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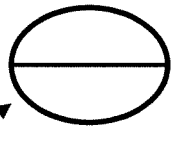
III. Planet Earth & Maps

A. Shape of the Earth:

1. Oblate spheroid – An oblate spheroid is a sphere that is flattened at the poles and slightly bulging at the equator.
   ⇒ The Earth is only slightly an oblate spheroid, and this diagram is exaggerated.



Oblate Spheroid

a. Earth's Dimensions

Polar Diameter	12,714 km
Equatorial Diameter	12,757 km
Polar Circumference	40,008 km
Equatorial Circumference	40,076 km

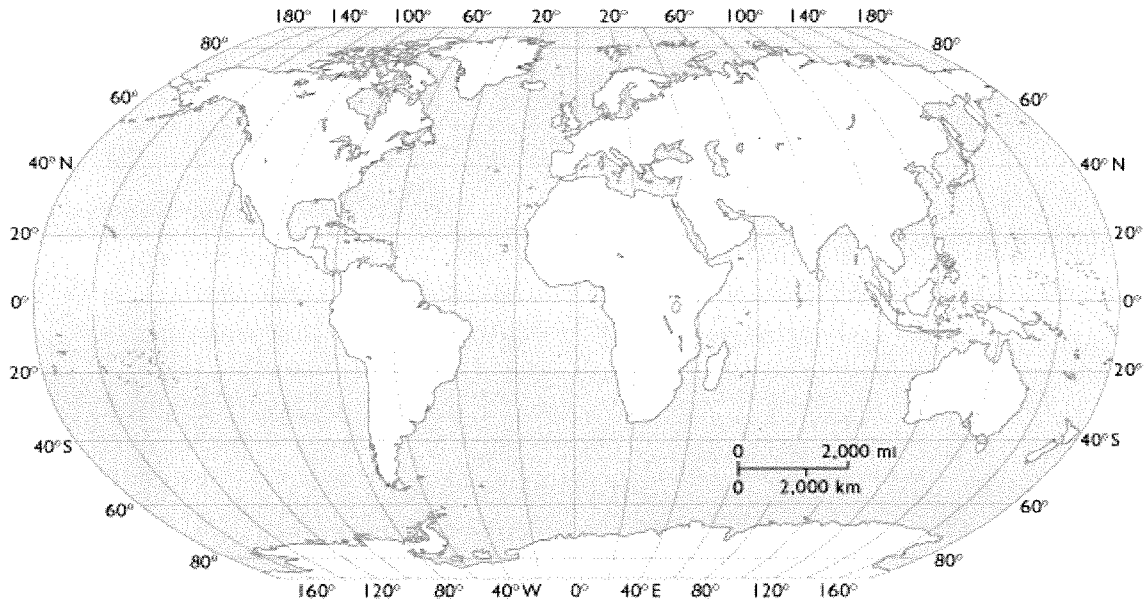
2. Evidence of Earth's shape (besides distances):
   a. Observations of the horizon – As a ship sails towards you on shore, you will see the top of the mast first, then the sail and finally the hull.
   b. Lunar Eclipses - Earth's shadow is cast on the moon, and it is visibly curved.
   c. Photos of Earth from space - from space it appears to be perfectly round and smooth (This is **not** the case).
   d. Altitude of Polaris (North star) – As we change our latitude, the altitude of Polaris changes too. Mathematically this can be shown, but it comes down to this:
      The altitude of Polaris is equal to the latitude of the observer.
   e. Gravity measurements - Objects weigh more at the poles than at the equator. This occurs because the distance from the center of the Earth to the poles is less than from the center of the Earth to the equator, so the force of gravity is more at the poles. The force of gravity is greatest the closer you are to the center of the Earth.

B. Structure of the Earth

1. Lithosphere – The outermost "layer" of the Earth (avg. thickness = 70 – 150km). It includes the crust and forms a continuous shell around the Earth (below oceans too).
2. Hydrosphere – The thin layer of water resting on the Lithosphere (Avg. thick= 4 km). It consists of the Earth's oceans, lakes, rivers and water in the ground. It covers approx. 70% of the Earth's surface.
2. Atmosphere – The "layer" of gases that surrounds the Earth and has an Approximate thickness = 150km. Most of its mass is concentrated in the first 11km above the Earth called the Troposphere.

