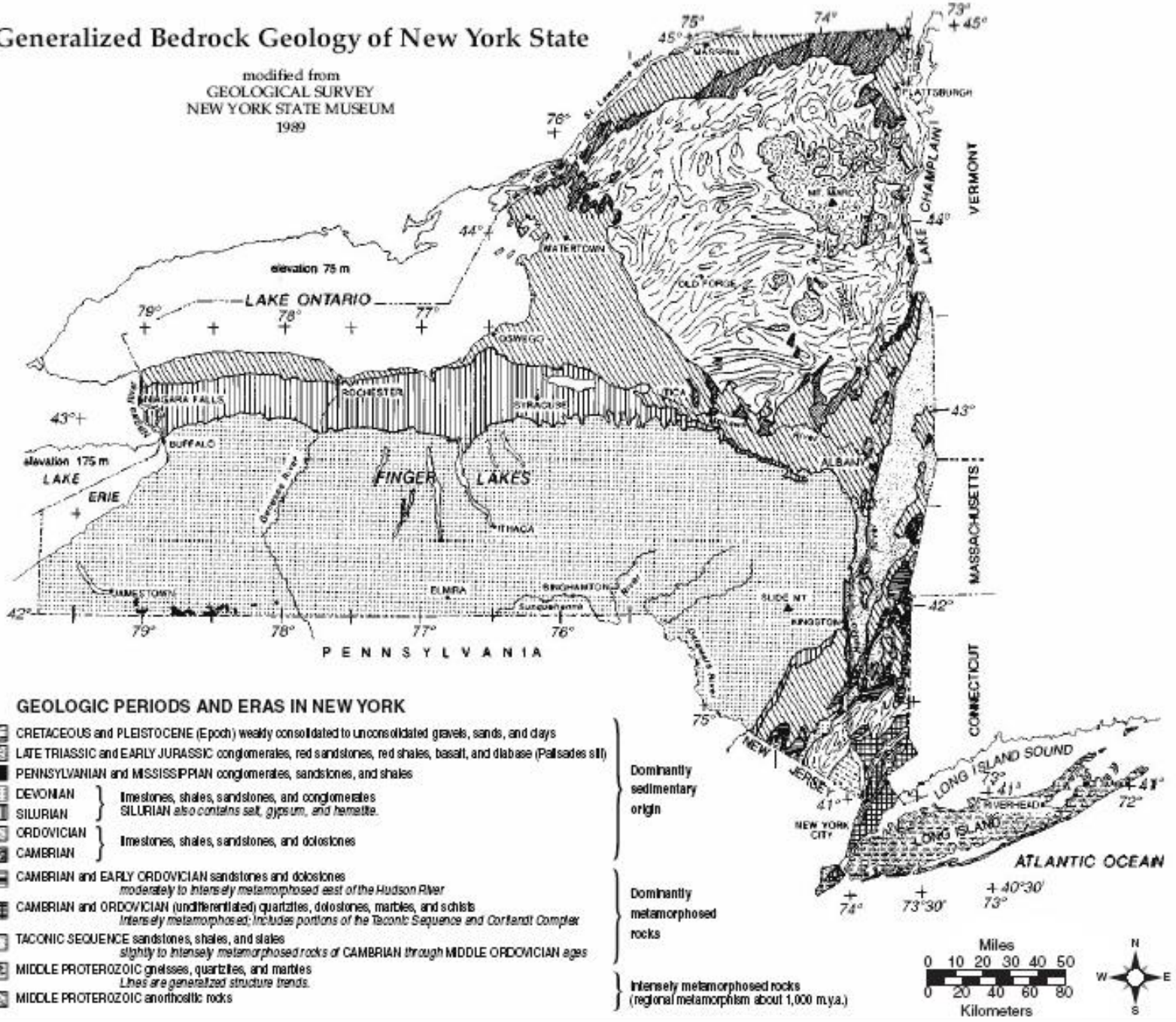
Generalized Bedrock Geology of New York State

modified from
GEOLOGICAL SURVEY
NEW YORK STATE MUSEUM
1989



GEOLOGIC PERIODS AND ERAS IN NEW YORK

- CRETACEOUS and PLEISTOCENE (Epoch) weakly consolidated to unconsolidated gravels, sands, and clays
- LATE TRIASSIC and EARLY JURASSIC conglomerates, red sandstones, red shales, basalt, and diabase (Palisades sill)
- PENNSYLVANIAN and MISSISSIPPIAN conglomerates, sandstones, and shales
- DEVONIAN, SILURIAN — limestones, shales, sandstones, and conglomerates; SILURIAN *also contains salt, gypsum, and hematite.*
- ORDOVICIAN, CAMBRIAN — limestones, shales, sandstones, and dolostones

Dominantly sedimentary origin

- CAMBRIAN and EARLY ORDOVICIAN sandstones and dolostones
  moderately to intensely metamorphosed east of the Hudson River
- CAMBRIAN and ORDOVICIAN (undifferentiated) quartzites, dolostones, marbles, and schists
  Intensely metamorphosed; includes portions of the Taconic Sequence and Cortlandt Complex
- TACONIC SEQUENCE sandstones, shales, and slates
  slightly to intensely metamorphosed rocks of CAMBRIAN *through* MIDDLE ORDOVICIAN *ages*
- MIDDLE PROTEROZOIC gneisses, quartzites, and marbles
  Lines are generalized structure trends.
- MIDDLE PROTEROZOIC anorthositic rocks

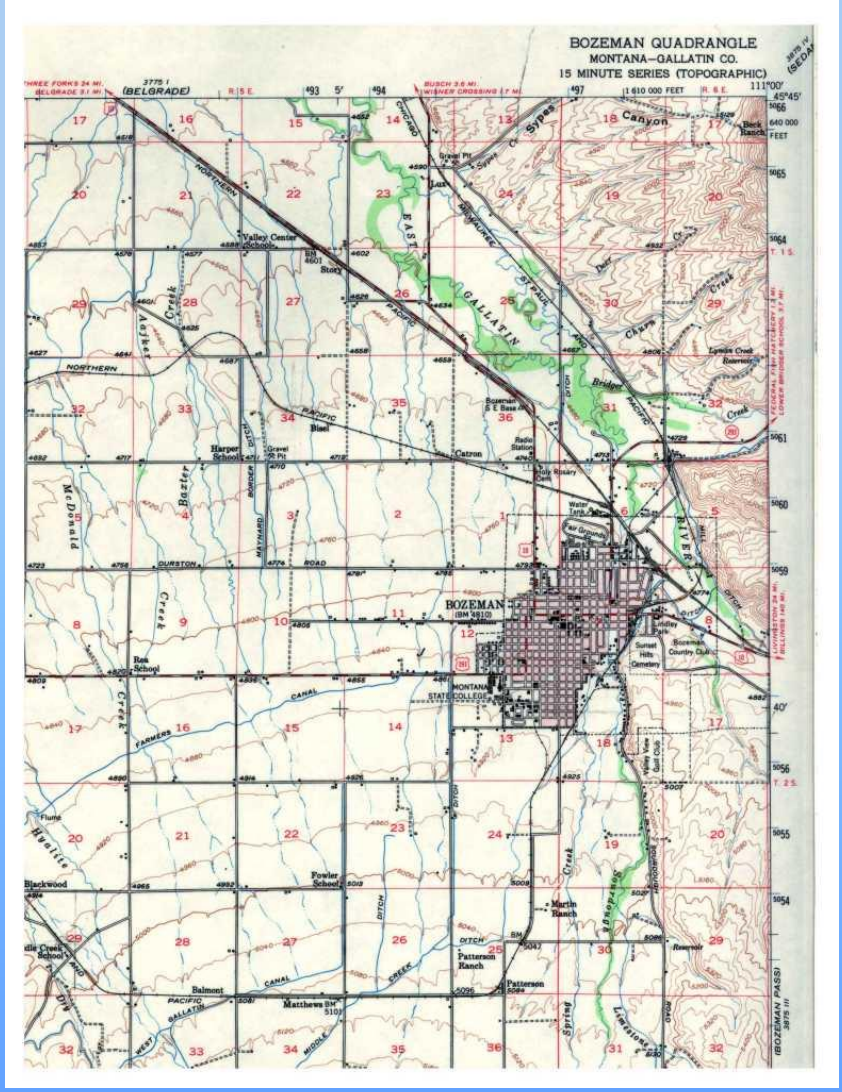
Dominantly metamorphosed rocks

Intensely metamorphosed rocks (regional metamorphism about 1,000 m.y.a.)

