# Models and Dimensions of Earth

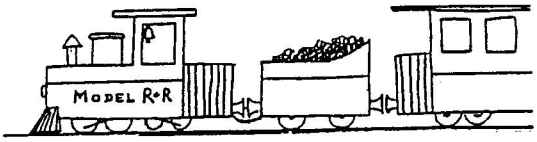
**I. Model** = Anything that represents the properties of an object

A. Types and Examples of Models:

1. Physical -provides us with information through our sense of sight.

globe

2. Mechanical -a physical model with moving parts so that it can perform the functions or movements as the original object.




Model train

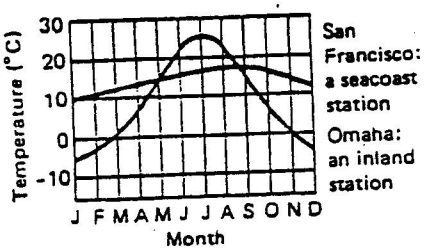
3. Mathematical -mathematical relationships expressed by symbols, formulas and equations.

$E = mc^2$ $\quad$ $\text{Density} = \frac{\text{mass}}{\text{volume}}$

$V = l \times w \times h$ $\quad$ $C = \pi d$

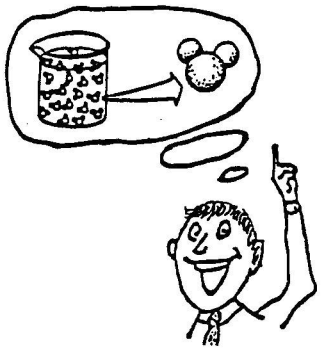
Equations

4. Graphic -a graph to provide a "picture" of a relationship of symbols, formulas and equations.




Line graph

5. Mental -models that can only exist in someone's mind.



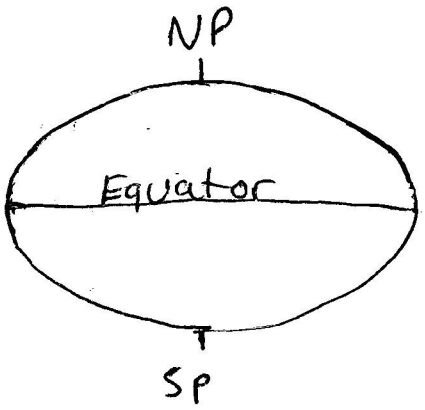
← water molecule

$H_2O$

## II. Shape of Earth

A. Oblate Sphere - Flattened sphere

1. Flattened at poles
2. bulges at equator
3. Diagram of an oblate sphere



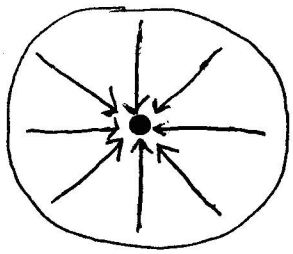

NOT TO SCALE

4. Earth's equatorial circumference is greater than its polar circumference.
   a. Equatorial circumference - 24,900 mi
   b. Polar circumference - 24,860 mi

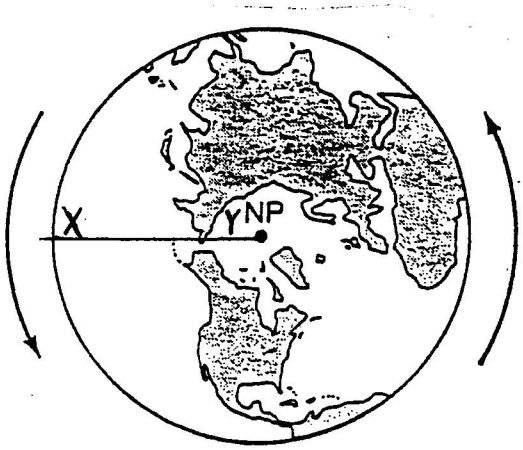
## B. Causes of Earth's Shape

1. Gravity - an inward pulling force. This force pulls inward equally in all directions and causes earth to be spherical.

| KEY |
| --- |
| = force of gravity |



2. Centrifugal Force - an apparent outward force caused by the spinning (or rotating) of earth on its axis. This force causes earth to bulge.
   a. The faster the rotational speed, the greater the centrifugal force.
   b. (1) How long does it take each location to make one complete rotation?
      X 24 hrs
      Y 24 hrs
      (2) Which location, X or Y, travels a greater distance to make one complete rotation?
      X
      (3) At which location, X or Y, is the rotational speed greater?
      X
      (4) At which location, X or Y, is centrifugal force greater?
      X

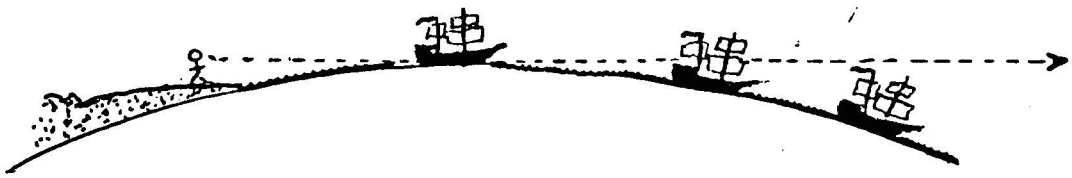



   c. Therefore, the greater centrifugal force causes earth to bulge at the Equator.

## C. Evidence of Earth's Shape

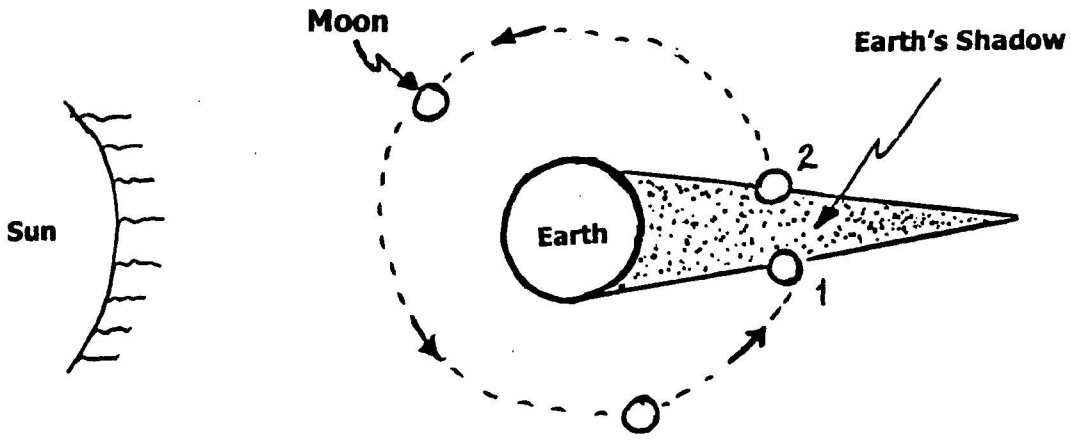
1. Photographs from space reveal that Earth is almost a perfect sphere / very very spherical.

2. Observations of ships on the horizon



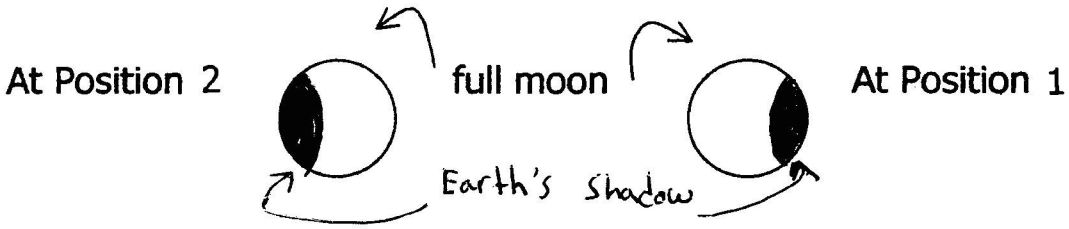
The gradual "appearance" or "disappearance" of a ship over the horizon is evidence that earth's surface is curved.

3. Observations of an Eclipse of the Moon (as viewed from Earth)
   a. As viewed from space:




As the moon orbits Earth, and travels from position 1 to position 2, it passes through Earth's shadow.

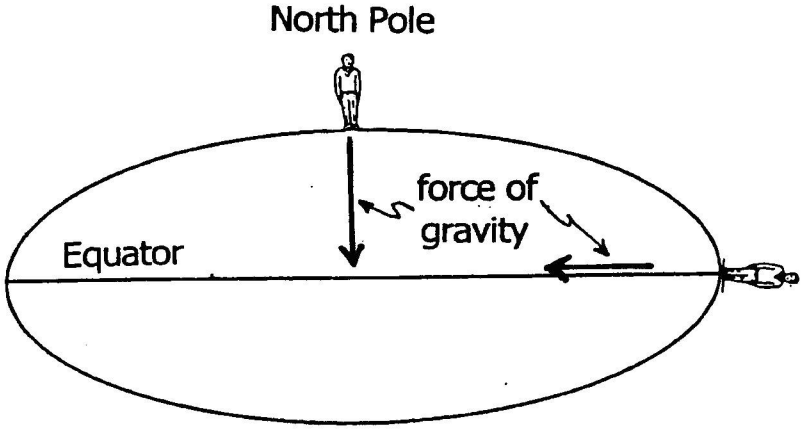
b. As viewed from Earth:




c. Earth's shadow on the moon (full moon) during a lunar eclipse provides evidence that Earth is Spherical.

