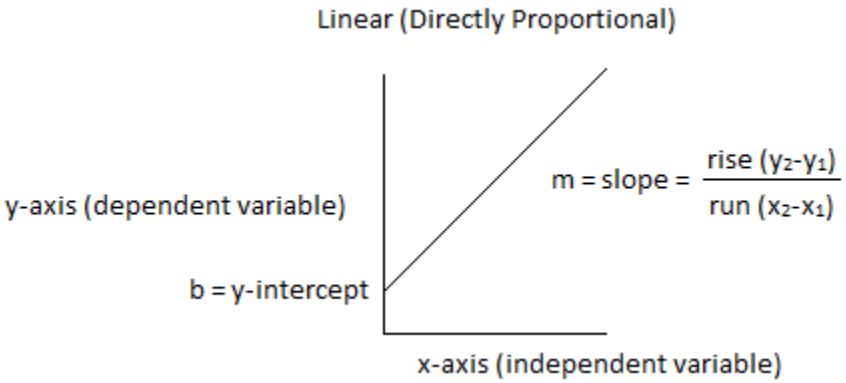
7.1 - Measurement

Scientific Method

- **Formulate a Question** – Through simple observations you will formulate a question or a question or problem will be posed to you.
- **Develop a Scientific Hypothesis** – A proposed explanation for the question or problem that is testable.
- **Experiment** – A set of controlled observations to test the hypothesis.
    - **Qualitative Data** – Physical characteristics (using your five senses) that is gathered during the experiment.
    - **Quantitative Data** – Numerical information that is gathered during the experiment.
    - **Independent (Manipulated) Variable** – The variable or value that you will plan to change.
    - **Dependent (Responding) Variable** – The variable or value that changes in response to what you have changed.
    - **Standard Control** – A standard value that is used for comparison.
    - **Constant** – Factors that are not allowed to change during the experiment.
- **Analyze the Results** – Analyze through graphing, calculating, finding percent error, etc.
- **Conclusion** – A claim that can be evaluated using evidence.

Example of Analyzed Results



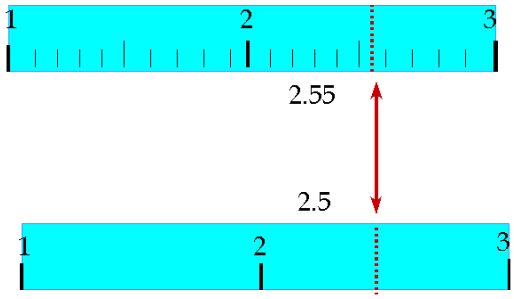
Distinctions in Science

- **Observational Science** – Testing and verifying ideas of the present using the Scientific Method.
- **Historical Science** – Interpreting evidence from the past using scientific models.

7.1 - Measurement

Significant Digits – All known digits of a number that is measured plus one estimated digit.

Example of Rounding Using Significant Digits:



Scientific Notation

Example of Scientific Notation:

- 460,000,000,000 particles = 4.6 x 10^{11} particles
- 0.000000028 grams = 2.8 x 10^{-8} grams

System International (SI) Unit

Base Units

Quantity	Base Unit
Time	Second (s)
Length	Meter (m)
Mass	Kilogram (kg)
Temperature	Kelvin (K)
Amount	Mole (mol)

Density

$$density\ (\rho) = \frac{mass\ (g)}{Volume\ (mL\ or\ cm^3)}$$

7.1 - Measurement

Scientific Models

A scientific model is a physical, conceptual, or mathematical representation of a real scientific phenomenon that is difficult to observe directly. Scientific models are used to explain and predict the behavior of real objects or systems.

Scientific models should:

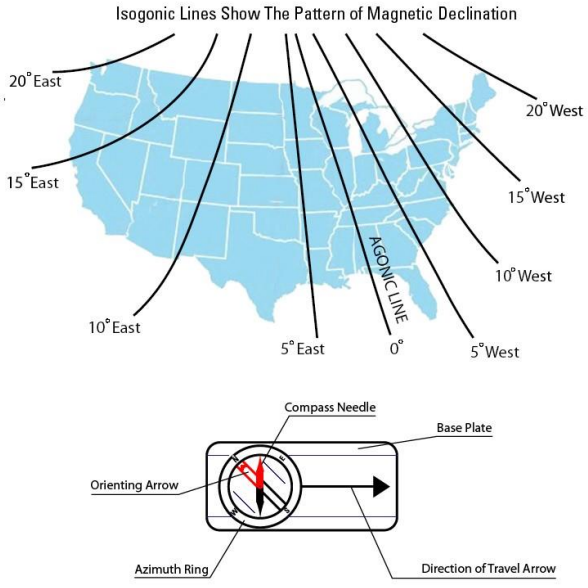
- Be able to explain as many characteristics of observations as possible.
- Be as simple as possible with as little assumptions, correction factors, and limitations as possible. ("Occam's razor" principle)
- Be able to predict observable scientific occurrences and data.