Miles
0 10 20 30 40 50
0 20 40 60 80
Kilometers

N
W E
S

Topographic Maps

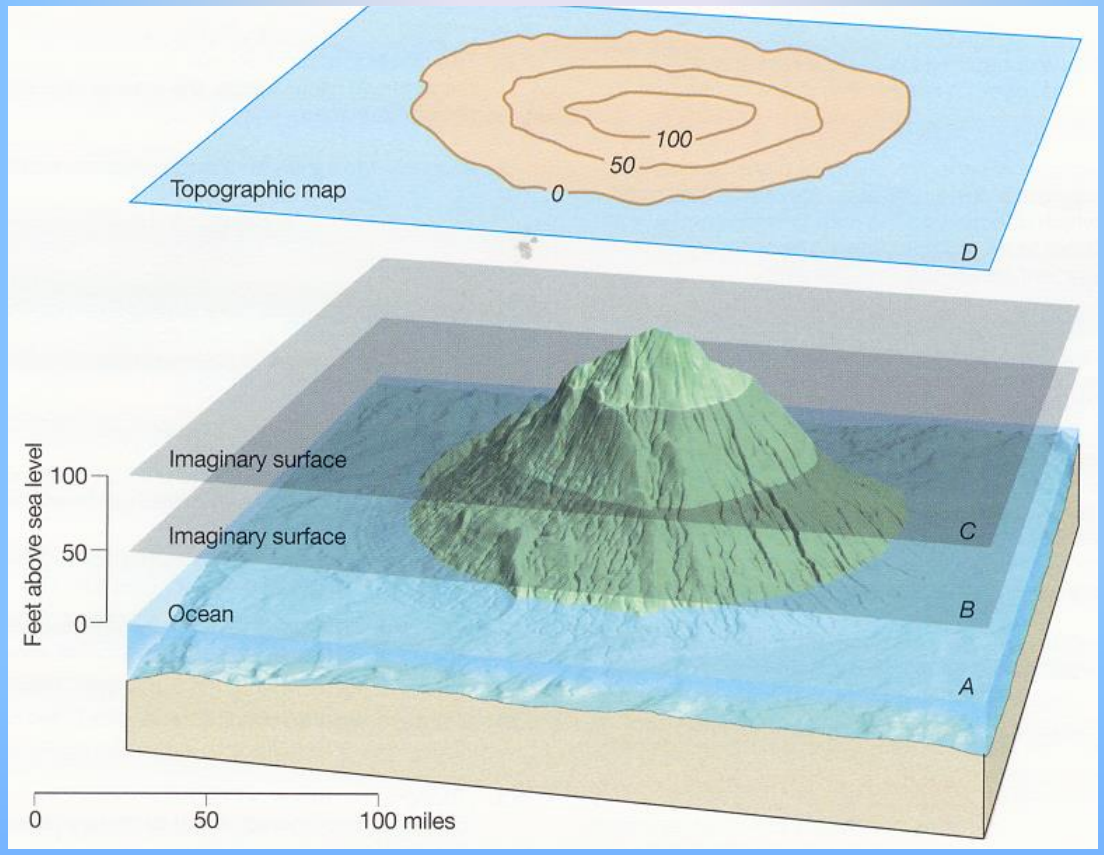


Introduction

A. Topographic maps are essential tools in geologic and engineering studies because they show the configuration of Earth's surface in remarkable detail and permit one to measure horizontal distances and **vertical** elevations. This is accomplished by means of carefully surveyed **isolines** connecting points of ***equal elevation*** to represent elevations of hills and valleys. They are also used by the military, hikers, hunters, campers, and anyone who for whom knowledge of the three-dimensional nature of the land surface is useful.

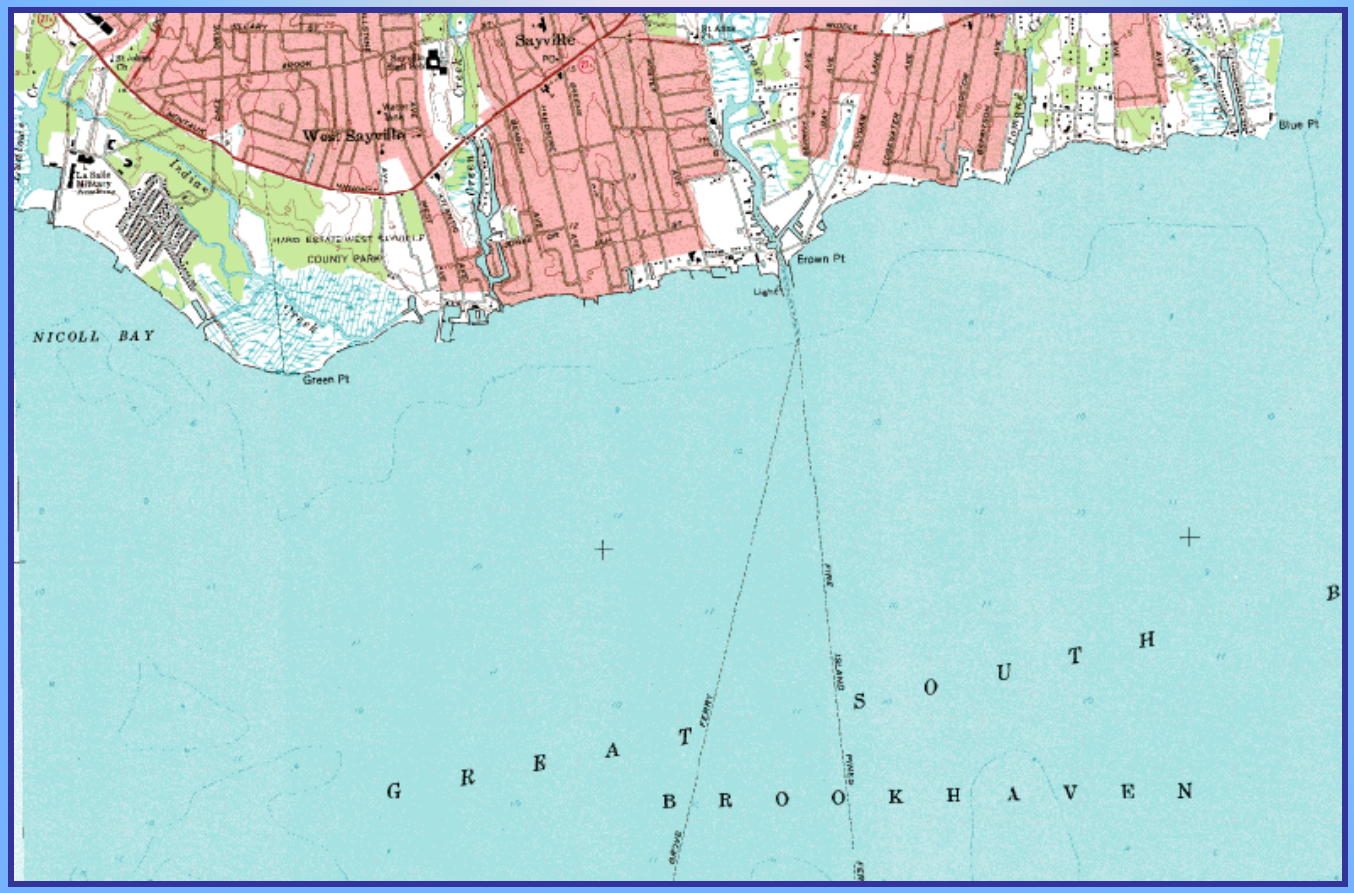
B. Topographic maps are also called **contour maps**.

II. Representing Elevation



A. Contour Lines
   1. Connect points of **equal elevation** with respect to **sea level**
   2. Represent **vertical** distance (altitude can also be used).
   3. Contour lines are plotted in **brown**.

3. Bathymetric contours



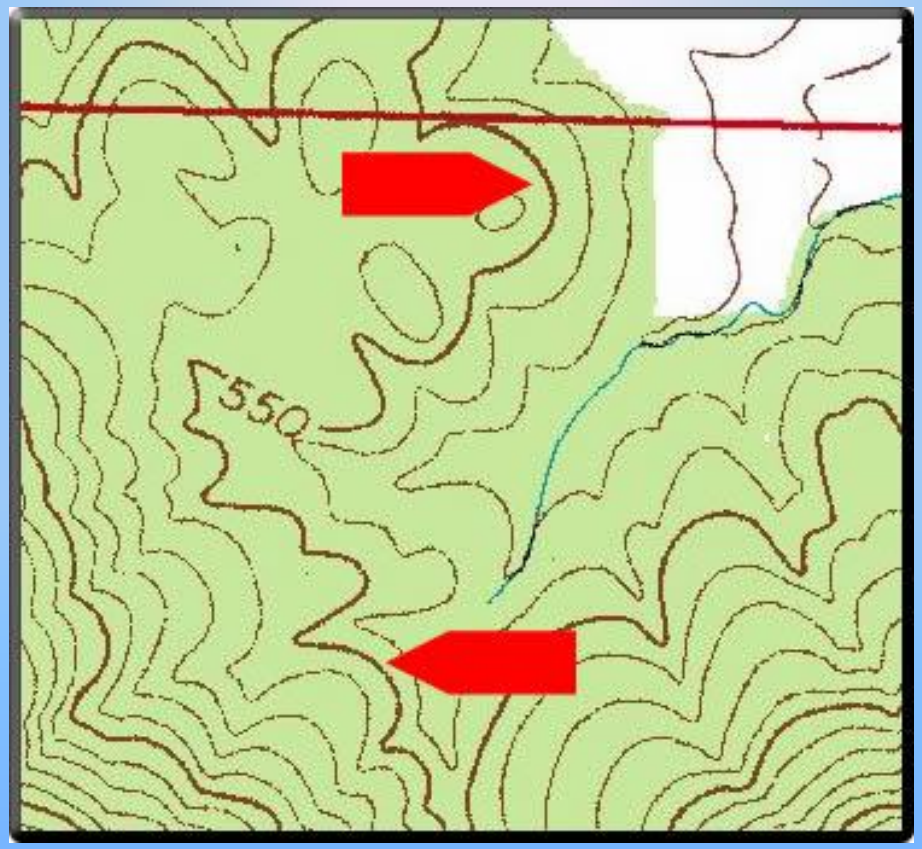
a. Show the shape and slope of the **ocean bottom** surface **(Depth !)**

b. Shown in **blue** **or** **black**, depending on their location.