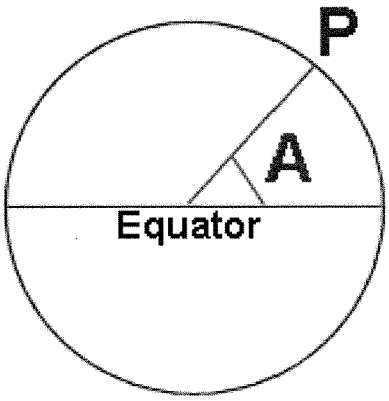
C. Locations on Earth

1. Coordinate system – a system of intersecting lines used to determine locations on the surface of the Earth. It provides a frame of reference for traveling and describing positions.



2. Latitude and Longitude - Latitude and longitude is a coordinate system that enables us to describe exact locations on Earth.
   a. Latitude – Latitude is the distance north or south of the equator and it is measured in degrees because it is an angular distance. On a map, latitude lines are drawn east to west and are **parallel** to the **equator**, which is the starting "point" for all latitude coordinates.

On this diagram, A is the angle, but P is where that latitude line would be "drawn" all around the Earth parallel to the Equator.



What is the latitude of the following locations?

North Pole = _____

South Pole = _____

Equator = _____

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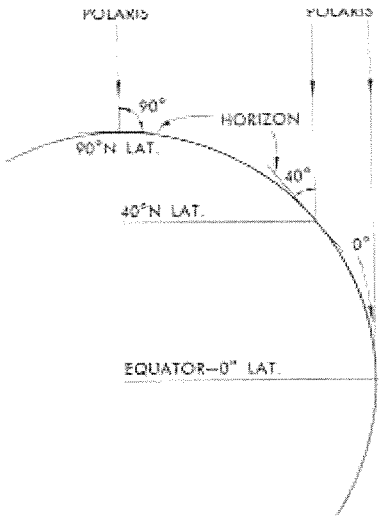
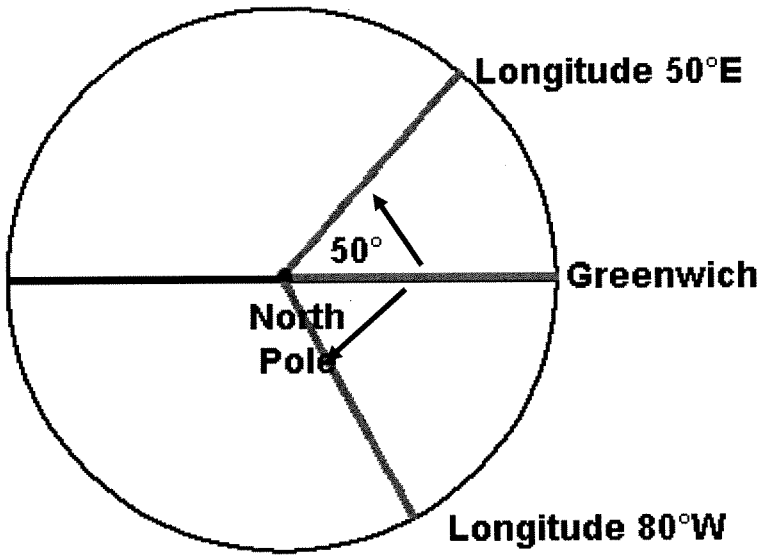


** Remember that in the Northern Hemisphere, the altitude of Polaris equals the latitude of the observer.**

b. Longitude – Longitude is the distance east or west of the Prime Meridian and it is measured in degrees because it is an angular distance. On a map, longitude lines are drawn north to south. They are also called **meridians** and **long lines** because unlike latitude lines, longitude lines are all the same length. The starting "point" for longitude is the **Prime Meridian** and it passes through Greenwich, England.

