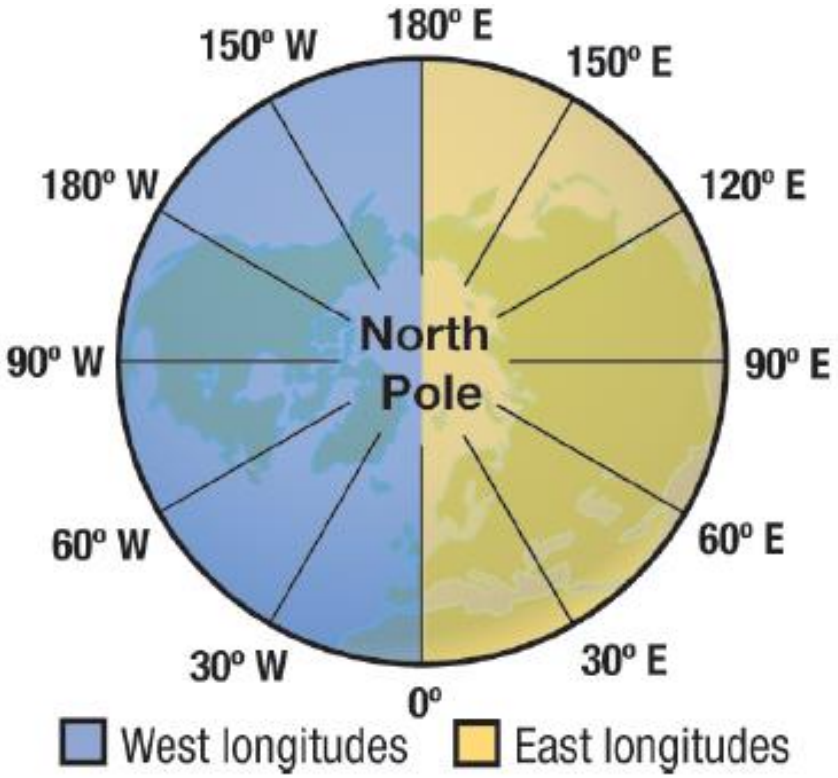
Can you name of these globe positions?

3.1 Longitude

- ***Longitude lines* (or *meridians*) run north to south on a globe.**
- **The *prime meridian*, is an imaginary line that goes through Greenwich, England.**
- **The prime meridian is the 0° line of longitude.**