Crater Lake

- Bathymetric contours are also used for lakes and other bodies of water.

4. Index Contours



a. _____ brown lines with elevations printed on them.

b. Usually every _____ line.

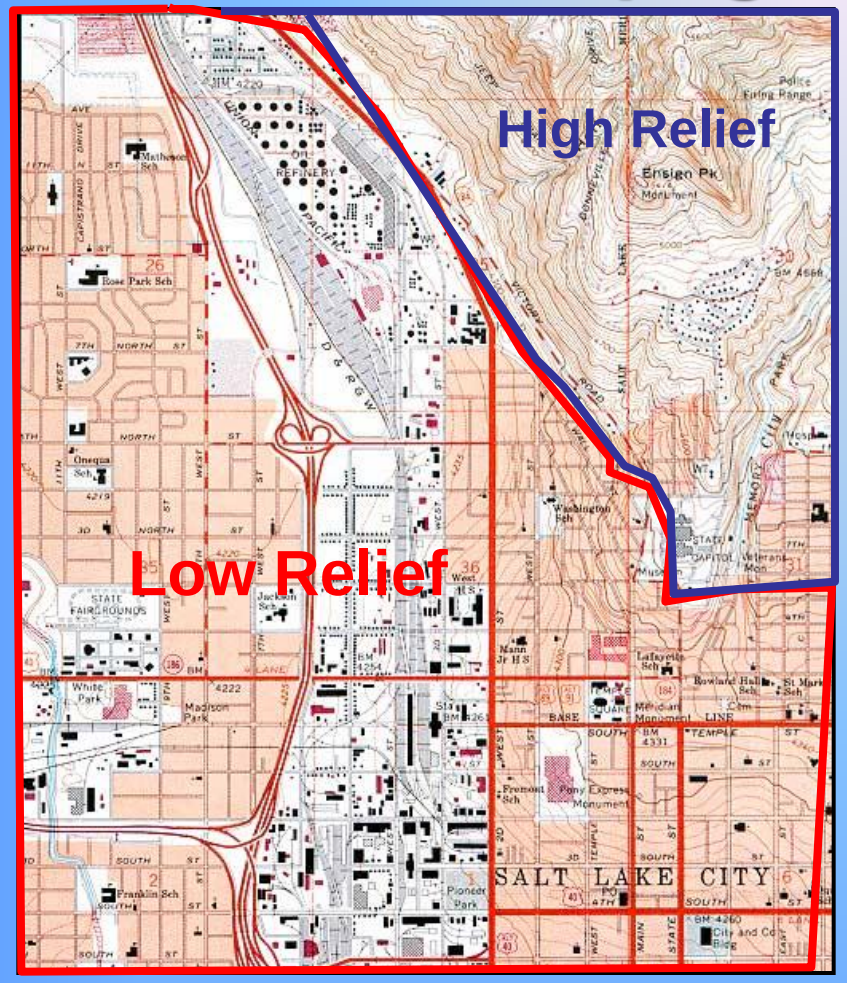
c. Not used if the map area has low _____.

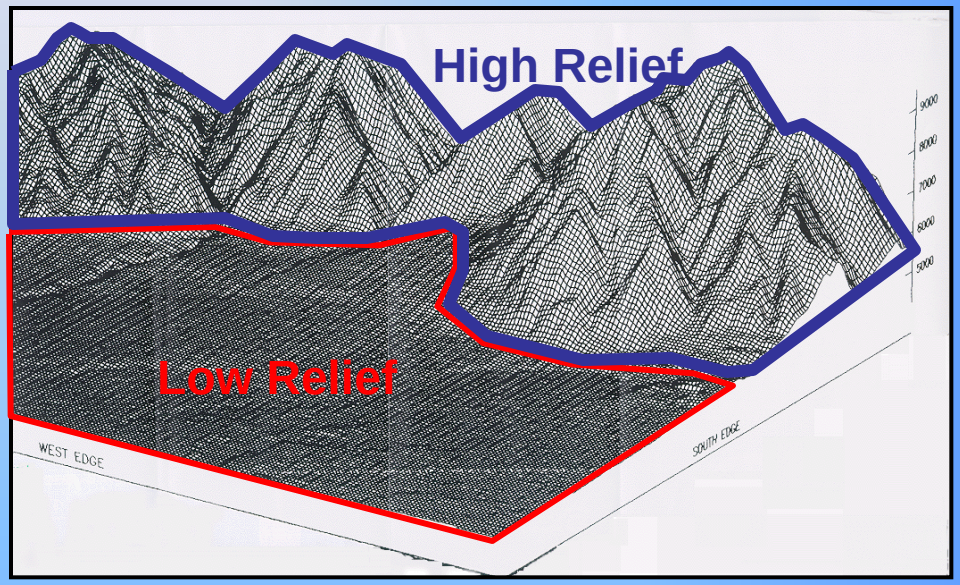
Dark

fifth

relief

Topographic Relief





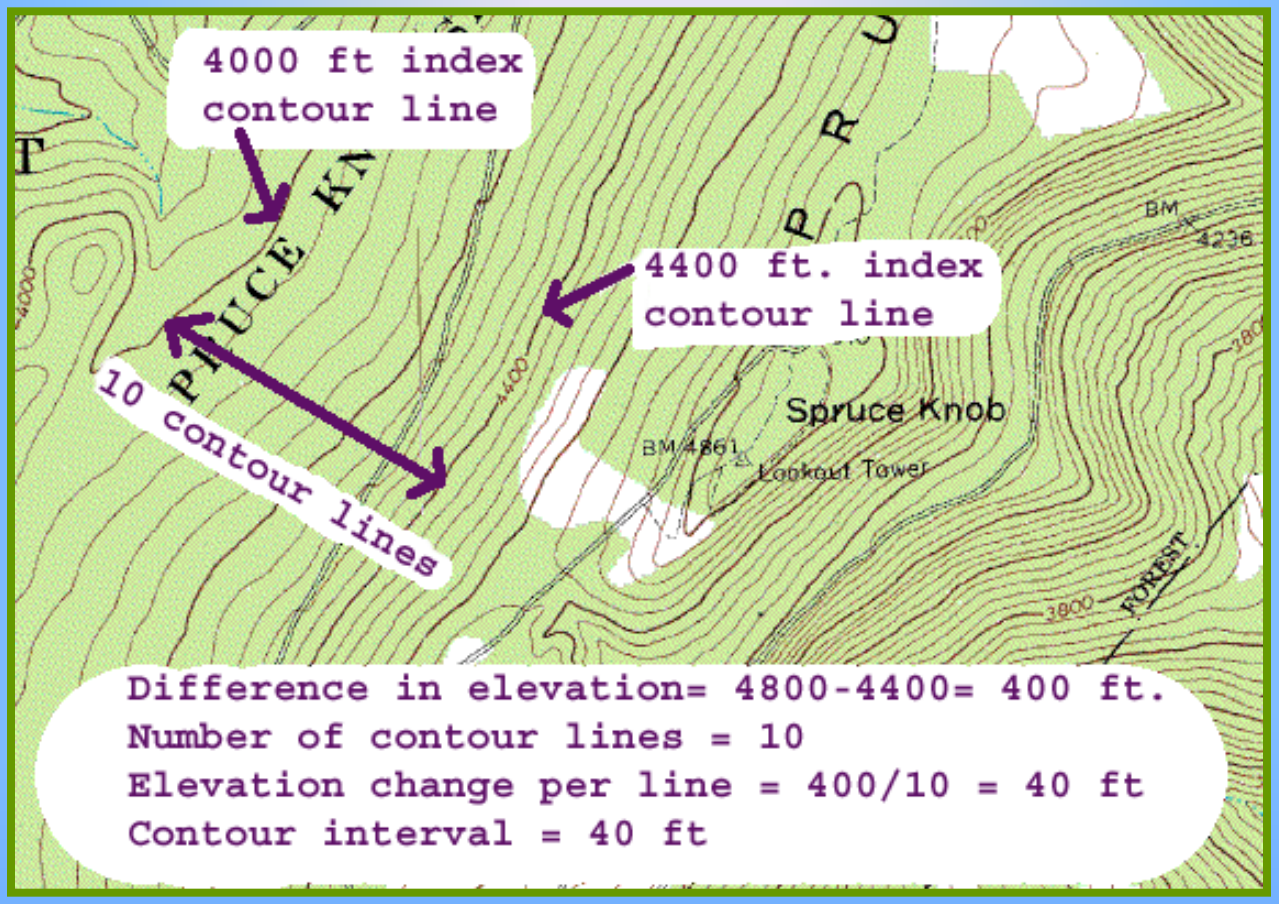
Digital Relief Map of Salt Lake City

(1) Relief is the difference between the **highest** and **lowest** elevation.