4. Measurement of Gravity

a.




b. The shorter the distance between two objects, the greater the gravitational force. Therefore a person or object that is closer to the center of Earth (the center of gravity) would weigh more than when the person or object is farther from the center of gravity.

c. (1) If Earth is an "oblate spheroid", where on the surface of Earth would a person be closer to the center of Earth?

at the poles

(2) Where on the surface of Earth would a person weigh the most?

at the poles

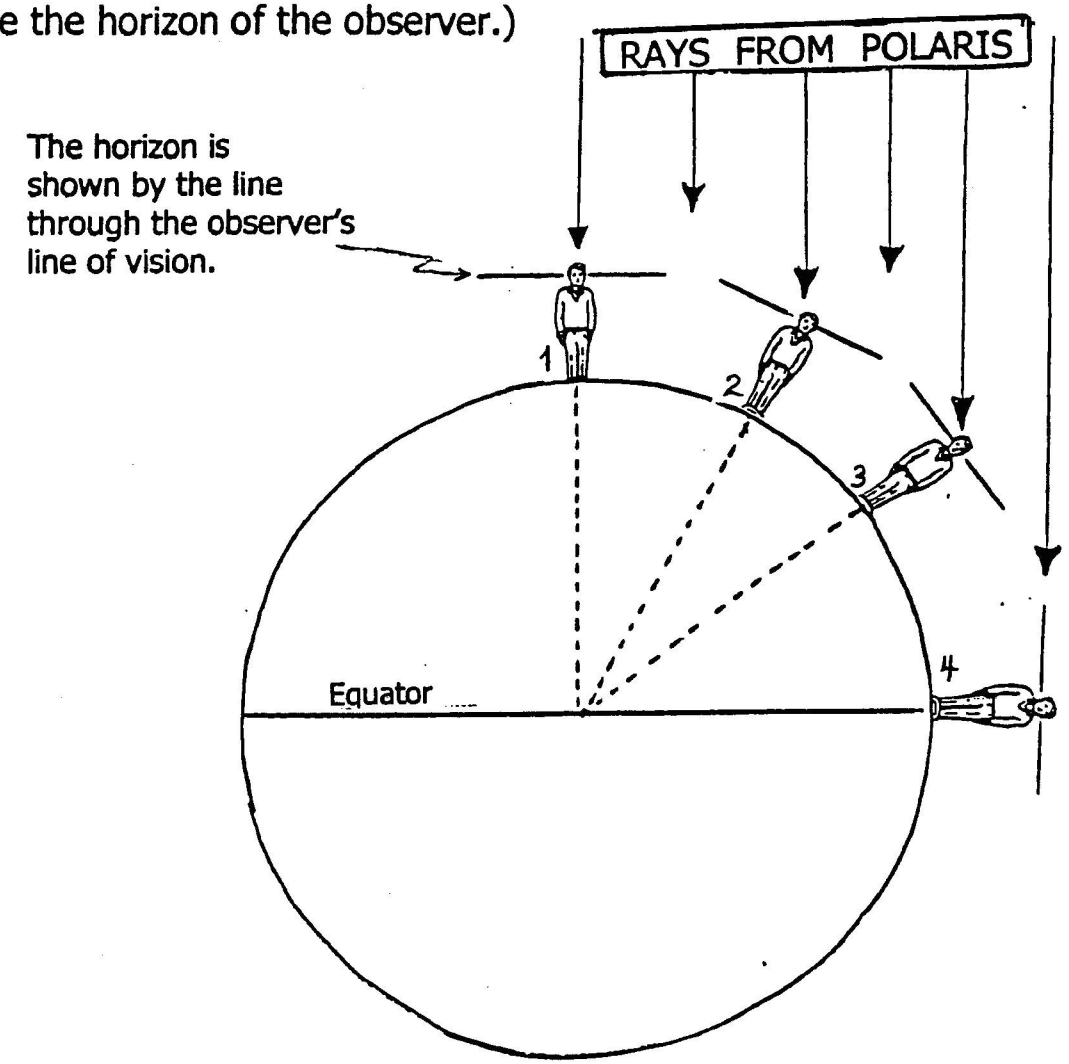
d. Under what circumstance would a person weigh the same everywhere on Earth?

If earth was a perfect sphere

5. Observation of the North Star, Polaris
   a. The altitude of Polaris changes as an observer moves north or south (in the Northern Hemisphere); this is because Earth is Spherical, and its surface is curved.

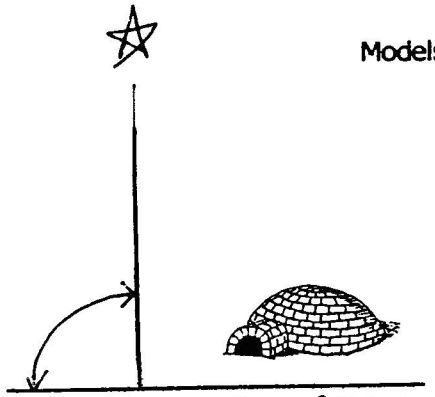
   (Altitude is the height, measured in degrees that a heavenly body is above the horizon of the observer.)

   b.

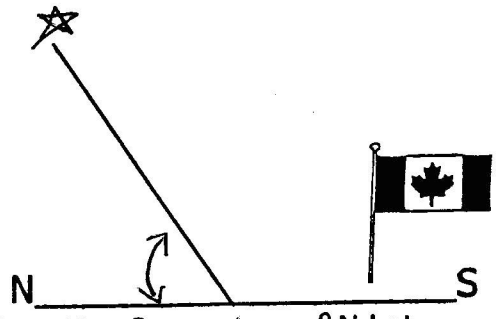



| OBSERVER | LATITUDE | ALTUTUDE OF POLARIS |
|---|---|---|
| 1 | 90° | 90° |
| 2 | 60° | 60° |
| 3 | 35° | 35° |
| 4 | 0° | 0° |

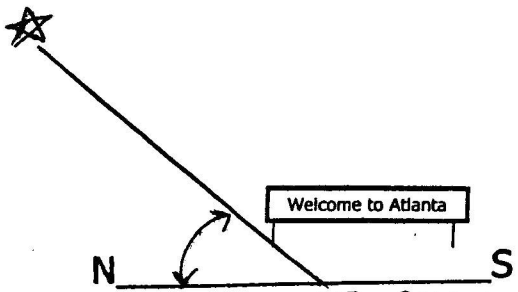
c.



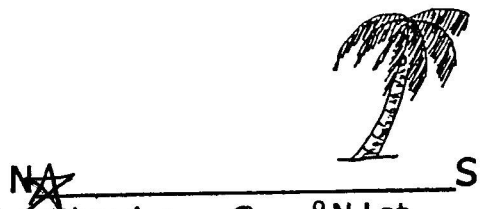
Location 1 = 90 °N Lat.




Location 2 = 60 °N Lat.



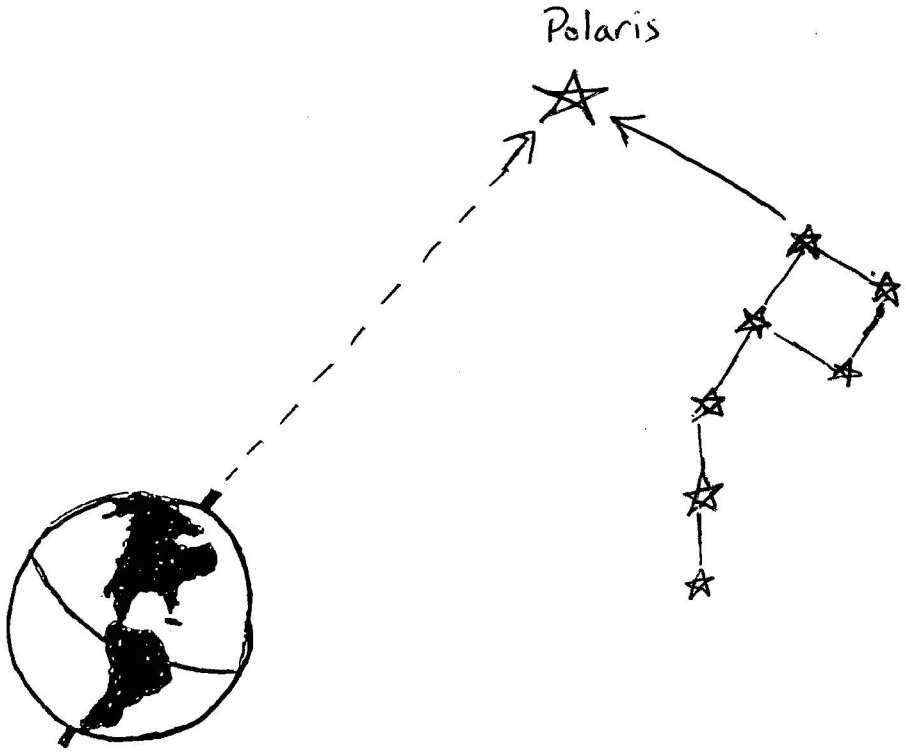

Location 3 = 35 °N Lat.




Location 4 = 0 °N Lat.

d. Summary : The altitude of Polaris (above the horizon) is equal to the latitude of the observer.

