

MEASURING THE EARTH

A) The shape of the Earth:

- a) An oblate spheroid (flattened sphere)
- b) Flattened at poles
 - 1) polar circumference 40,008 km
 - 2) polar diameter 12,714 km
- c) Bulging at the equator
 - 1) equatorial circumference 40,076 km
 - 2) equatorial diameter 12,757 km
- d) From space the Earth appears to be a perfect sphere

B) Evidence for Earth's shape (ROUND vs FLAT)

- a) Photographs of the Earth from space or the moon (this is the **best** evidence because it's a direct observation).
- b) Earth's shadow seen on moon during eclipse.
- c) Ships disappear over horizon bottom first.
- d) Altitude of polaris varies with latitude.
- e) Angle of noon sun varies with latitude.

C) Evidence for Earth's shape (OBLATE SPHEROID)

- a) Gravitational measurements:
 - 1) stronger at poles (closer to center)
 - 2) weaker at equator (further from center)
- b) Altitude of polaris does not match latitude. *Moving 1° north or south on the earth's surface does not always result in a change of exactly 1° in the altitude of Polaris. If the earth was perfectly round this slight difference would not occur.*

D) Determination of circumference

- a) Eratosthenes experiment
 - 1) Get angle of noon sun at 2 locations on the same meridian (N-S line)
 - 2) Find difference between 2 angles
 - 3) Get distance between 2 locations
 - 4) Divide difference into 360°
 - 5) Multiply result by the distance = Circumf.

$$\text{Circumference} = \frac{360}{(\text{Angle } 2) - (\text{Angle } 1)} \times \text{Distance}$$

E) Diameter of the Earth

- a) $D = 2r$
- b) $D = (2) (6.37 \times 10^3)$
- c) $D = 12.74 \times 10^3$ or 1.274×10^4

F) Hydrosphere

- a) Water (salt and fresh) covering 70% of the Earth
- b) Averages 3.5 - 4.0 km in depth
- c) Oceans represent <1% of thickness of Earth

G) Atmosphere

- a) Gas envelope surrounding Earth
- b) 78% nitrogen, 21% oxygen, 1% other
- c) Extends to approx. 150 km.
- d) Layers:
 - 1) Troposphere (0 to 12 km)
 - 2) Stratosphere (12 to 50 km)
 - 3) Mesosphere (50 to 82km)
 - 4) Thermosphere (82+ km)
- e) Interfaces between layers are "pauses"
 - 1) Tropopause
 - 2) Stratopause
 - 3) Mesopause

H) Lithosphere

- a) Solid, rocky, outer shell of the Earth. (Covered by **regolith**, the loose rock & soil)
- b) Averages 20-25 km.
- c) Thicker under continents - thinner under oceans.

POSITIONS ON THE EARTH

A) Coordinate system (grid)

- a) Latitude (aka parallels)
 - 1) Measured in degrees/minutes
 - 2) 60 minutes = 1 degree
 - 3) Run east-west
 - 4) Change north-south
 - 5) Maximum latitude = 90E (N or S poles)
 - 6) Minimum latitude = 0E (equator)
 - 7) Size of a degree varies with latitude due to shape of the Earth
 - 8) Altitude of Polaris = latitude (N only)
- b) Determination of latitude
 - 1) Draw line to horizon
 - 2) Draw line to Polaris
 - 3) Angle formed by these lines is the latitude
 - 4) Applies to Northern hemisphere only

- c) Longitude (aka meridians)
 - 1) Measured in degrees/minutes
 - 2) Run North-south connecting poles
 - 3) Change north-south
 - 4) Prime meridian (0E) through Greenwich Eng.
 - 5) Time changes 1 hour per 15E long. change
 - 6) West = earlier / East = later

B) Fields

- a) Region of space w/measurable values
 - 1) Examples: elevation/temperature/pressure
- b) Scalar fields
 - 1) Values have magnitude only
 - 2) Examples: elevation/temperature/pressure
- c) Vector fields
 - 1) Values have magnitude and direction
 - 2) Examples: Wind/magnetic fields

C) Gradient (aka slope, rate of change)

$$\text{gradient} = \frac{\text{change in field value between 2 points}}{\text{change in distance between 2 points}}$$

D) Isolines

- a) Lines on a map connecting points of equal value
- b) Special isolines:
 - 1) Isotherms - equal temperature
 - 2) Isobars - equal atmospheric pressure
 - 3) Contour lines - equal elevation
 - c) Interval - value difference between adjacent lines
 - d) Index isoline - marked with its value
 - e) Isolines interval small (close) = steep gradient
Isoline interval large (far apart) = gentle slope
 - f) Contour lines seem to point in opposite direction of stream flowing across them (point uphill)
 - g) Sea level = 0 elevation
 - h) Contour lines w/hatch marks = slope downward
 - i) Max elevation is a value higher than the highest contour line but less than the next WOULD be.

E) Map legend

- a) Gives distance scale (km and/or miles)
- b) Key to symbols of man-made and natural features
- c) Indicates direction