(2) A region with low relief will be relatively **flat**.

(3) In areas with low relief, few contour lines will be required and all will be labeled

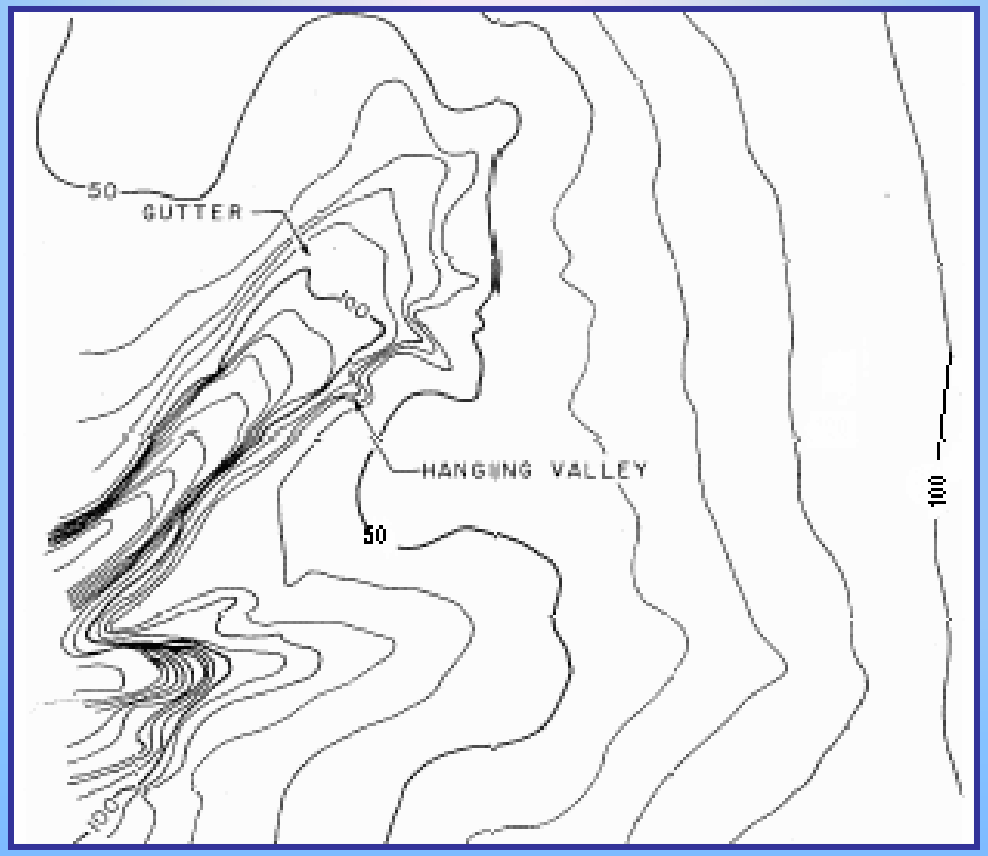
6. The Contour Interval



a. The difference in elevation between two **consecutive** contour lines.

b. Specified on the bottom margin of a map as either **feet** or **meters**.

Determine the Contour Interval



Elevations are in meters

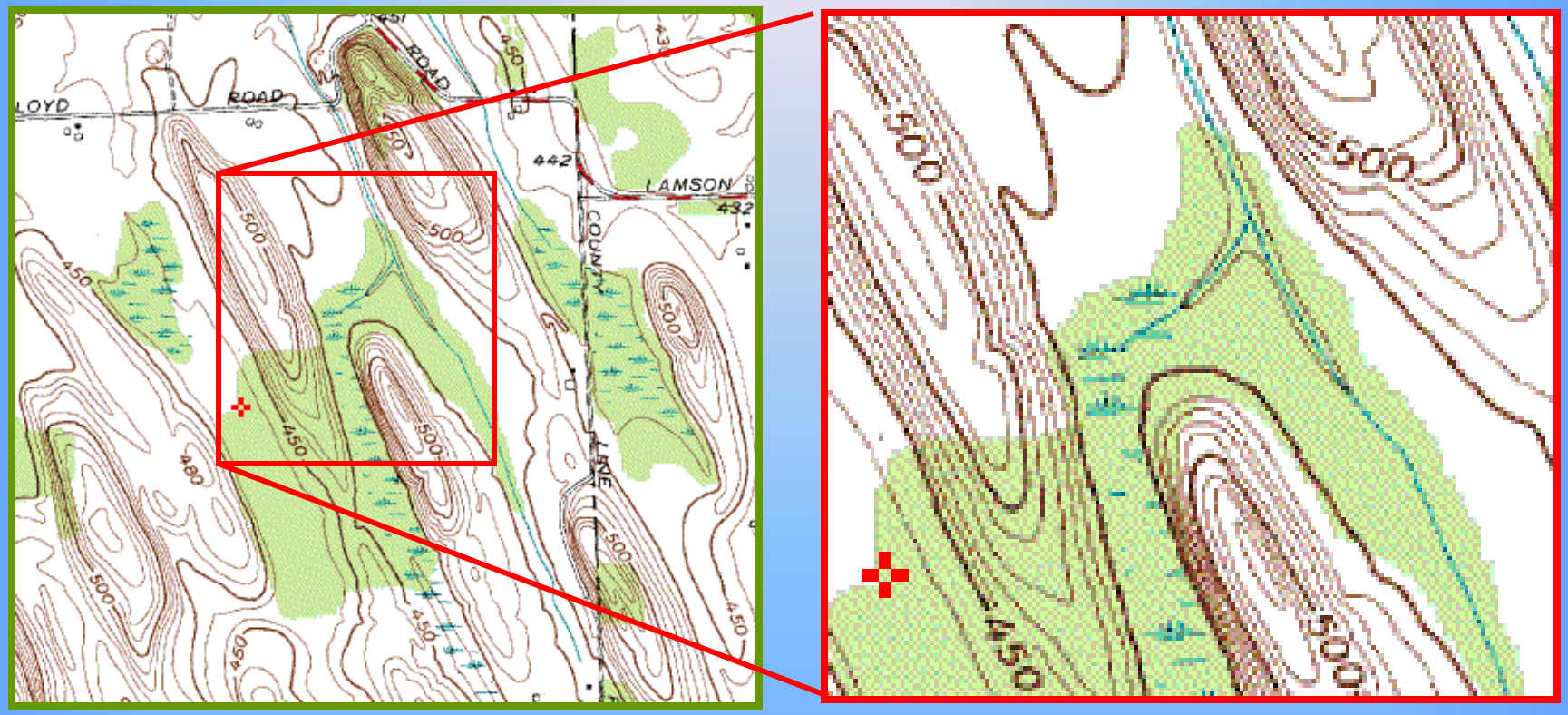
c. Maps use the smallest contour interval that will allow easy readability and provide as much detail as possible.

(2) **Large** intervals are used if there is a high relief.

(3) **Small** intervals are used for low relief.