e. Locating the North Star

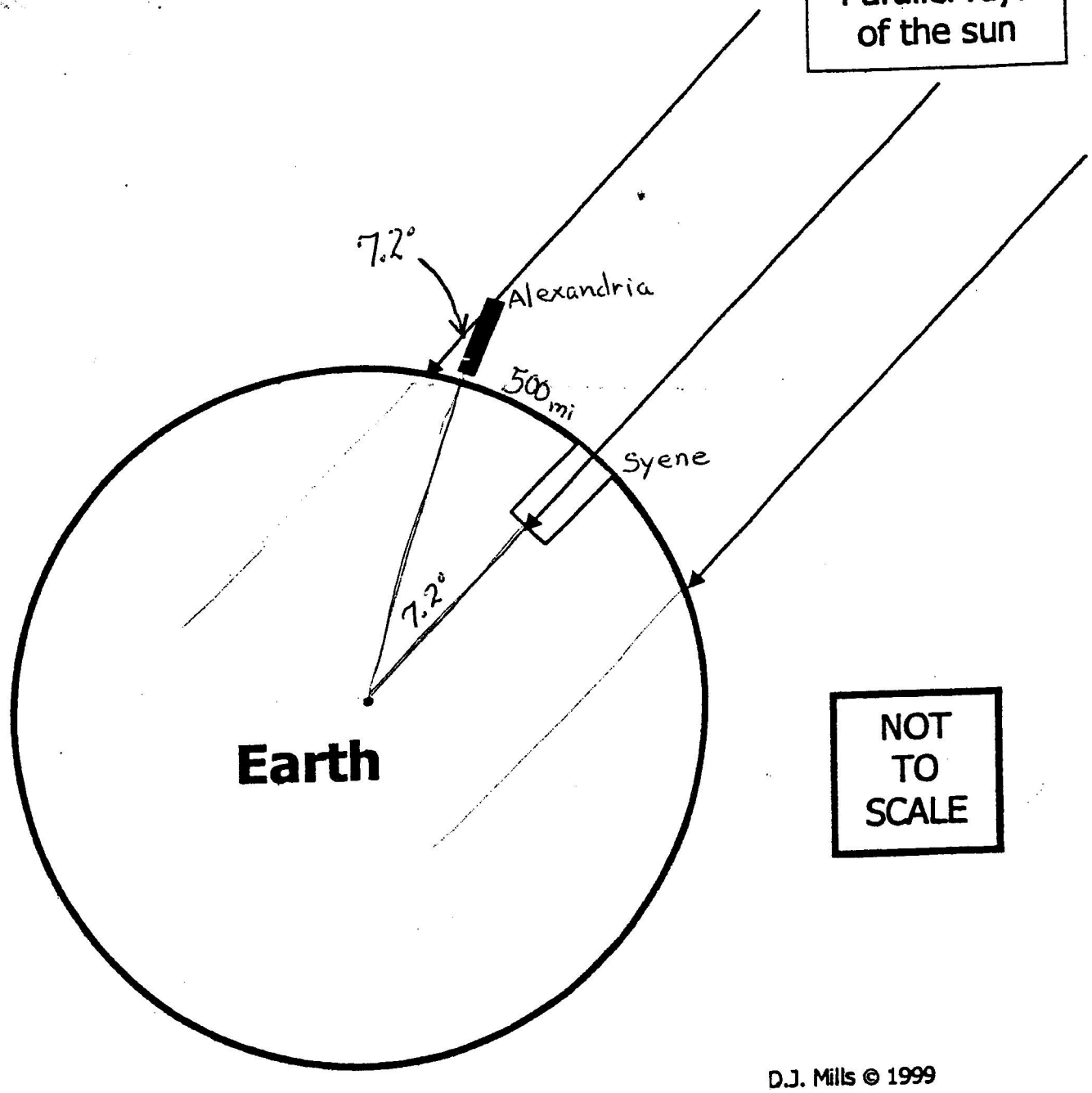


## III. SIZE OF EARTH

A. The Greek mathematician, Eratosthenes, is credited as being the first man to make a scientific determination of Earth's circumference. The time was about 200 BC – over 2000 years ago!

1.

Eratosthenes
273-192 BC



2. Eratosthenes' method for determining Earth's circumference:

Reference Table page = [redacted]

PART / WHOLE

$\frac{7.2^\circ}{360^\circ} = \frac{560}{C}$ (Angle / Distance)

$7.2C = 180{,}000$

$\frac{7.2C}{7.2} = \frac{180{,}000}{7.2}$

$C = 25{,}000$ miles

$\frac{La}{360^\circ} = \frac{S}{C}$

## B. Earth's other measurements

Once Earth's circumference is known, it's other dimensions: diameter, radius, volume and surface area, can be calculated.

1. Calculating Earth's diameter:

① $C = \pi d$

② $25{,}000 = 3.14\,d$

③ $\frac{25{,}000}{3.14} = \frac{3.14d}{3.14}$

④ $7961.7 = d$

2. Based on Earth's diameter, its radius would be: ~4000

3. Using the formula for the volume of a sphere, $V = 4/3\ \pi r^3$
Earth's volume is _____.

① $V = \frac{4}{3}\pi r^3$

② $V = \frac{4}{3} \times 3.14 \times (4000)^3$

③ $V = 1.3 \times 3.14 \times 64{,}000{,}000{,}000$

④ $V = 4.18 \times 64{,}000{,}000{,}000$

⑤ $V = 267{,}520{,}000{,}000\ mi^3$

4. Using the formula for area of a sphere, $A = \pi r^2$, Earth's surface area is _____.

$A = 4\pi r^2$

$A = 4 \times 3.14 \times (4000)^2$

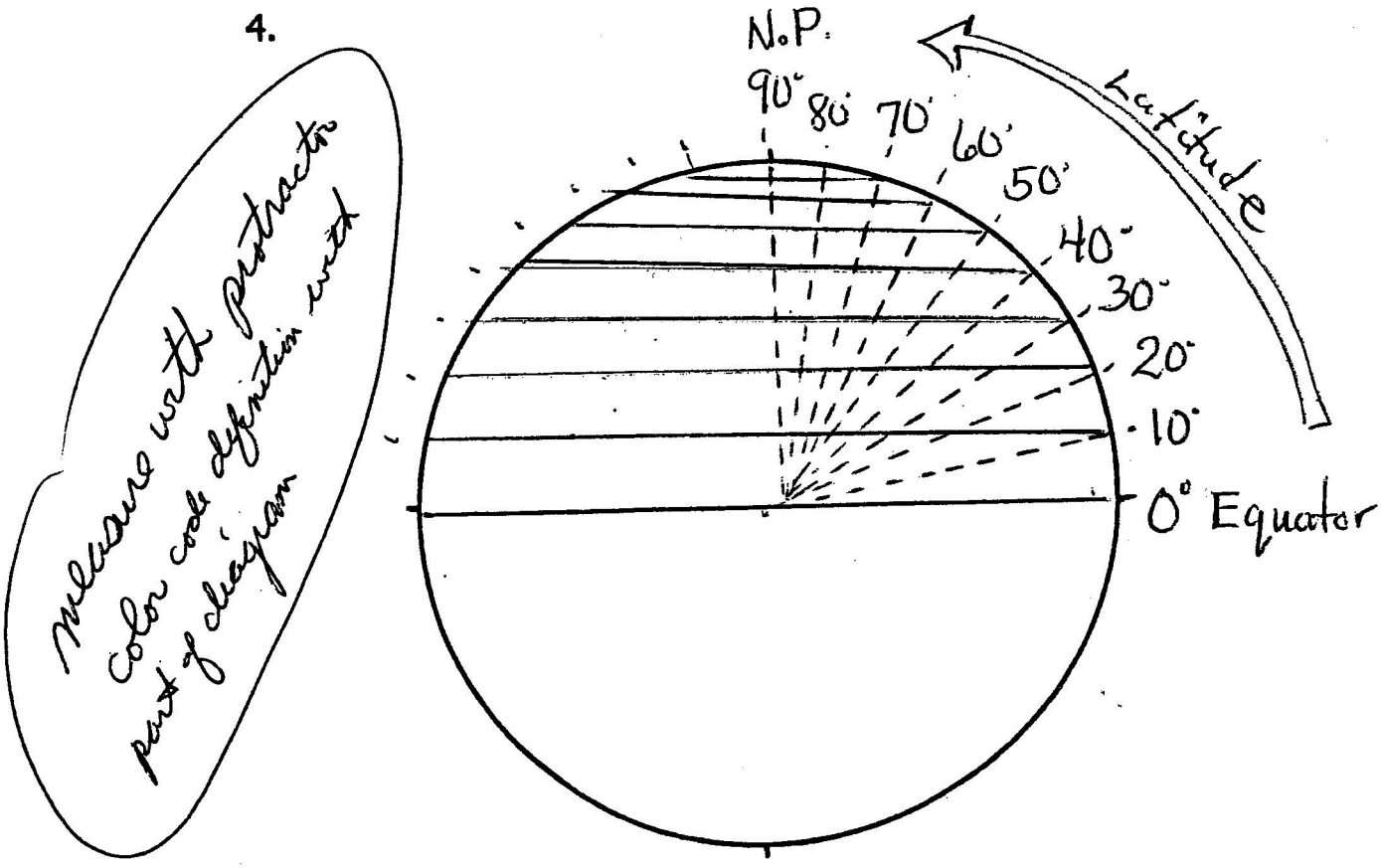
$A = 12.56 \times 16{,}000{,}000$

$A = 200{,}960{,}000\ mi^2$

IV. Latitude and Longitude

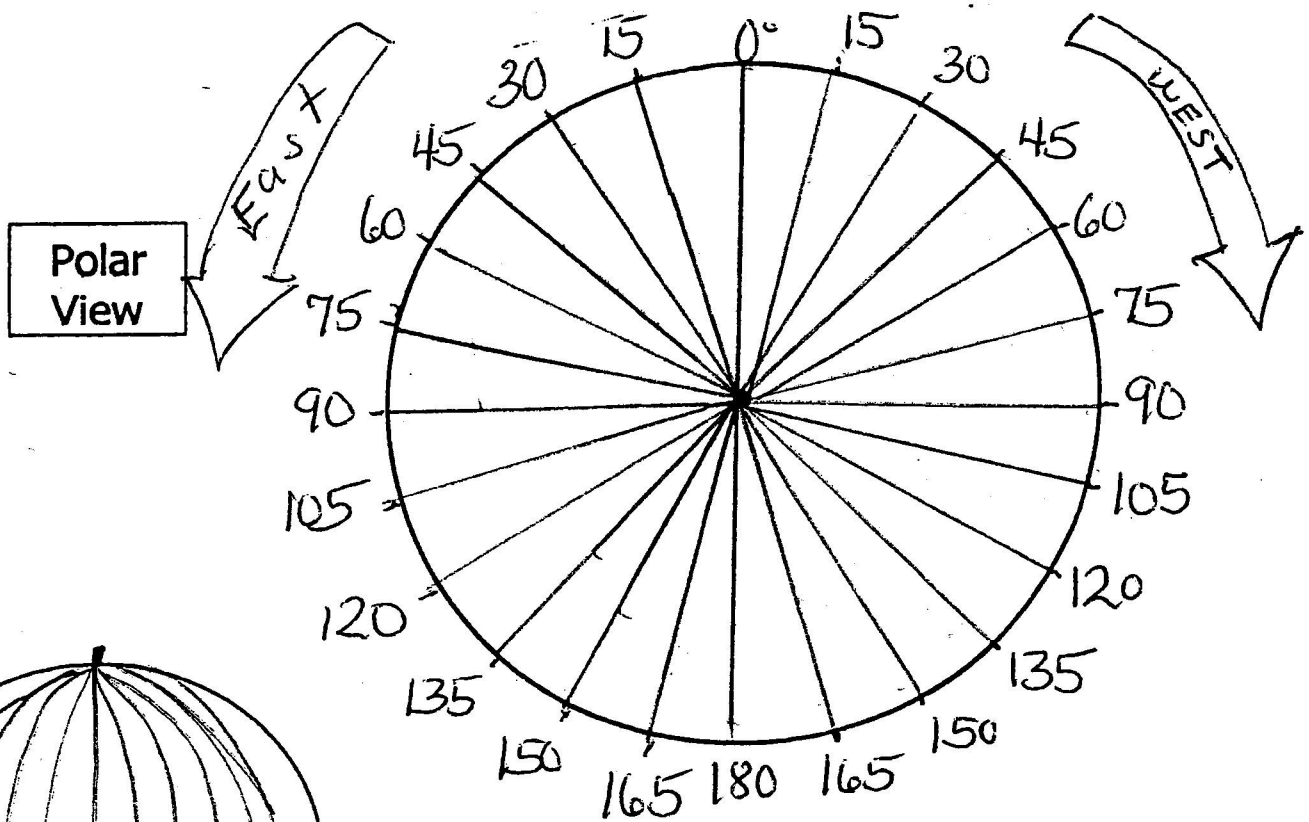
A. Latitude - angular distance north or south of the Equator