This is a top view of two of Earth's longitude lines. Notice that 50°E is nothing more than a line drawn 50° from the Greenwich line or what we call the PRIME MERIDIAN. Likewise all longitude lines are lines drawn from the North Pole to the South Pole at certain angles away from the Prime Meridian.



3. Solar Time vs. Clock Time – Our system of time is based on observations of the Sun. For instance, noon is defined as the time of day the Sun reaches its highest point in the sky. Longitude lines separate different time zones and each time zone is **15°** of longitude "wide". Since the **Prime Meridian** is the starting point for longitude, it is also the starting point for time. As you know, the Prime Meridian passes through Greenwich, England, so the world's time is based on what is called **Greenwich Mean Time (GMT)**.

Why is this important?

If you know your local time and **GMT**, then you can determine your approximate longitude by multiplying the time difference by **15°**. If your local time is **earlier** than GMT, then you are **west** of the Prime Meridian and if your local time is **later** than GMT, then you are **east** of the Prime Meridian.

Example 1: What is your longitude if your local time is 5:00pm and Greenwich Mean Time is 12 noon?

Example 2: What is your longitude if your local time is 1:00pm and Greenwich Mean Time is 4:00 PM?

Example 3: What is your longitude if locally the Sun is at its highest point in the sky and GMT is 2:00 PM?

Example 4: What is your longitude and latitude if you are sailing across the Prime Meridian and you look up and see Polaris at an altitude of 50°? (Make sure you include the correct compass directions.)

D. Topographic Maps

1. Field - any region of space in which every point has a **measurable** quantity.

Example: temperatures or air pressures on a weather map.

a. Isolines – Isolines are lines that connect points of **equal value** on a map.

Example: isobars (equal pressure), isotherms (equal temps).

2. Contour maps – Contour maps (AKA topographic maps) show the shape of the Earth's surface including changes in elevation (altitude or height) above sea level. Like most maps, contour maps are a top view.

a. Contour lines - a type of isoline that connects points of equal elevation above sea level. Contour lines are separated from the next adjacent contour line by a fixed elevation called a contour interval.

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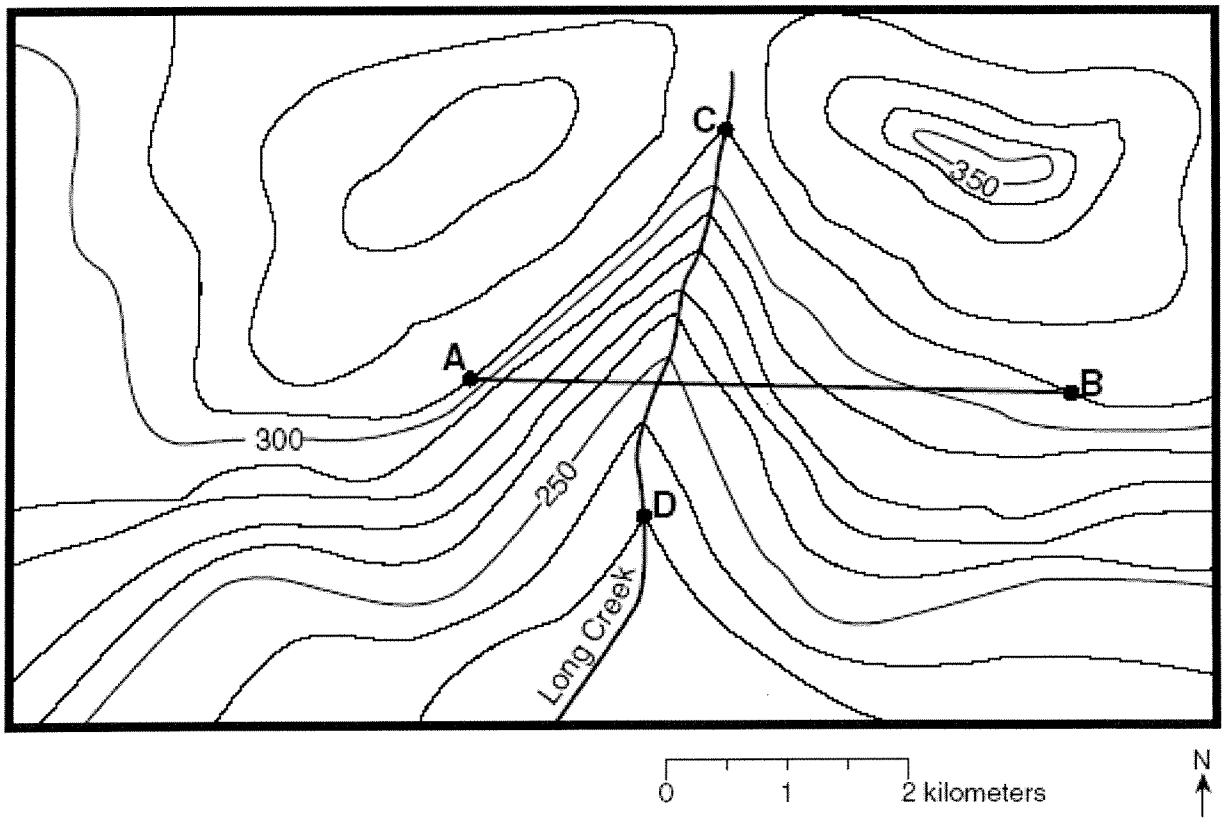