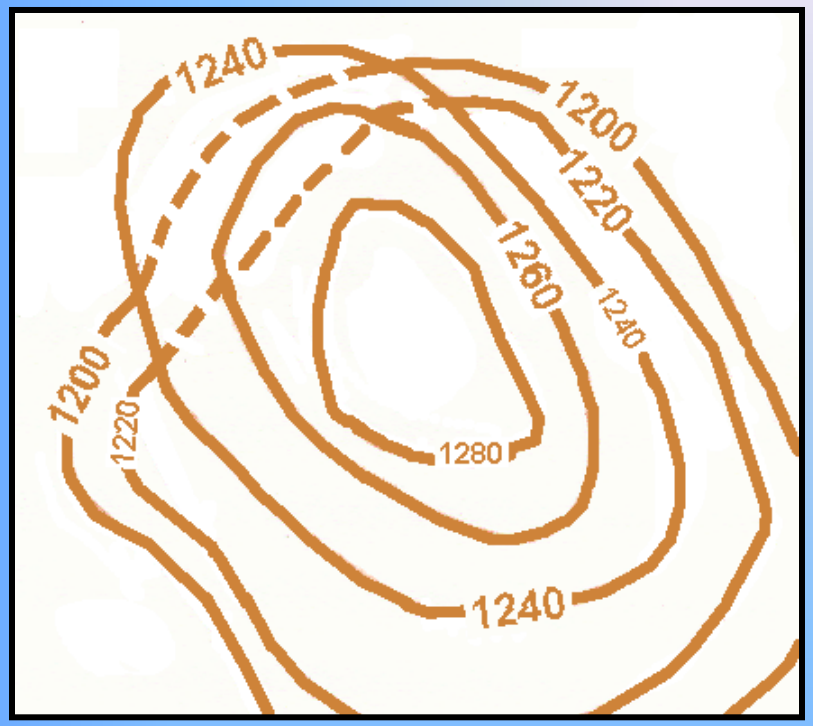
Rules for Contour Lines

a. Every point on a contour line is of the exact **same** elevation



(1) Contour lines always close to form an irregular **circle**.
(2) Sometimes part of a contour line **extends beyond** the mapped area.
(3) This is why the entire circle formed can't be seen.

c. Contour lines never cross one another



Overhanging Cliff

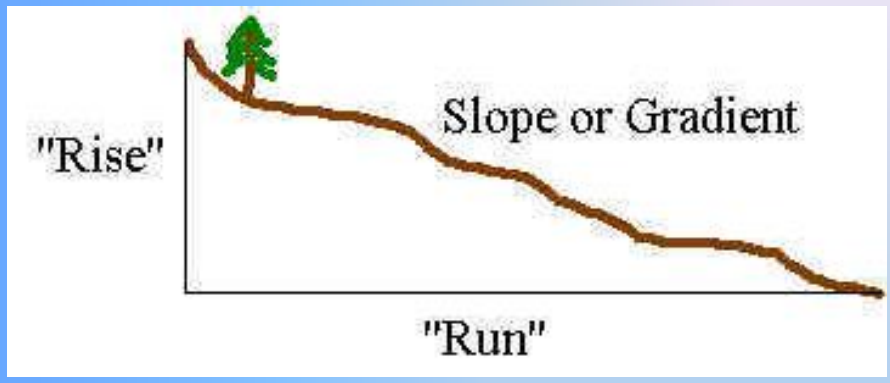
Vertical Cliff

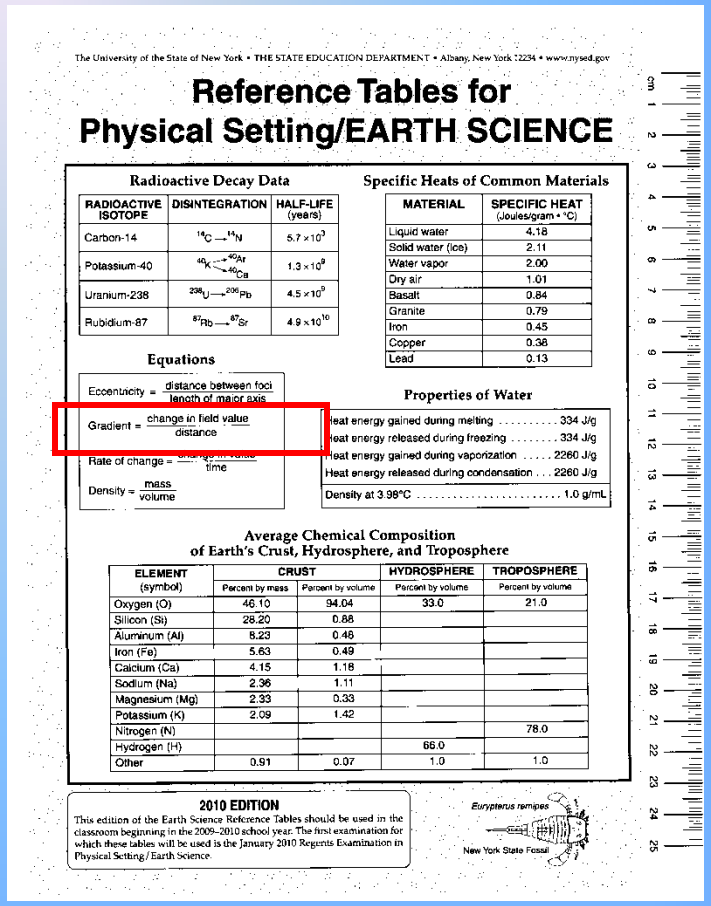
(1) A map location can't have **two** elevations.

(2) A rare exception is where an **overhanging cliff** is present. In this case the hidden contour lines are dashed.

(3) If the cliff is vertical the contour lines will merge to form a **single** contour line.

d. Gradient (Slope)





The University of the State of New York • THE STATE EDUCATION DEPARTMENT • Albany, New York 12234 • www.nysed.gov

Reference Tables for Physical Setting/EARTH SCIENCE

Radioactive Decay Data

RADIOACTIVE ISOTOPE	DISINTEGRATION	HALF-LIFE (years)
Carbon-14	$^{14}C \rightarrow {}^{14}N$	5.7×10^3
Potassium-40	$^{40}K \rightarrow {}^{40}Ar$, $^{40}K \rightarrow {}^{40}Ca$	1.3×10^9
Uranium-238	$^{238}U \rightarrow {}^{206}Pb$	4.5×10^9
Rubidium-87	$^{87}Rb \rightarrow {}^{87}Sr$	4.9×10^{10}

Specific Heats of Common Materials

MATERIAL	SPECIFIC HEAT (Joules/gram • °C)
Liquid water	4.18
Solid water (ice)	2.11
Water vapor	2.00
Dry air	1.01
Basalt	0.84
Granite	0.79
Iron	0.45
Copper	0.38
Lead	0.13

Equations

Eccentricity = distance between foci / length of major axis

Gradient = change in field value / distance

Rate of change = change in value / time

Density = mass / volume

Properties of Water

Heat energy gained during melting	334 J/g
Heat energy released during freezing	334 J/g
Heat energy gained during vaporization	2260 J/g
Heat energy released during condensation	2260 J/g
Density at 3.98°C	1.0 g/mL

Average Chemical Composition of Earth's Crust, Hydrosphere, and Troposphere

ELEMENT (symbol)	CRUST		HYDROSPHERE	TROPOSPHERE
	Percent by mass	Percent by volume	Percent by volume	Percent by volume
Oxygen (O)	46.10	94.04	33.0	21.0
Silicon (Si)	28.20	0.88		
Aluminum (Al)	8.23	0.46		
Iron (Fe)	5.63	0.49		
Calcium (Ca)	4.15	1.18		
Sodium (Na)	2.36	1.11		
Magnesium (Mg)	2.33	0.33		
Potassium (K)	2.09	1.42		
Nitrogen (N)				78.0
Hydrogen (H)			66.0	
Other	0.91	0.07	1.0	1.0

2010 EDITION

This edition of the Earth Science Reference Tables should be used in the classroom beginning in the 2009–2010 school year. The first examination for which these tables will be used is the January 2010 Regents Examination in Physical Setting/ Earth Science.

Eurypterus remipes

New York State Fossil

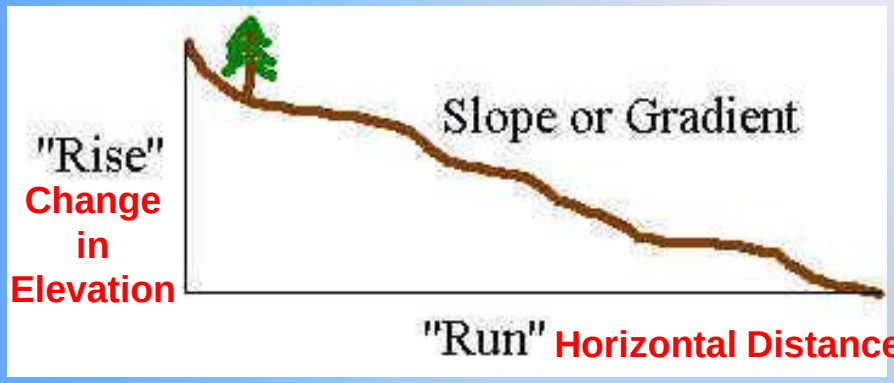
(1) Gradient is a measure of the **steepness** of a slope.