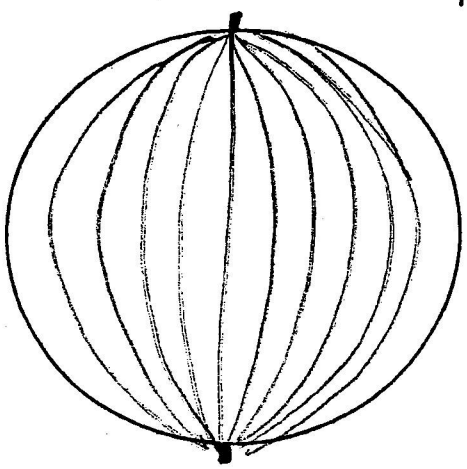
1. Parallels - lines used for measuring latitude; run east-west "parallel" to the Equator.
2. Equator - 0° Lat.; starting place for measuring latitude
3. North/South Pole - 90° Lat.; maximum latitude
4.



B. Longitude - angular distance east or west of the Prime Meridian

1. Meridians - lines used for measuring longitude; run north/south from pole to pole
2. Prime Meridian - 0° Long.; starting place for measuring longitude
3. International Date Line - 180° Long. maximum longitude

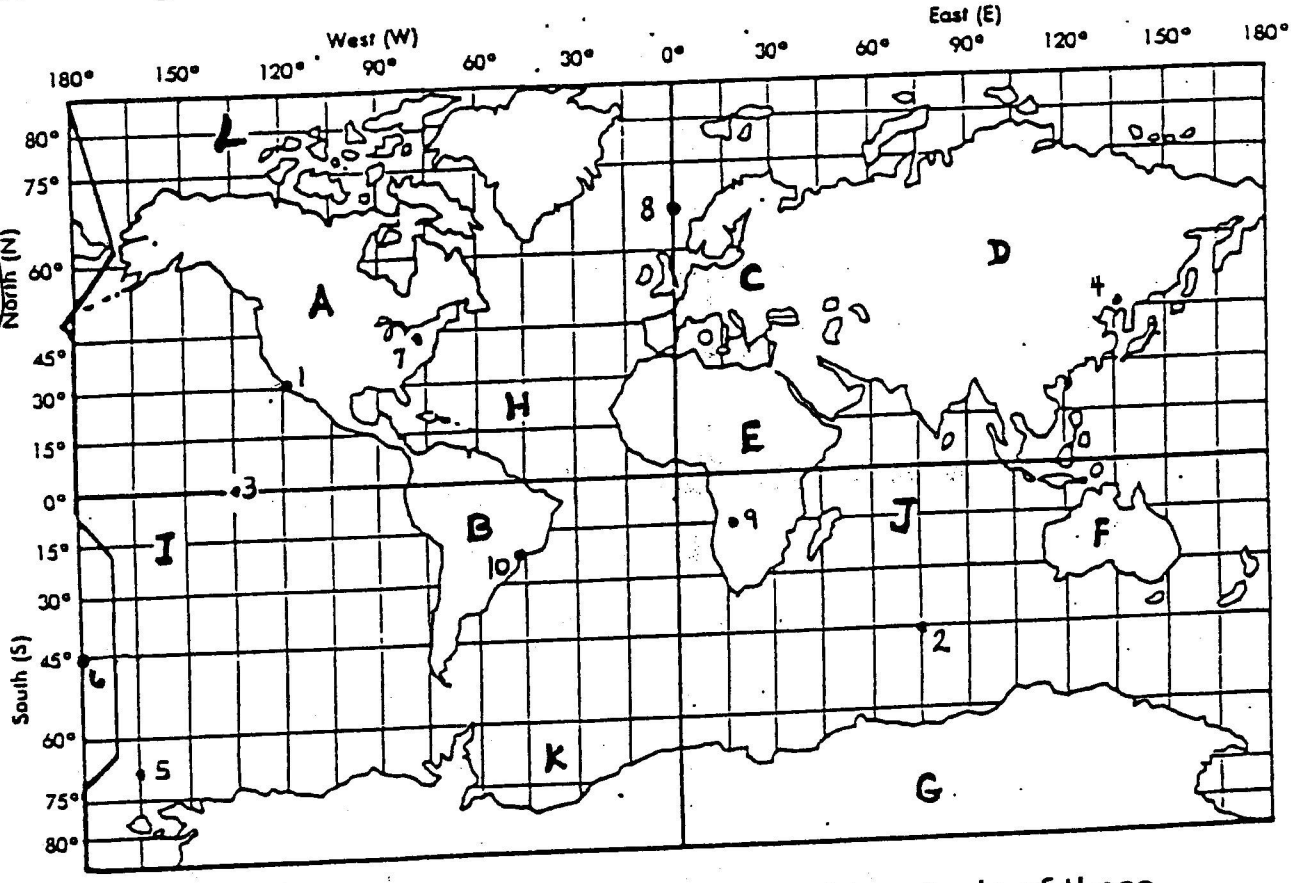


Side/Equatorial View

## C. Determining Latitude and Longitude (Continents and Oceans)

classwork homework before lab




1. Use the map above to determine the latitude and longitude of these numbered and lettered locations. Name the Continents and Oceans indicated by the letters.

| Location | Latitude | Longitude |
|---|---|---|
| 1 | 30 N | 120 W |
| 2 | 45 S | 75 E |
| 3 | 0 | 135 W |
| 4 | 45 N | 135 E |
| 5 | 65-70 S | 165 W |

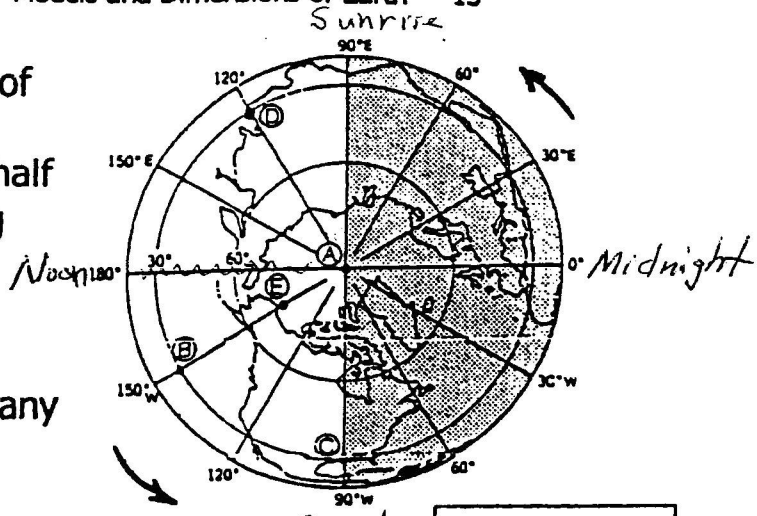
| Location | Latitude | Longitude |
|---|---|---|
| 6 | 45 S | 180 |
| 7 | 40-45 N | 75-80 W |
| 8 | 65-70 N | 0 |
| 9 | 15 S | 15 E |
| 10 | 20-25 S | 45-49 S |

| CONTINENTS | |
|---|---|
| A | North America |
| B | South America |
| C | Europe |
| D | Asia |
| E | Africa |
| F | Australia |
| G | Antarctica |

| OCEANS | |
|---|---|
| H | Atlantic |
| I | Pacific |
| J | Indian |
| K | Antarctic |
| L | Arctic |

## D. Earth's Time Zones

1. As Earth rotates on its axis, half of earth is facing the sun and is experiencing daylight; the other half is in darkness and is experiencing night.



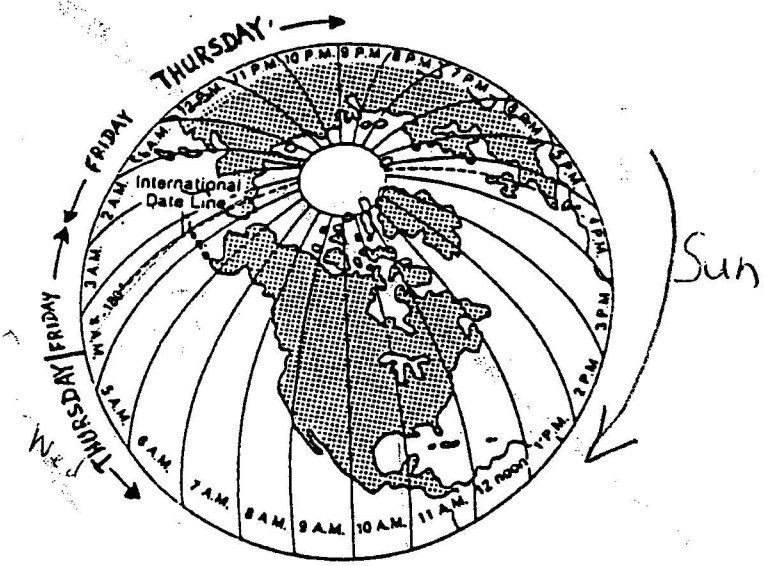

2. When the sun is directly over a certain meridian, it is 12 noon at any location at or near that meridian.

3. Think:
Earth is a sphere /degrees in a circle 360 = 15°
Time / Hours to make one complete rotation = 24

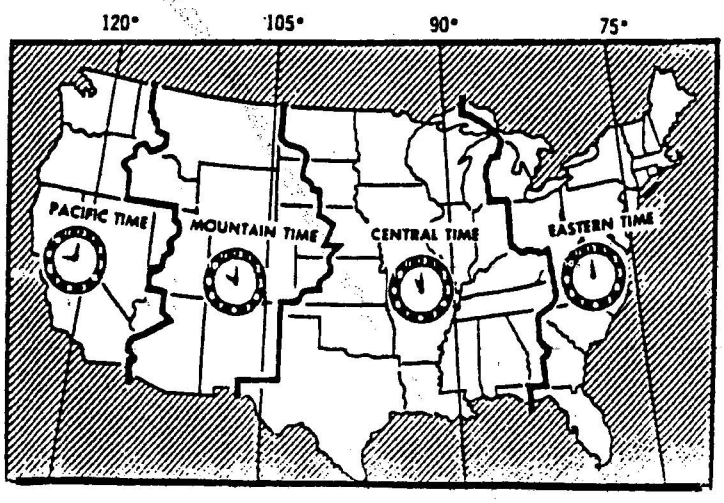
**Earth's Rotational Speed**

4. a. Number of time zones on Earth = 24
   b. Approximate width of each time zone = 15°