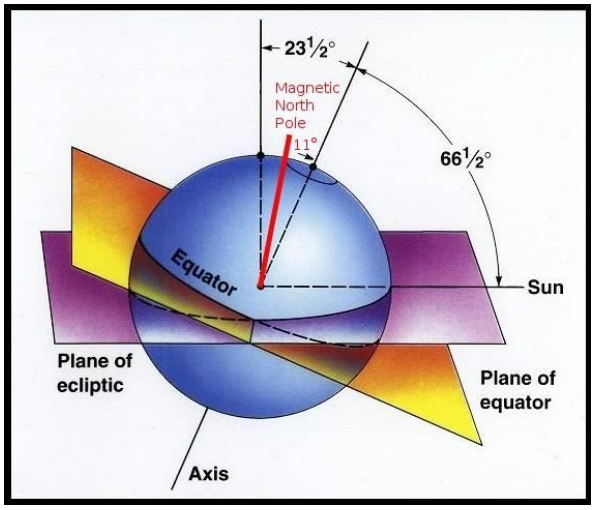
Models of the Earth

Maps can be used as a graphical and mathematical model of the physical Earth.

Magnetic Declination Maps

Since the Earth's true north (geographical North Pole) and the Earth's magnetic north are different by 23.5˚ (called the magnetic declination), some maps like below show points with the same magnetic declination.