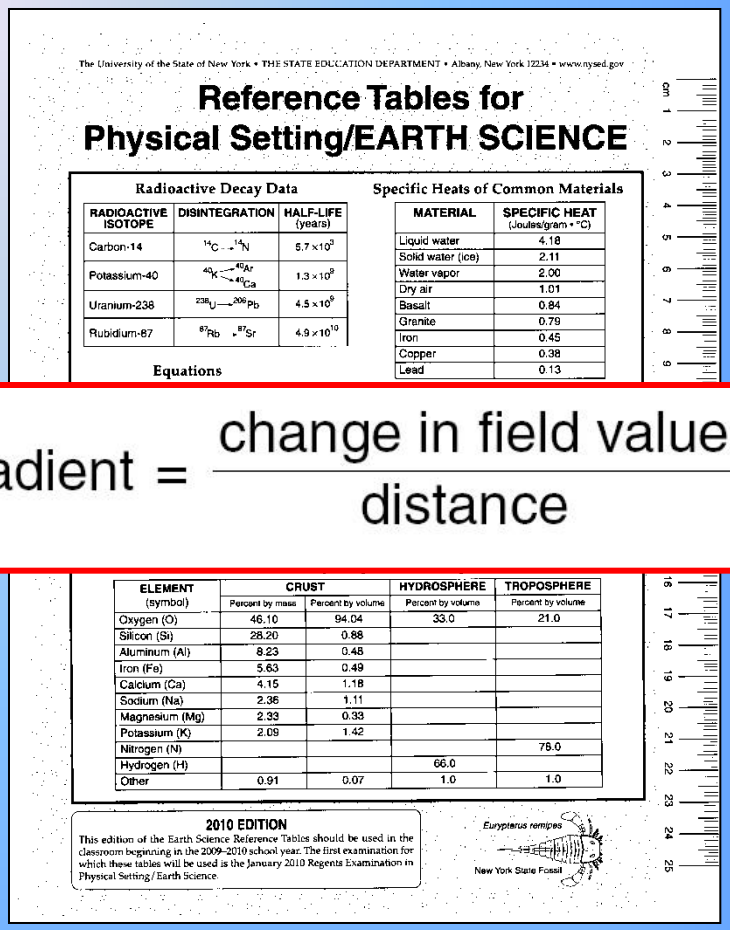
(2) Gradient is determined by finding the **change in elevation** over a **horizontal** distance. Expressed as:

(a) Feet per mile

(b) Meters per kilometer (for metric maps)

d. Gradient (Slope)




The University of the State of New York • THE STATE EDUCATION DEPARTMENT • Albany, New York 12234 • www.nysed.gov

Reference Tables for Physical Setting/EARTH SCIENCE

Radioactive Decay Data

RADIOACTIVE ISOTOPE	DISINTEGRATION	HALF-LIFE (years)
Carbon-14	$^{14}C \rightarrow {}^{14}N$	5.7×10^3
Potassium-40	$^{40}K \rightarrow {}^{40}Ar$, $^{40}K \rightarrow {}^{40}Ca$	1.3×10^9
Uranium-238	$^{238}U \rightarrow {}^{206}Pb$	4.5×10^9
Rubidium-87	$^{87}Rb \rightarrow {}^{87}Sr$	4.9×10^{10}

Specific Heats of Common Materials

MATERIAL	SPECIFIC HEAT (Joules/gram • °C)
Liquid water	4.18
Solid water (ice)	2.11
Water vapor	2.00
Dry air	1.01
Basalt	0.84
Granite	0.79
Iron	0.45
Copper	0.38
Lead	0.13

Equations

ELEMENT (symbol)	CRUST Percent by mass	CRUST Percent by volume	HYDROSPHERE Percent by volume	TROPOSPHERE Percent by volume
Oxygen (O)	46.10	94.04	33.0	21.0
Silicon (Si)	28.20	0.88		
Aluminum (Al)	8.23	0.48		
Iron (Fe)	5.63	0.49		
Calcium (Ca)	4.15	1.18		
Sodium (Na)	2.36	1.11		
Magnesium (Mg)	2.33	0.33		
Potassium (K)	2.09	1.42		
Nitrogen (N)				78.0
Hydrogen (H)			66.0	
Other	0.91	0.07	1.0	1.0

2010 EDITION

This edition of the Earth Science Reference Tables should be used in the classroom beginning in the 2009–2010 school year. The first examination for which these tables will be used is the January 2010 Regents Examination in Physical Setting / Earth Science.

Eurypterus remipes

New York State Fossil

Change in field value = Change in elevation

Distance = Horizontal distance

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

Gradient is sometimes called:
Rise* over *Run

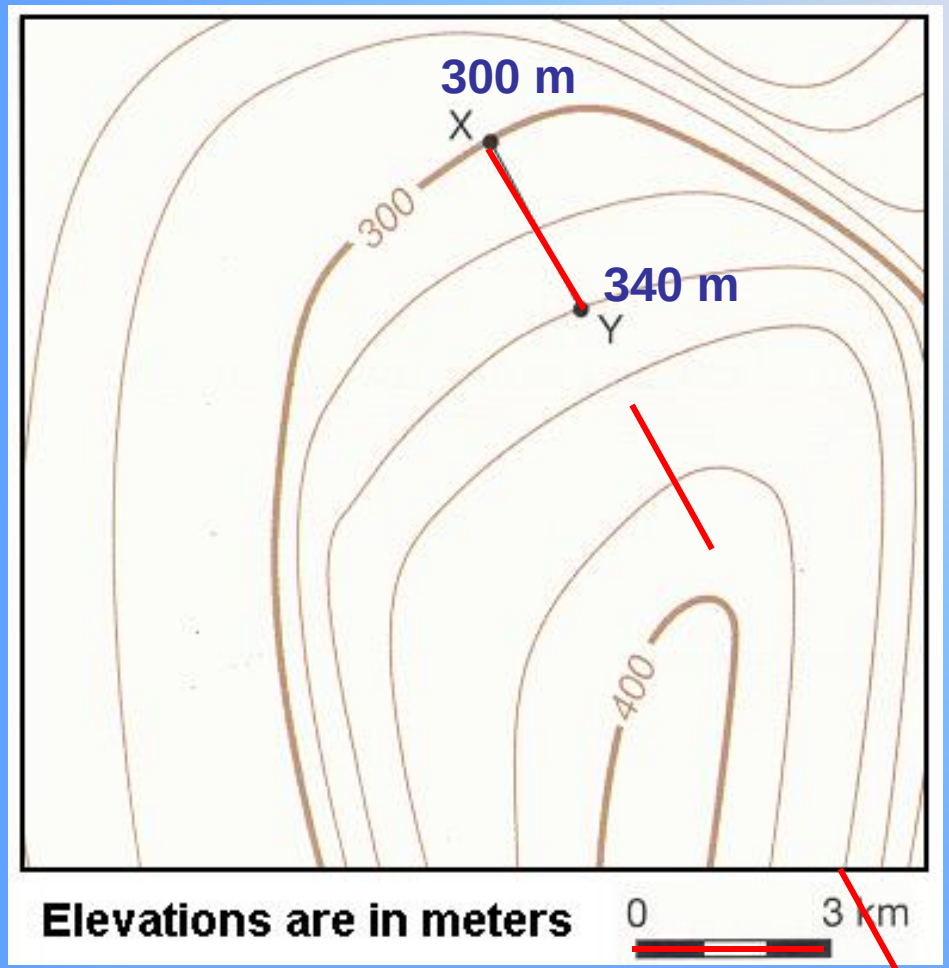
(1) Gradient is a measure of the **steepness** of a slope.

(2) Gradient is determined by finding the **change in elevation** over a **horizontal** distance. Expressed as:

(a) Feet per mile

(b) Meters per kilometer (for metric maps)

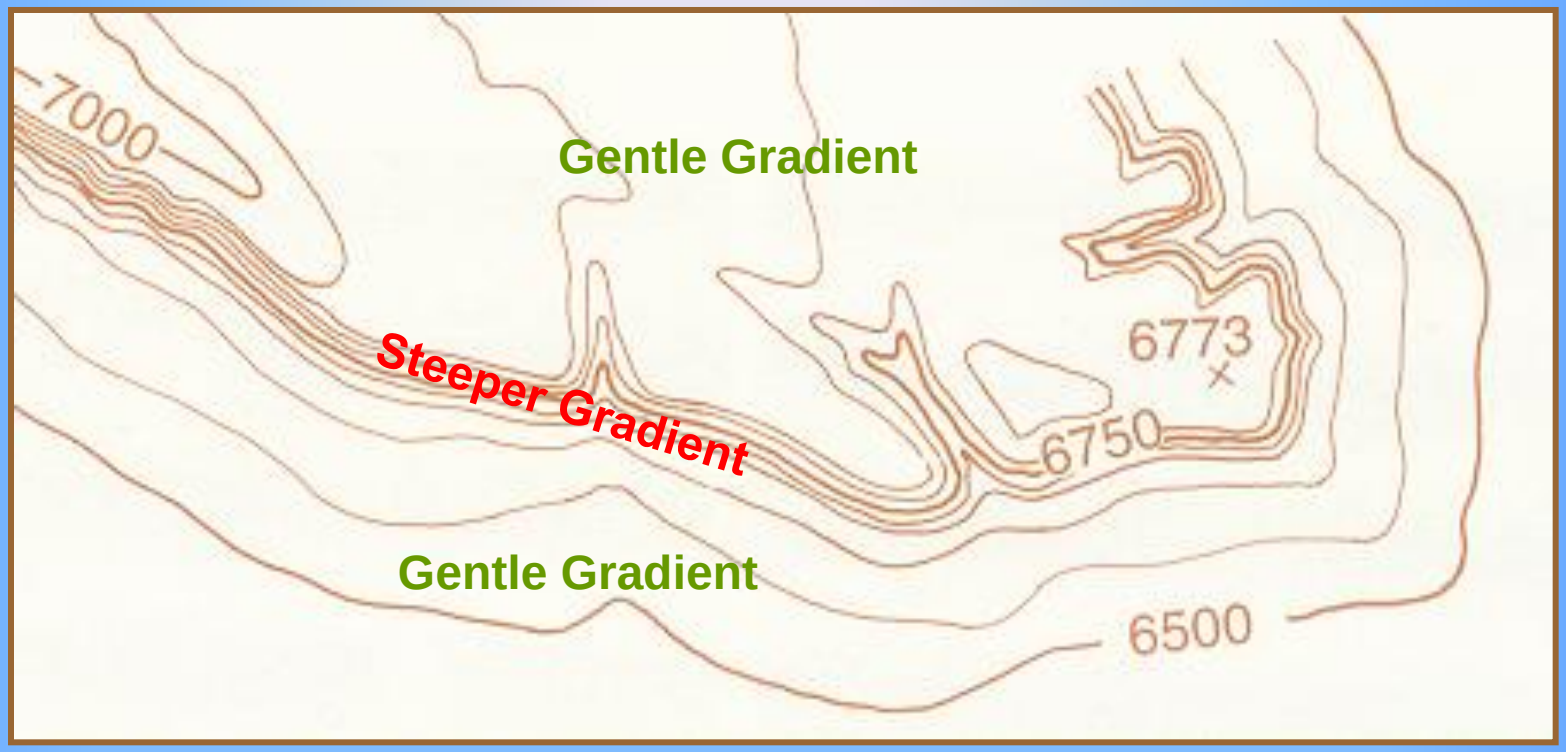
Find the Gradient Between Points X and Y