5. a. If it is Wednesday, and you cross the International Date Line going west, it would then be Thursday




   b. It is Tuesday, and you cross the International Date Line while traveling east, it would then be Monday




6. a. How many time zones are there in the continental U.S.?
   4
   b. Is it earlier or later in California that New York?
   earlier
   c. If it is 8:00 EST, what time is it in PST? 5:00
   d. It is 6:00 MST, what time is it in EST? 8:00

## V. Fields - _____

_____

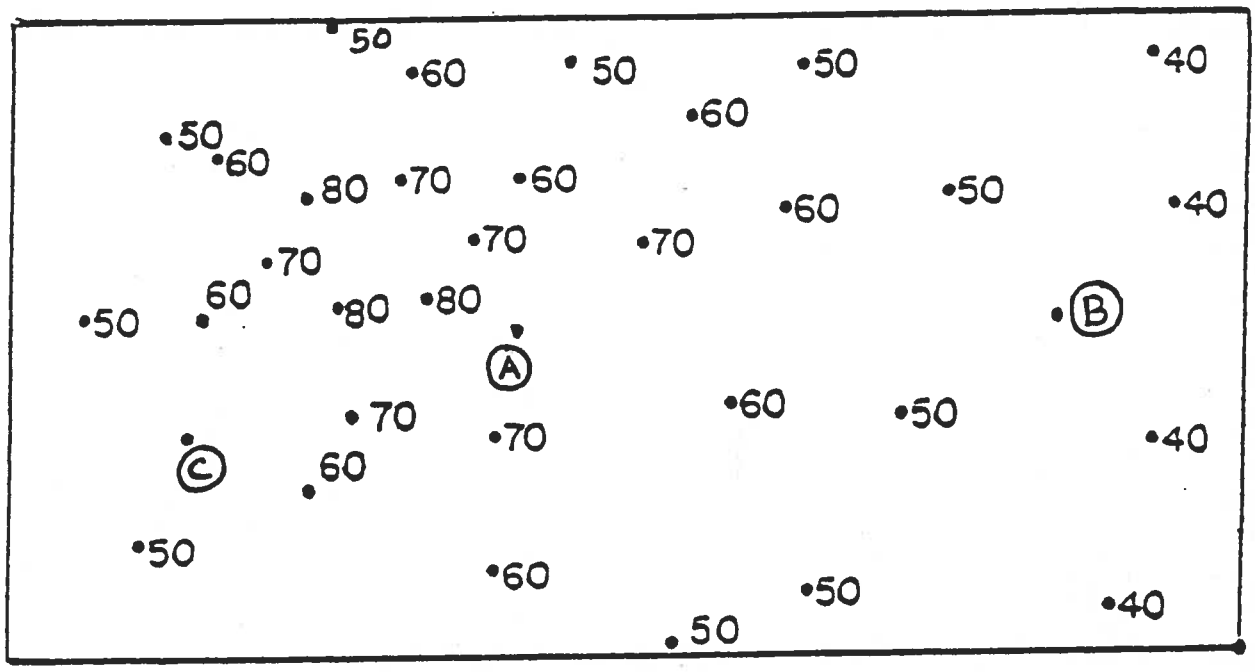
_____

A. Isolines -

_____

_____

B. The diagram below shows an elevation field map of a geographical region; the elevation is in feet (above sea level). Complete this field map by drawing elevation isolines for 40, 50, 60, 70 and 80 feet.




1. What is the approximate elevation of point

   A _____

   B _____

   C _____

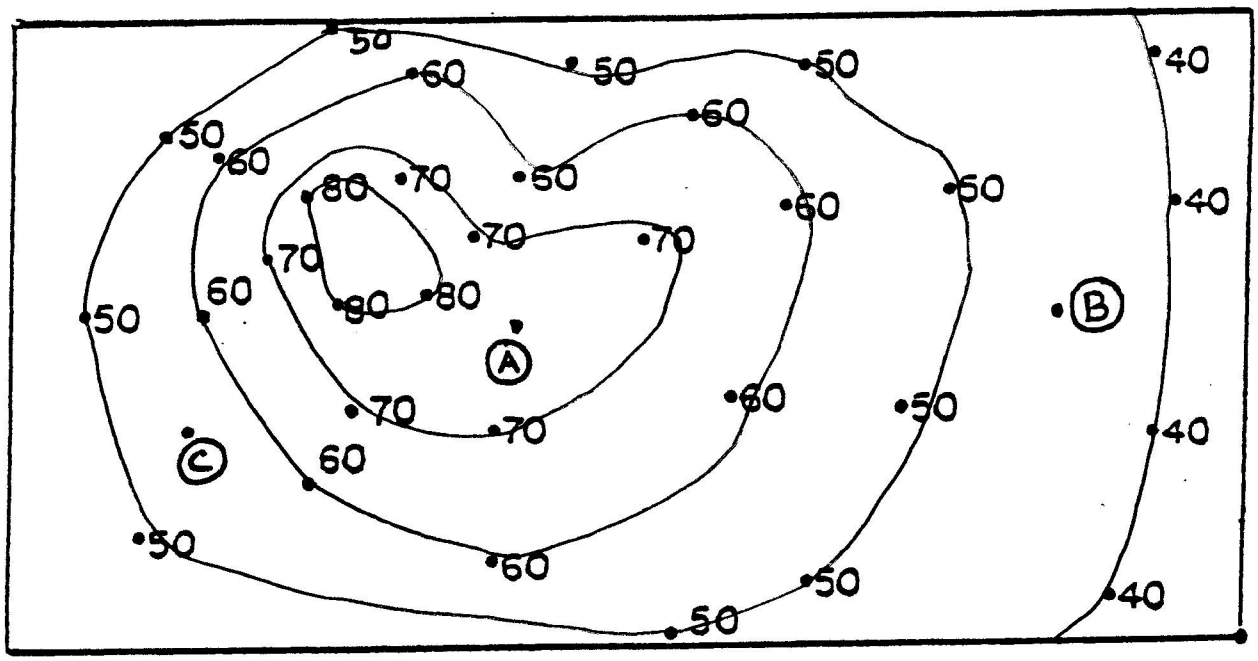
2. Isolines that show elevation are called _____.

## V. Fields - A Region of Space/area that has a measurable value of a given property at every point.

### A. Isolines -

lines on a field map connecting all points of the same value

B. The diagram below shows an elevation field map of a geographical region; the elevation is in feet (above sea level). Complete this field map by drawing elevation isolines for 40, 50, 60, 70 and 80 feet.




1. What is the approximate elevation of point

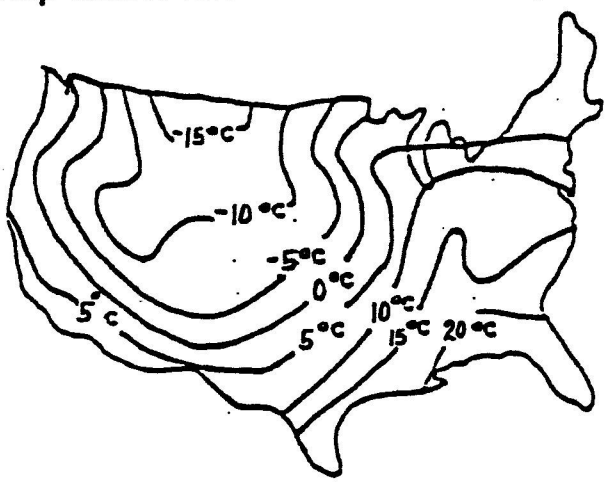
   A 71-79 ~74

   B 41-49 ~45

   C 51-59 ~56

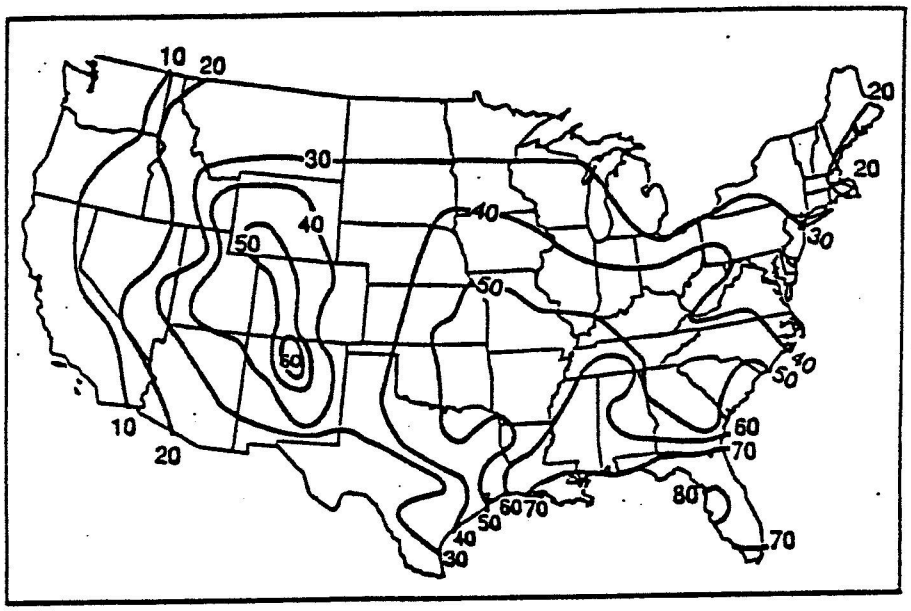
2. Isolines that show elevation are called contour lines.