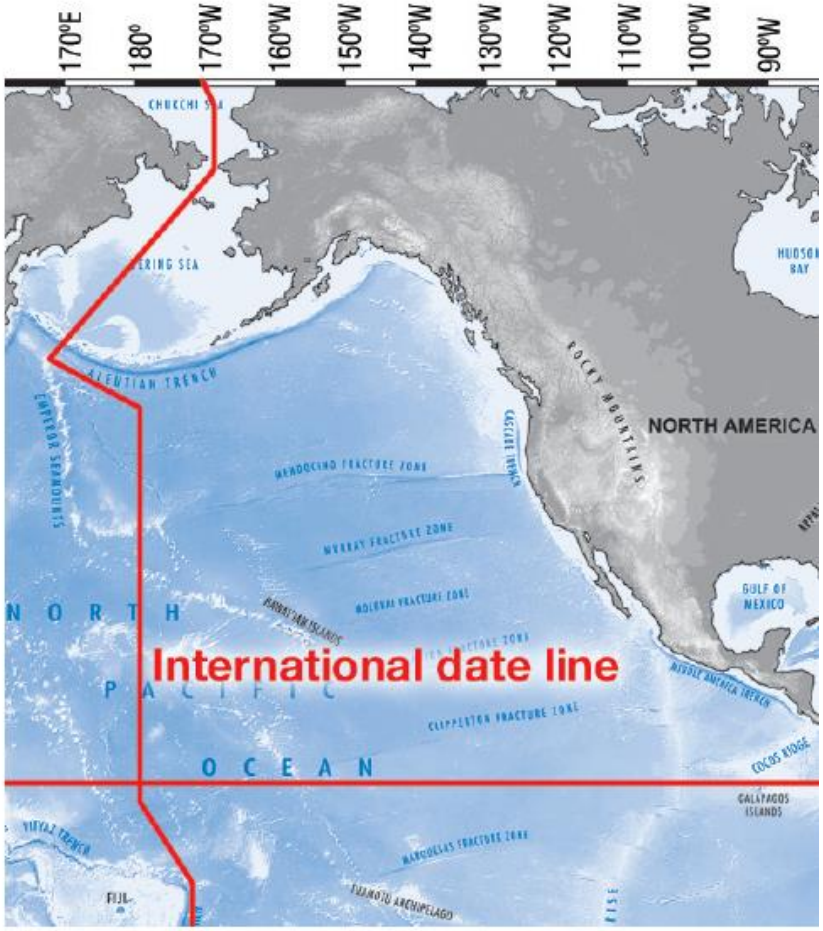


3.1 Longitude



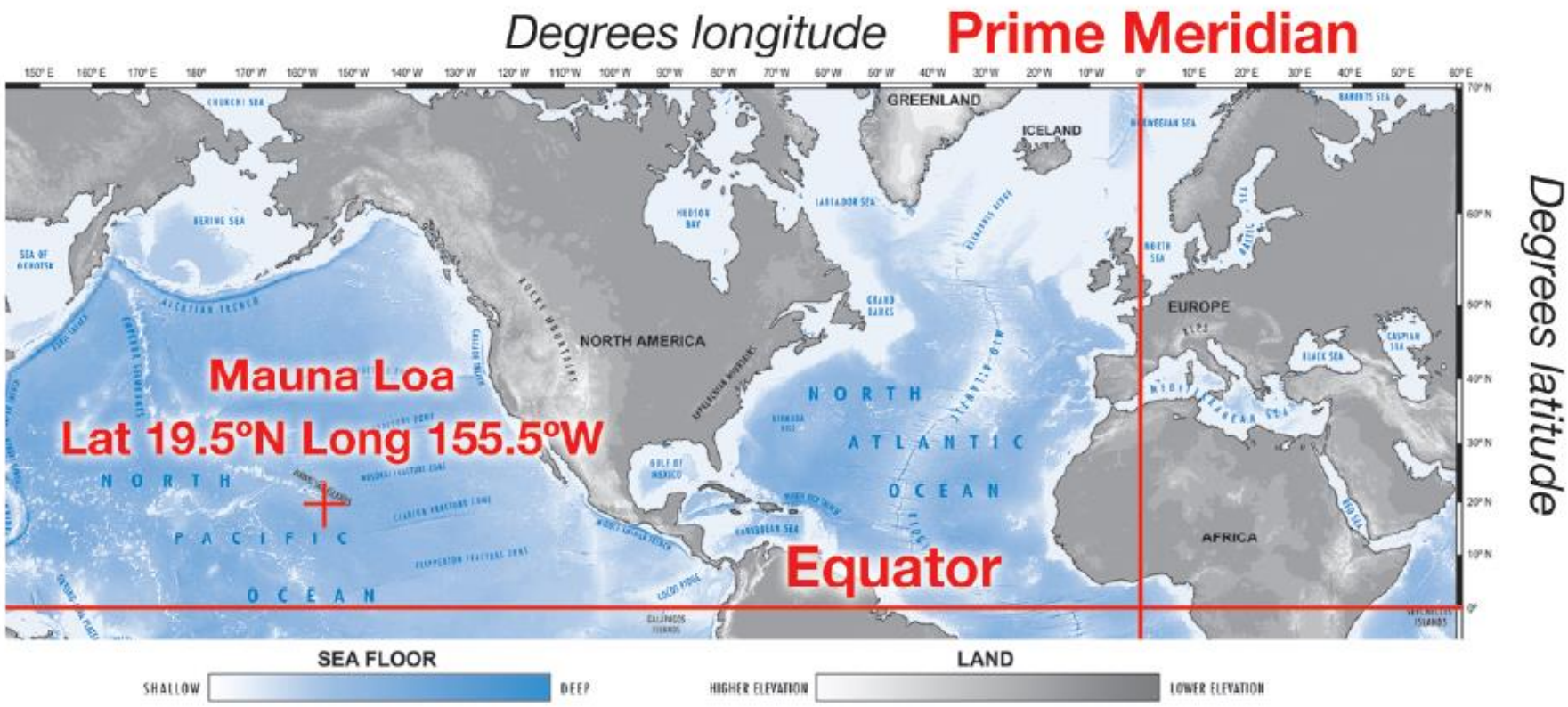
- **Longitude lines meet at the poles.**

3.1 Longitude



- The *international dateline* is an imaginary longitude line located mainly at 180°.
- For every 15° of longitude past the international dateline, time changes by one hour.