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

- **Gradient = change in elevation (m) / Horizontal Distance (km)**
- First find the change in elevation
  - Contour Interval = **20 m**
  - Elevation of Point X = **300 m**
  - Elevation of Point Y = **340 m**
  - Change in elevation = **40 m**
- Next measure the distance from X to Y
  - Distance = **3 km**
- Finally substitute into the equation
  - Gradient = $\frac{\text{40 m}}{\text{3 km}}$
- Answer: **13.3 m/km**

Gradient

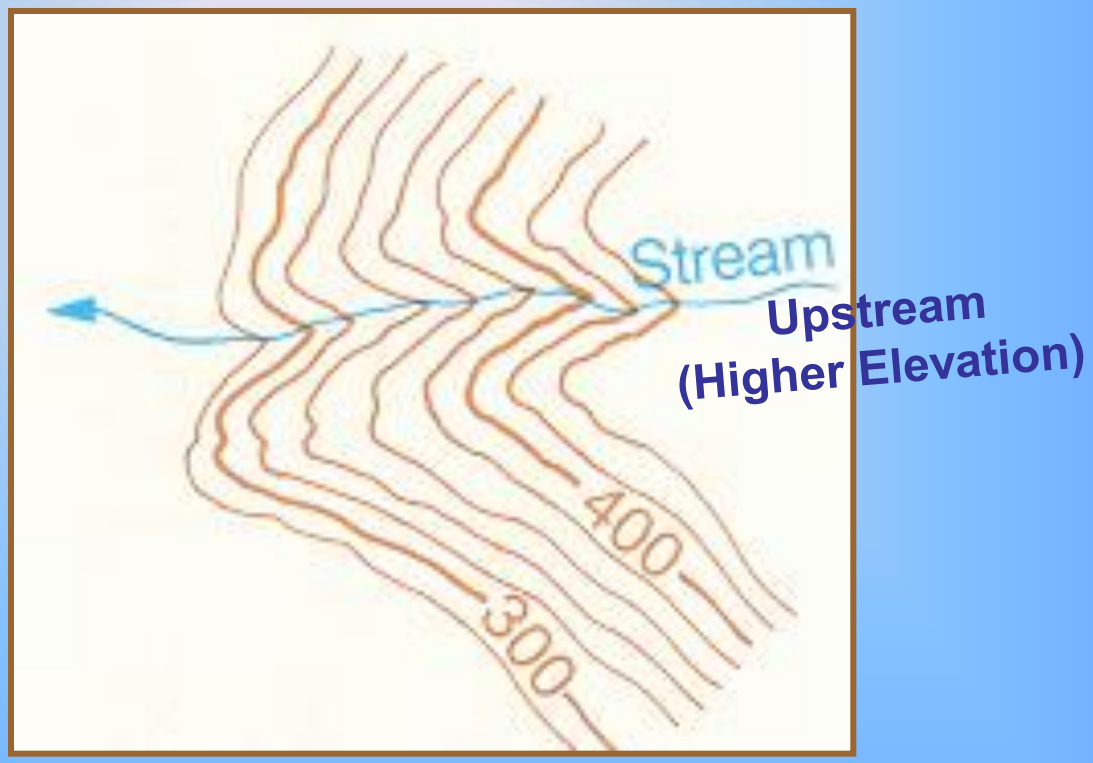


(3) Can be inferred by the **spacing** of the contour lines.

(a) A steeper gradient will be shown by **closely spaced** contour lines.

(b) The more gentle the gradient, the **farther apart** the contour lines will be spaced.

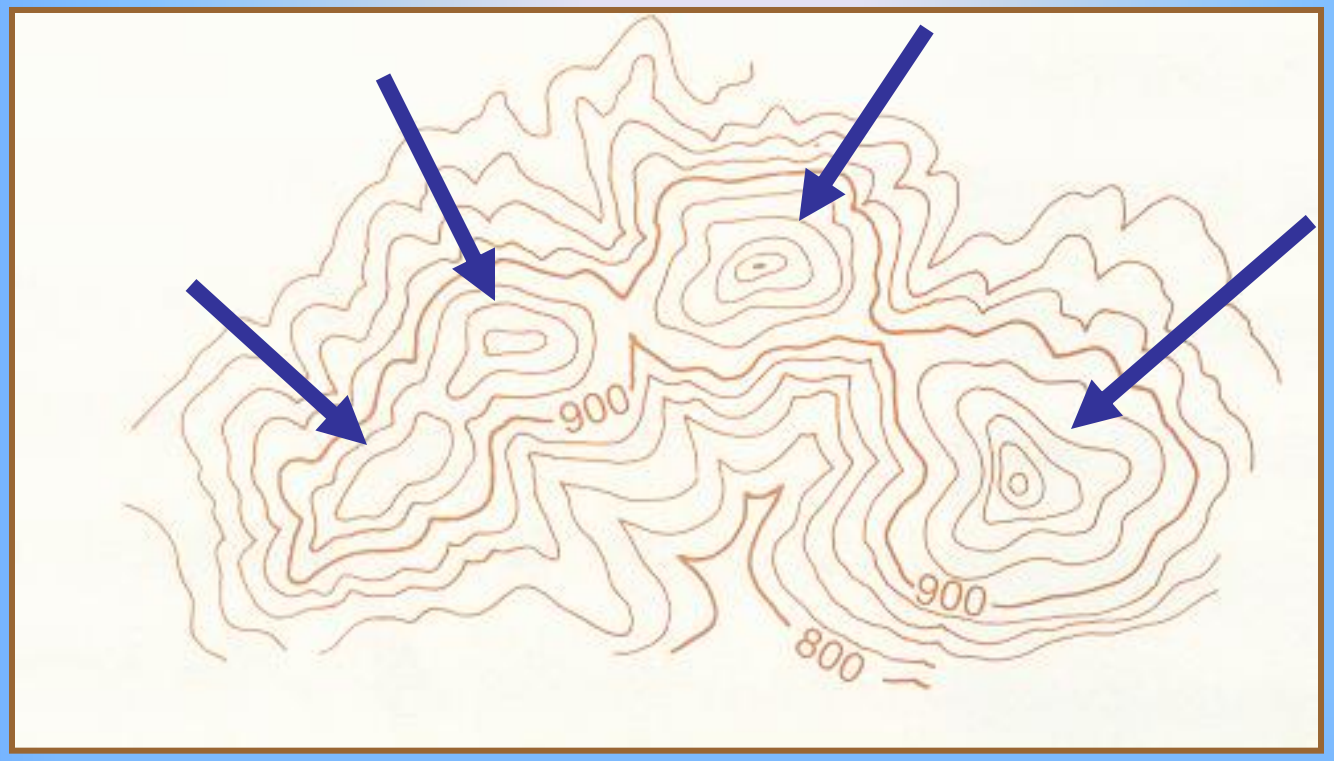
e. Stream Valleys



(1) Contour lines form a **V Pattern** when crossing a stream.