C. The field map below shows weather data plotted for a January morning.




1. What measurable property is shown on this map? temperature
2. Based on this property, the isolines on this map are called isotherms
3. What is the approximate measurement of this property for New York State? 5°C

D. The field map below shows the average yearly number of thunderstorms in the United States.




1. Approximately how many thunderstorms occur each year in:
   a. Albany, New York - 20-30
   b. Los Angeles, California - >10
   c. New Orleans, Louisiana - <70

# VI. Topographic Maps

... are maps of a elevation field

A. Topographic Maps show the elevation of the land by using contour lines, and show other natural and man-made features by using symbols.

B. Contour Line - isolines on a map connecting points of the same elevation

Elevation - distance (feet) above sea level

C. Contour interval - difference in elevation between two consecutive contour lines

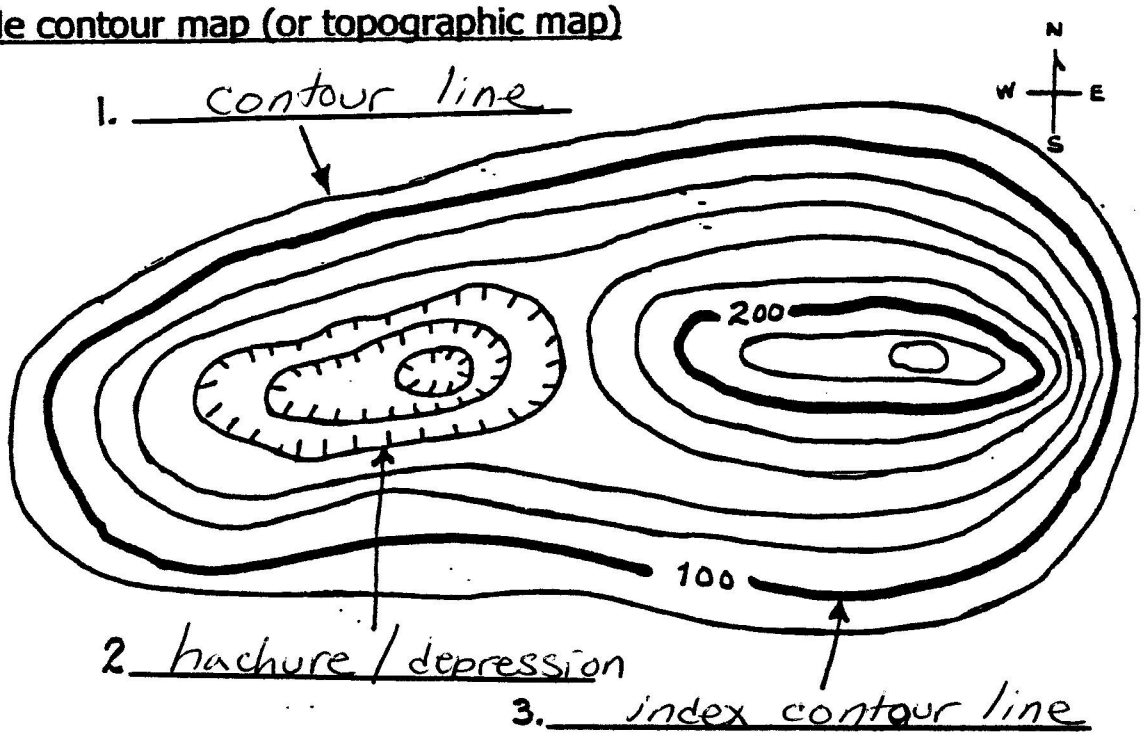
D. Index Contour Line - heavy, dark contour line, usually with numerical value for elevation marked (by 100 foot intervals

E. Depression Contour Line – Special contour lines used to show a hole or crater on Earth's surface. These lines are drawn like contour lines but are marked on the inside.

F. Bench Mark (B.M.) - marker in the ground indicating the exact elevation above sea level

G. Spot Elevations – are the elevations of such places as road intersections, hilltops, lake surfaces and other points of special interest. These points are located on the map by a small cross (+), unless the location is obvious, such as certain road intersections or hilltops.

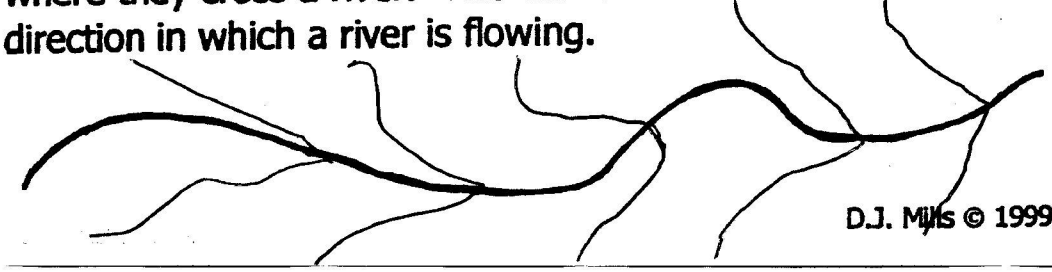
H. A simple contour map (or topographic map)




1. contour line
2. hachure / depression
3. index contour line

4. Contour Interval - 20 feet
5. Highest possible elevation (of the hilltop)- 259 ft
6. Which is the steepest side of the hill: north, south, east or west?
7. How do contour lines show a steeper slope?
   lines are closer together
8. What three (3) basic features of a landform do contour lines show?
   a. elevation
   b. steepness / gradient
   c. Shape (size)

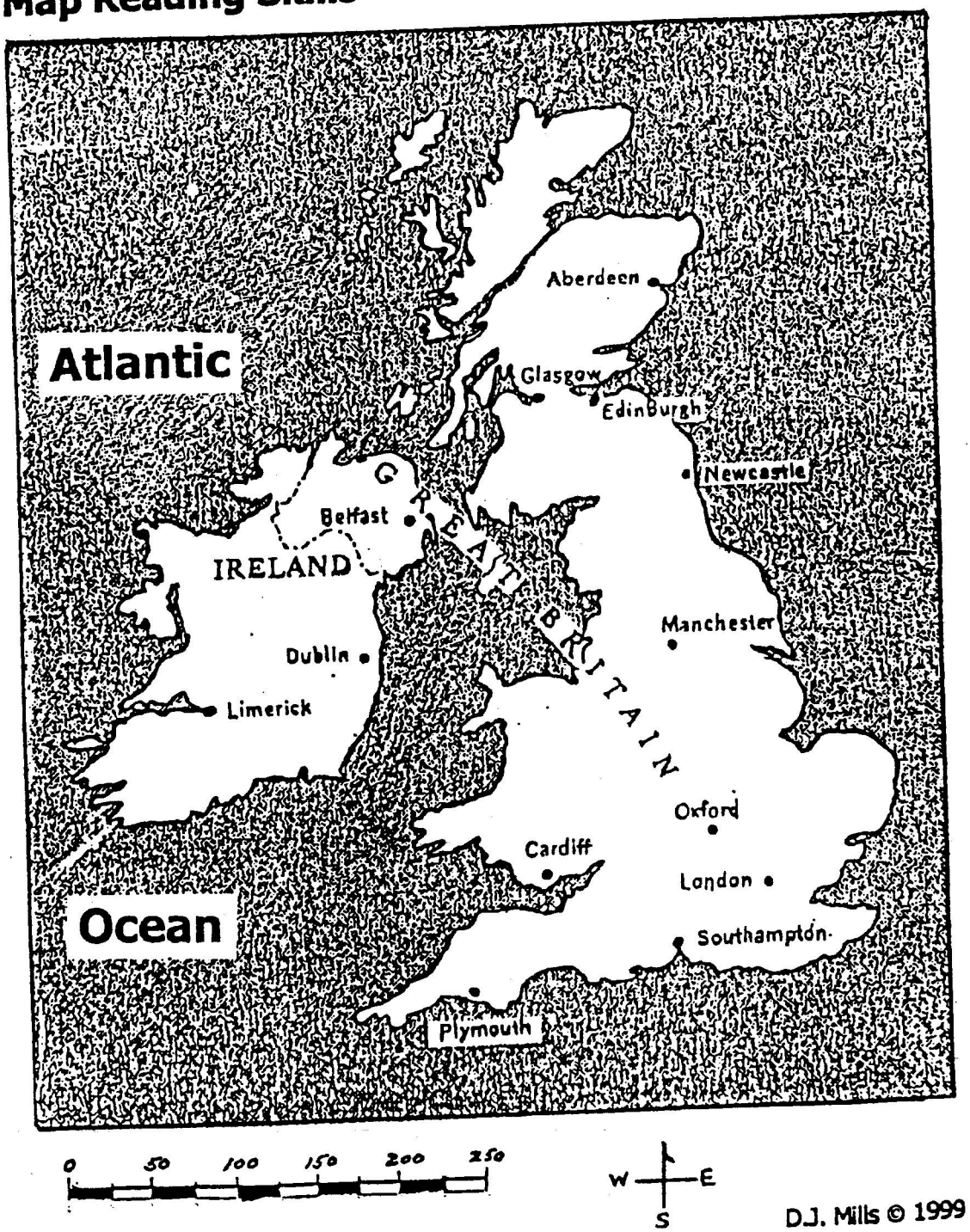
I. River Valleys (the law of V's) – contour lines bend upstream where they cross a river. This can be used to determine the direction in which a river is flowing.