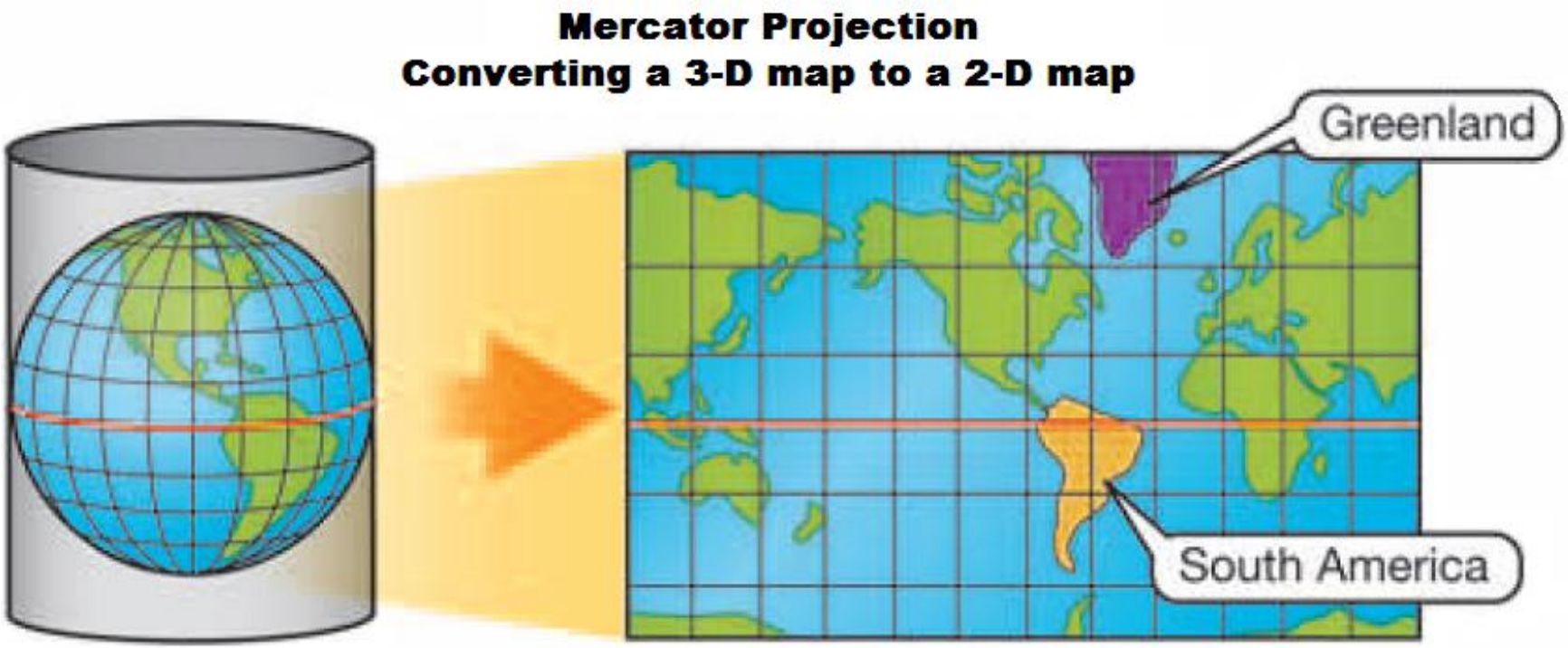
Latitude and Longitude



3.1 Projections

- **Imagine trying to flatten a globe to make a map for traveling.**
- **A *Mercator projection* converts the center (most useful) section of the globe.**
- **Near the poles, the landforms are distorted on a flat map.**
- **Greenland and Antarctica appear much larger on maps than on globes.**

3.1 Projections

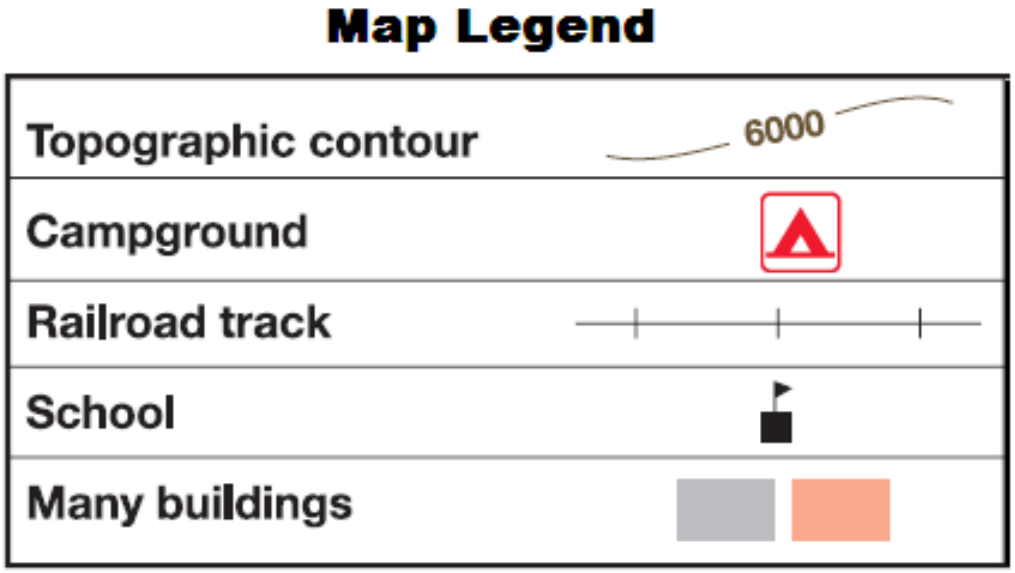


3.1 Features of maps

- On maps, there is usually a symbol that indicates *direction*—north, south, east, and west.

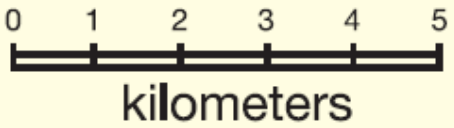
3.1 Features of maps

- **Maps usually have a *legend* that lists and explains the symbols that are used on the map.**



3.1 Features of maps

- **Here are three kinds of map scales.**

Types of map scales		
Fractional 1/100,000	**Verbal** 1 cm = 1 km	**Bar** 

Can you suggest a use for each type of scale?

3.1 Features of maps

- A legend on a road map might include special lines to indicate different kinds of roads or the locations of parks, airports, and hospitals.

Can you locate all of the features of this map?