b. Contour interval - the difference in value between two adjacent contour lines.

What is the contour interval in the map above?

c. Hachured lines - show holes in the Earth's surface or closed depressions. The first hachured line has the same value as the closest contour line and each additional hachured line has a **lower value** according to the contour interval.

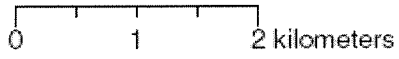
d. Profiles - Topographic maps show the top view of the Earth's surface, but a profile gives a side view. These allow better visualization of how steep the landscape feature is.

Draw the profile (side view) of the contour map above.

e. Direction - most maps indicate which direction is north, and many include latitude and longitude along the margins.

f. Scale – A scale on a map shows how distances on the Earth's surface are represented on the map. It can be displayed as a **ratio** or a **line** representing distances.

Examples: **ratio – 1:10,000** means that 1-inch on the map equals 10,000 on the Earth's surface.

Line - 

How to use a line scale: Place a straight edge of a piece of paper along the map where you're measuring and mark the paper at the two locations. Next, put that piece of paper along the scale to see the distance.

What is the distance between point A and B on the map above?

What is the distance between point C and D on the map above?

What direction is Long Creek flowing?

What is the highest possible elevation on this map?

g. Gradient – (AKA slope) Gradient shows how quickly **some value** changes between two places. When we use gradient with contour maps we will consider how **elevation** changes between to locations, but it can be used to determine how air pressure changes between two locations too (AKA **pressure gradient**).

$$\textbf{Gradient} = \frac{\textbf{change in field value}}{\textbf{change in distance}}$$

Example: A hill drops 200 feet (field value) between two points that are 5 miles apart. Gradient = $\frac{200 \text{ feet}}{5 \text{ miles}}$ = 40 feet/mi.

Example: The elevation of Mohonk Lake is 1260 feet above sea level and the elevation of RVHS is 330 feet a.s.l. What is the gradient if the distance between the two locations is 3.5 miles?

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Example: The peak of a mountain has an elevation of 735 meter a.s.l. and the bottom has an elevation of 210 meters. What is the gradient if the distance between these two locations is 10 km?

Example: The air pressure at RVHS is 1025 mb and in Kingston it is 1005mb. What is the pressure gradient if the distance between these locations is 10 miles? What is the name of this wind?

Here are some important things to remember about Contour Maps

1. Every point on one contour line has the same elevation.
2. Contour lines never cross.
3. Contour lines close somewhere, although it may not be shown on the map.
4. Contour lines are farther apart on gentle slopes (gradient) and closer together on steep slopes.
5. Contour lines bend or "point" upstream (up hill) when the cross streams.
6. Highest elevations are found when the contour lines form small closed circles.
7. Remember hachured lines are depressions and the outermost one is the same elevation as the adjacent "normal" contour lines.