J. Common Symbols on Topographic Map

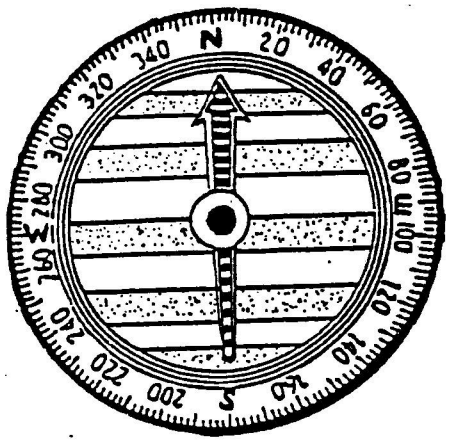
1. ■ ■ - house, building
2. □ = barn/garage
3. = church
4. - school
5. - swamp
6. = railroad
7. - cemetery
8. - gravel pit/quarry/mine

## VII. Map Reading Skills



A. Directions on a map

Complete the statements below to give the correct direction between the cities on the map of Great Britain from the previous page. Use the terms: north, northeast, east, southeast, south, southwest, west or northwest.




1. Dublin is west of Manchester.
2. Manchester is east of Dublin.
3. Southampton is southeast of Dublin.
4. Belfast is northwest of London.
5. Glasgow is north of Cardiff.
6. Limerick is southwest of Aberdeen.
7. Aberdeen is northeast of Limerick.
8. Manchester is south of Newcastle.

15

B. Distance on a map.

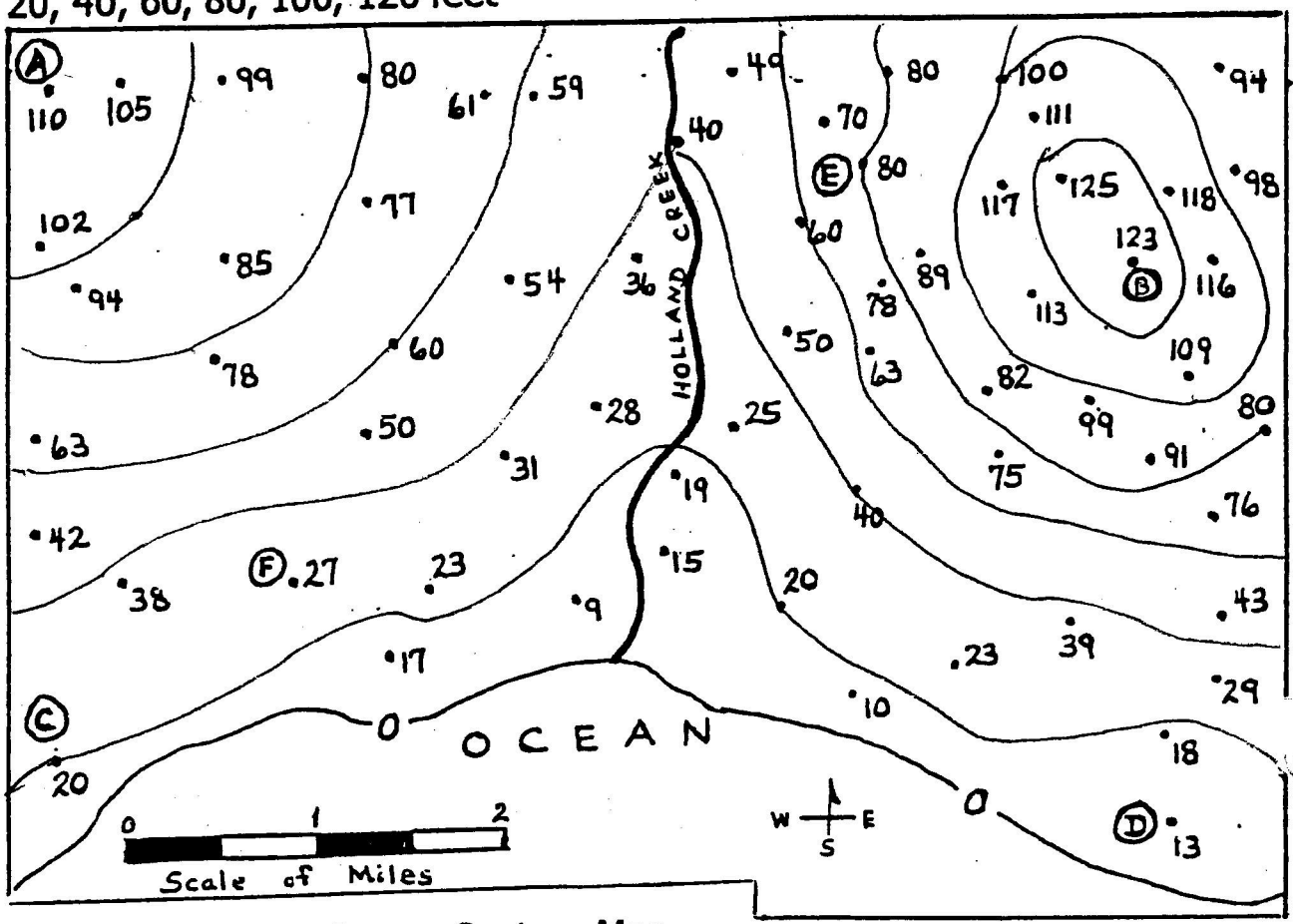
Use the given scale of miles on the map to determine the distance between the cities listed below.

1. Cardiff to Oxford = 95 - 105 miles
2. Manchester to Dublin = 180 - 195 miles
3. Oxford to London = 55 - 70 miles
4. Plymouth to Limerick = 230 - 245 miles
5. London to Manchester = 150 - 165 miles
6. Aberdeen to Southampton = 400 - 420 miles
7. Which is the greater distance,
   a. from Aberdeen to Belfast
   or
   b. from Dublin to Oxford

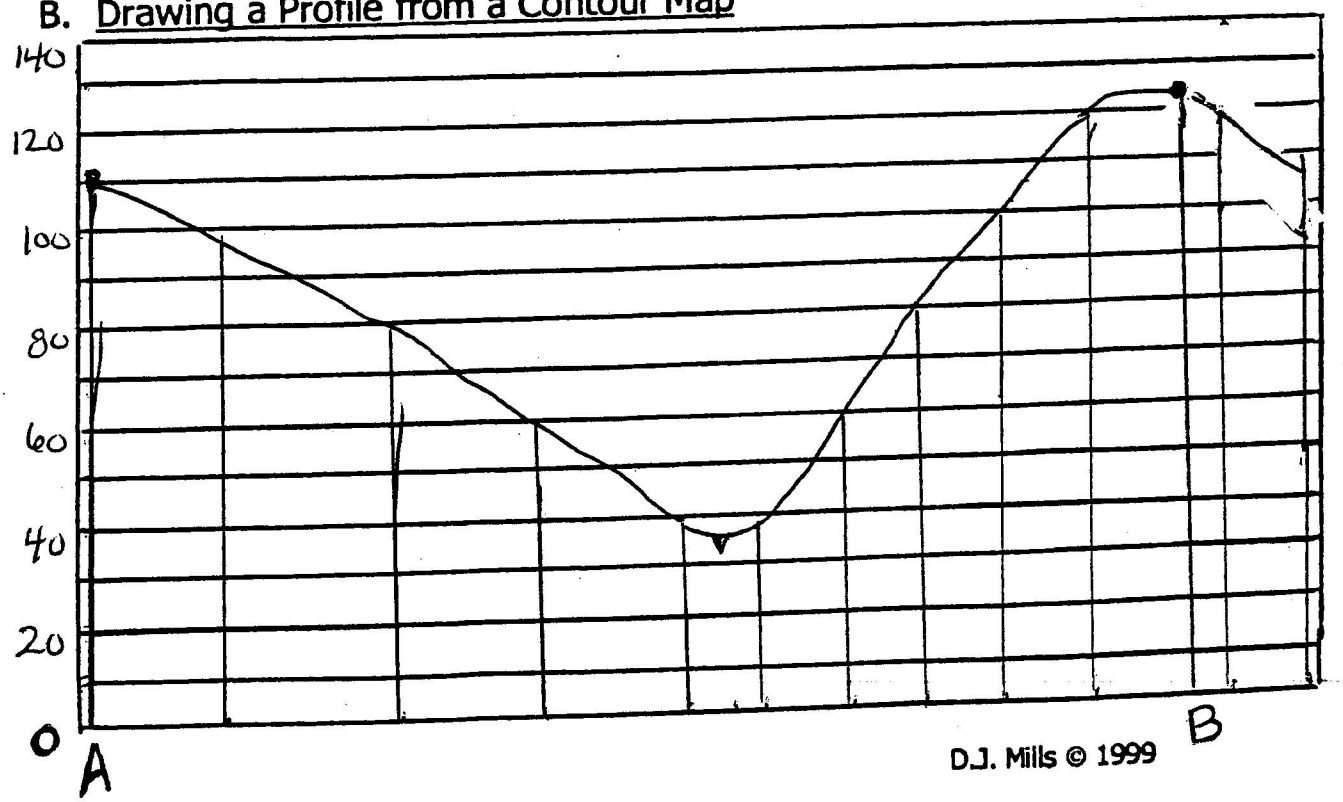
# VIII. Topographic Map Skills

Have different students do each line on the overhead projector.