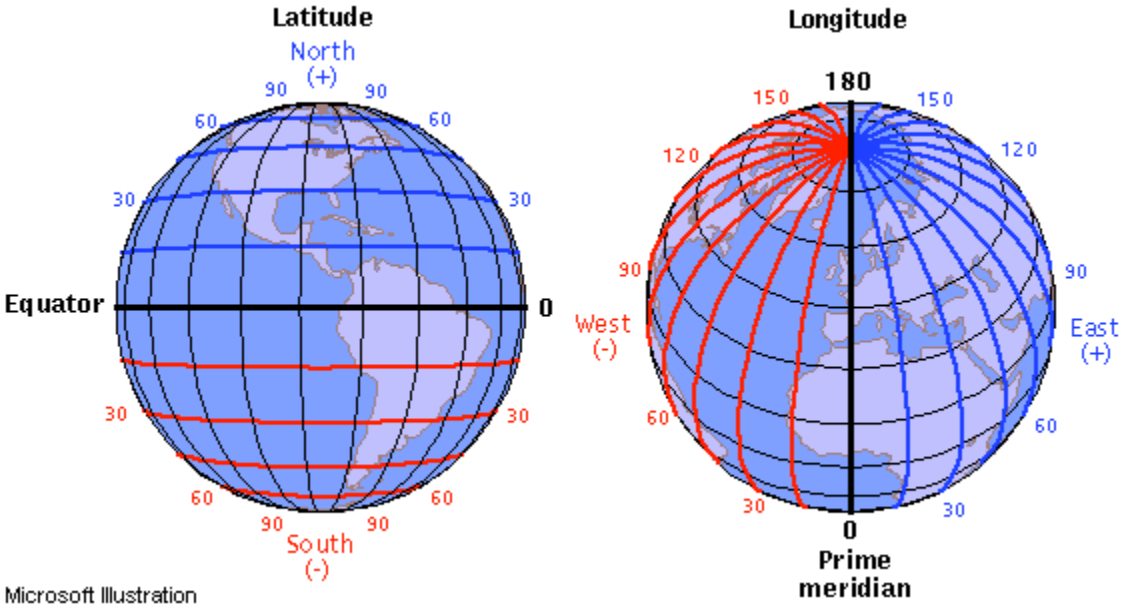


7.1 - Measurement

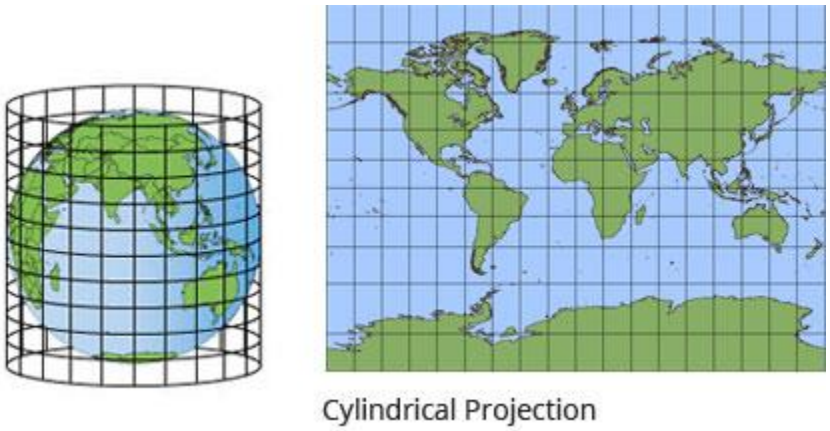
Latitude and Longitude Maps

Latitude – The horizontal lines that represent the distance north or south from the equator in degrees. The North Pole would be 90˚ north latitude and the South Pole would be 90˚ south latitude.

Longitude – The vertical lines or meridians that run east and west through the prime meridian (represents 0˚ longitude). The Western Hemisphere which encompasses North America, are found west of the prime meridian and run between 0˚ and 180˚. The Eastern Hemisphere which encompasses most of Europe and Asia run between 0˚ and 180˚ east longitude.



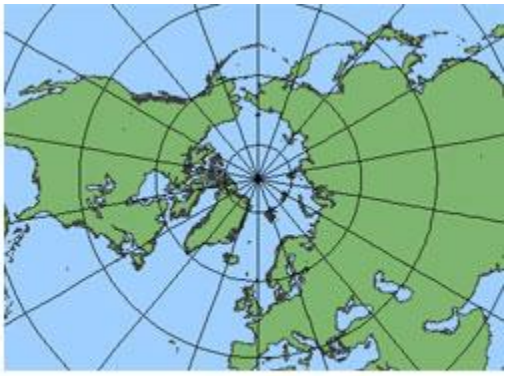
Cylindrical Projection – Called the Mercator projection, this shows the Earth's latitude and longitude as straight lines with equal amounts of space. The limitations of this model are that because of the spacing of the latitude lines, the areas near the poles look wider and longer (Greenland looks almost as large as Arica).


Cylindrical Projection

7.1 - Measurement

Conic Projection – This map moves the contents of the globe into a cone and is then unrolled to form a flat plane. The cone touches the globe at each line of longitude but at only one latitude. There are fewer distortions along the lines of latitude. The limitation of this model is looking at areas near the North and South Poles.

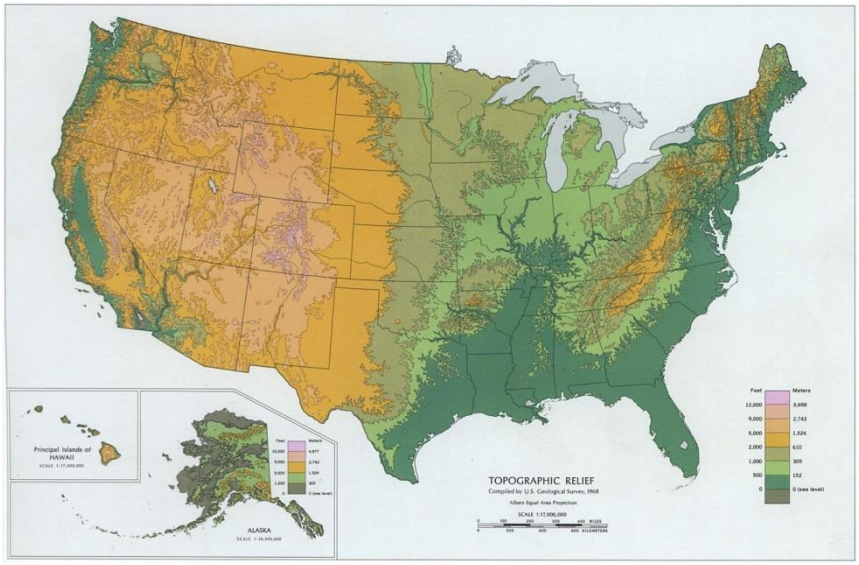
Azimuthal Projection – This map is made by moving the contents of the globe onto a flat plane. There is little distortion at one single point and this model is often used for areas near the North and South Poles.



Azimuthal Projection

7.1 - Measurement

Topographical Projections – This model shows surface features of topography including natural features such as rivers, lakes, mountains, and demonstrates elevation.



A topographical map shown below can be interpreted by:

- The closer the lines are together, the steeper the slope of the terrain.
- The smaller the loop, the higher the elevation.