A. Drawing Contour Lines on a Field Map – draw contour lines for 20, 40, 60, 80, 100, 120 feet



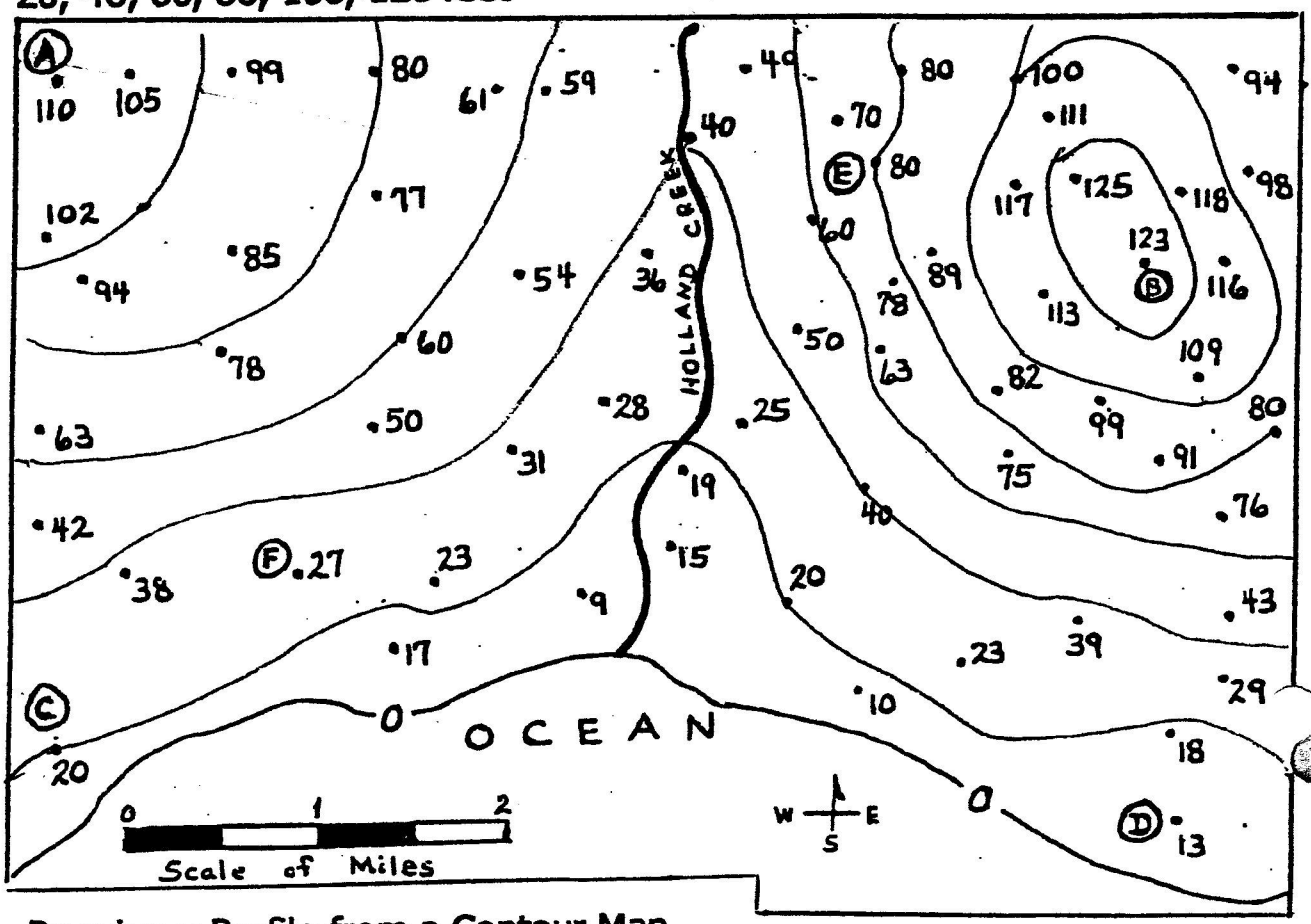

B. Drawing a Profile from a Contour Map



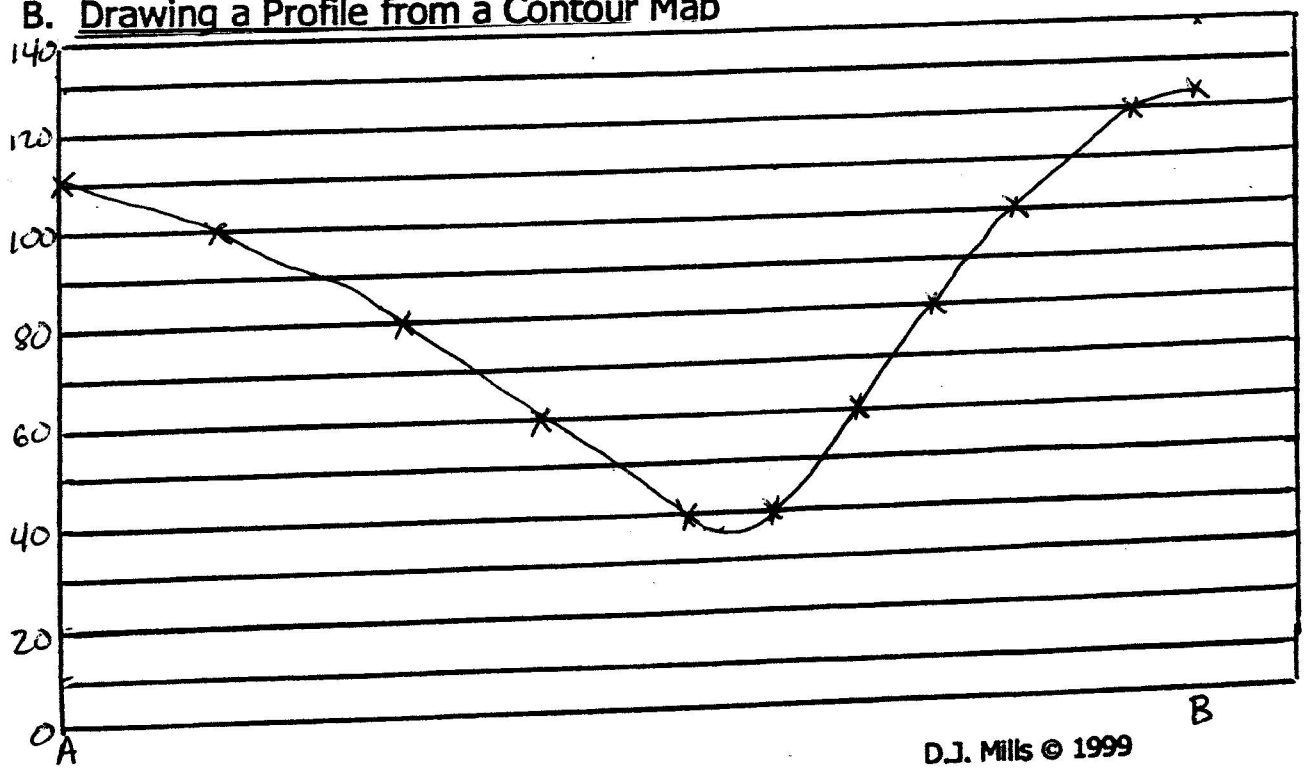
# VIII. Topographic Map Skills

Have different students do each line on the overhead projector.

A. Drawing Contour Lines on a Field Map – draw contour lines for 20, 40, 60, 80, 100, 120 feet




B. Drawing a Profile from a Contour Map



C. Gradient- rate at which elevation changes from place to place

1. Formula: Gradient = $\frac{\text{change in field value}}{\text{change in distance}}$

2. Calculating Gradient

Use the elevation field map that you drew contour lines on (which is on the previous page) to calculate the gradient between:

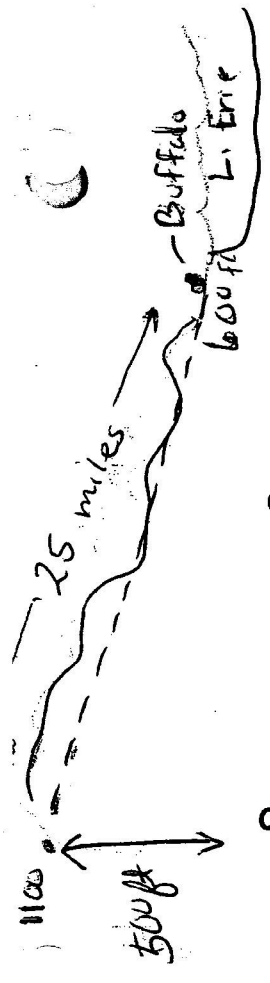
Reference Table page = 1

a. point A and point C

$$\text{Gradient} = \frac{110 - 20 \text{ ft}}{3.5 \text{ mi.}}$$

$$G = \frac{90 \text{ ft}}{3.5 \text{ mi.}} = 25.7 \text{ ft/mi.}$$

$$G = \frac{90 \text{ ft}}{3.75 \text{ mi.}} = 24 \text{ ft/mi}$$




b. point B and point D

$$\text{Gradient} = \frac{123 - 13 \text{ ft}}{3 \text{ mi}} = \frac{110 \text{ ft}}{3 \text{ mi.}} = 36.7 \text{ ft/mi}$$

c. point B and point E

$$\text{Gradient} = \frac{123 - 80 \text{ ft}}{1.5 \text{ mi.}} = \frac{43}{1.5} = 28.7 \text{ ft/mi.}$$

d. point F and point C

$$\text{Gradient} = \frac{27 - 20 \text{ ft.}}{1.5 \text{ mi.}} = \frac{7}{1.5} = 4.7 \text{ ft/mi.}$$

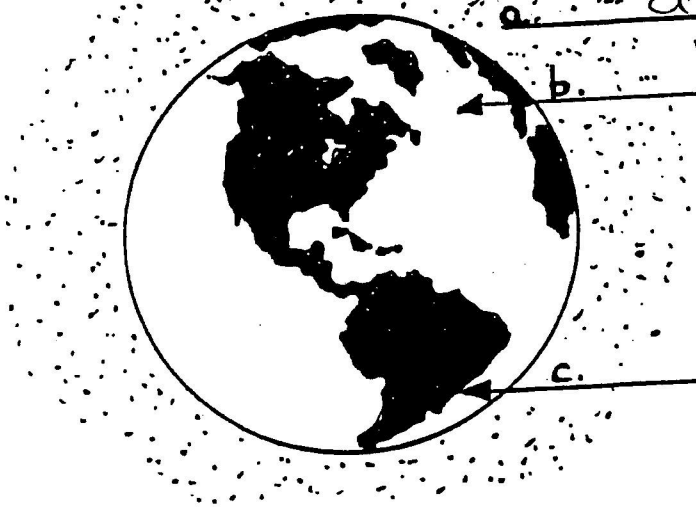
# IX. Parts of Earth

A. The three "spheres" of outer Earth

1. Atmosphere - the shell of gases that surrounds Earth.
2. Hydrosphere - the waters of Earth; its oceans, seas, lakes and rivers.
3. Lithosphere - the dense, solid outer shell of Earth composed of rock.

29 % of Earth's surface is covered by land.

4.




5. Which sphere of Earth is:
   a. most dense? lithosphere
   b. least dense? atmosphere

B. Earth's Interior