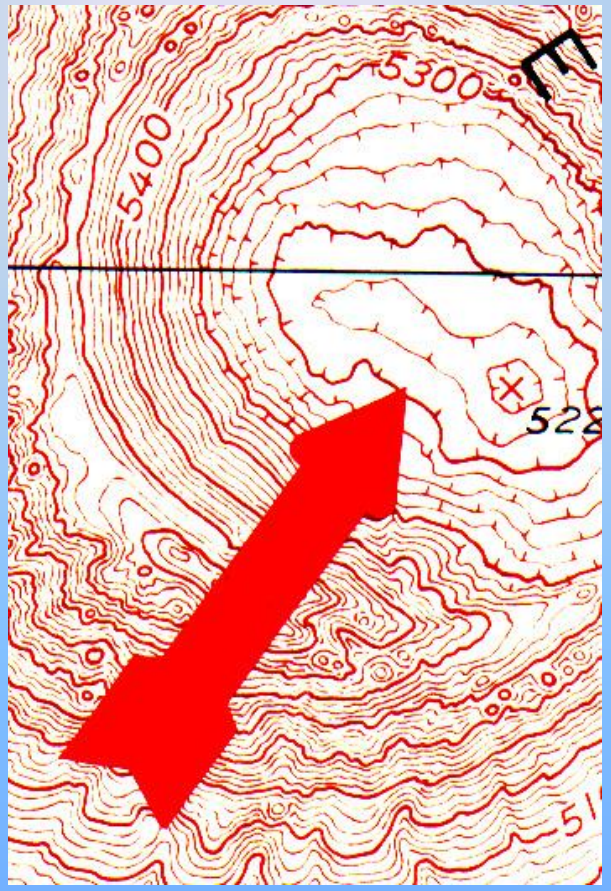
(2) The apex of the V always points **upstream** towards the **higher** elevation.

Hills



f. A concentric series of circular close contour lines represents a __hill__.

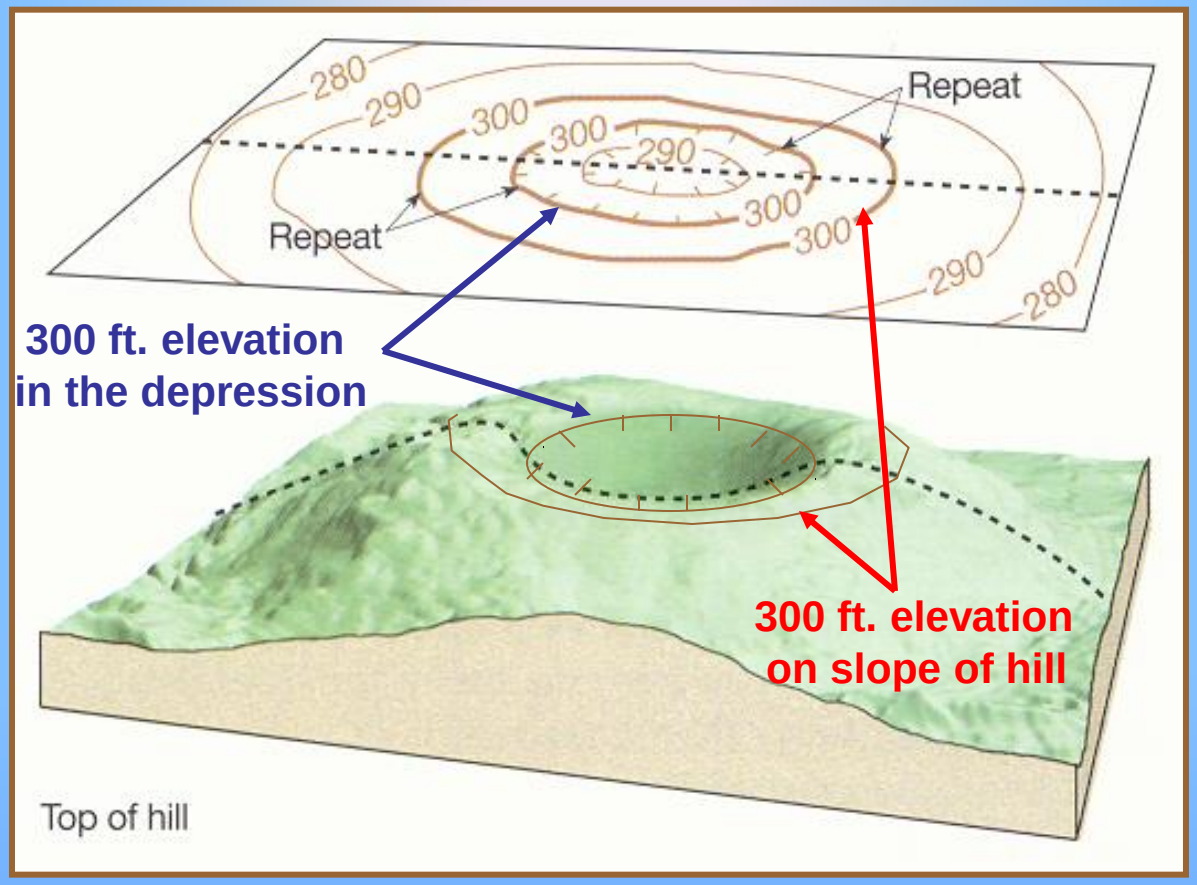
g. Depressions



(1) Depression contour lines have **hachure** marks on the downhill side.

- They represent **closed** depressions.

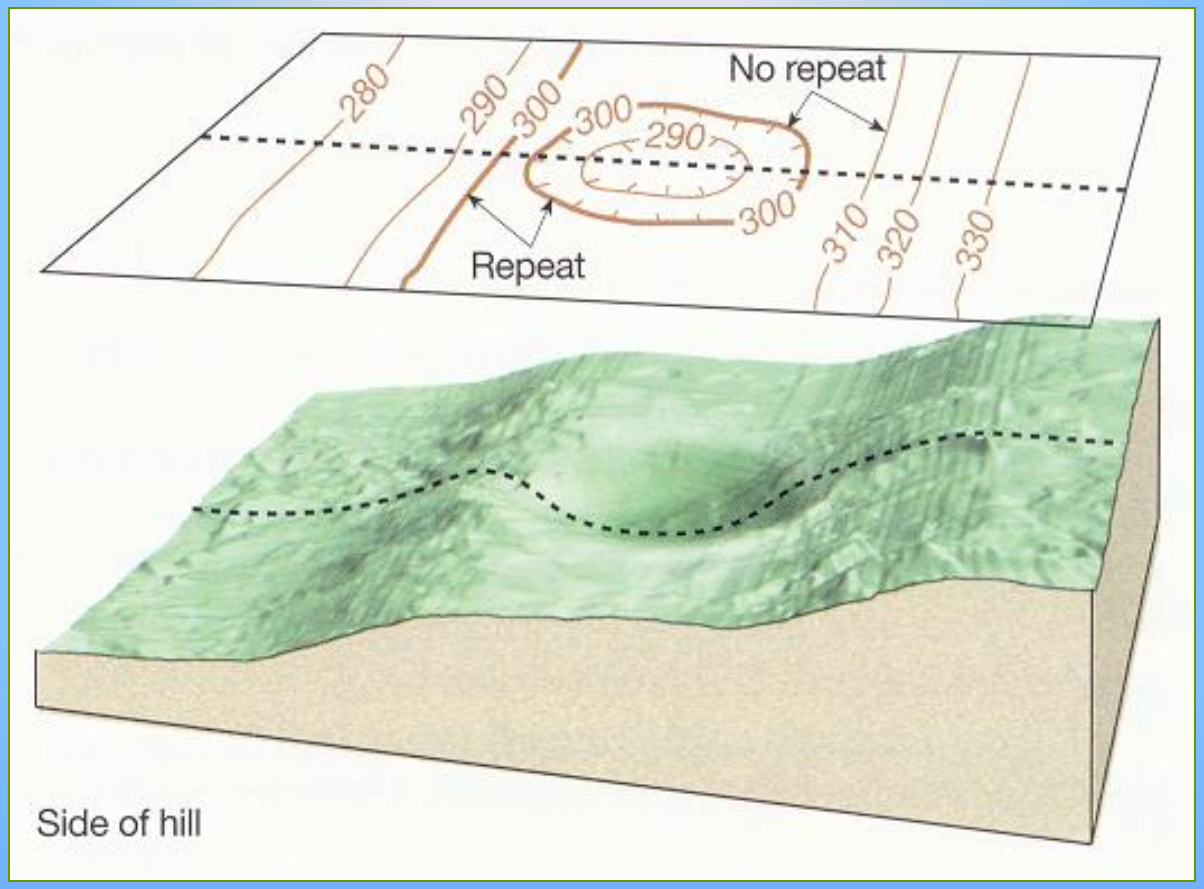
Repeating Contour Lines



(3) Contour lines **repeat** on opposite sides of the depression.

(4) This means that the **first** contour line inside the depression has the **same** elevation as the last contour line outside

A Depression on a Slope



- If the depression is on a slope, the contour lines will repeat on **only the lower** side.

B. Vertical Control Points

1. These are symbols on a map that indicate the **exact elevation** at that location.

2. Some types of vertical control points:

a. Bench Marks

(1) A **permanent brass plate** set into the ground.

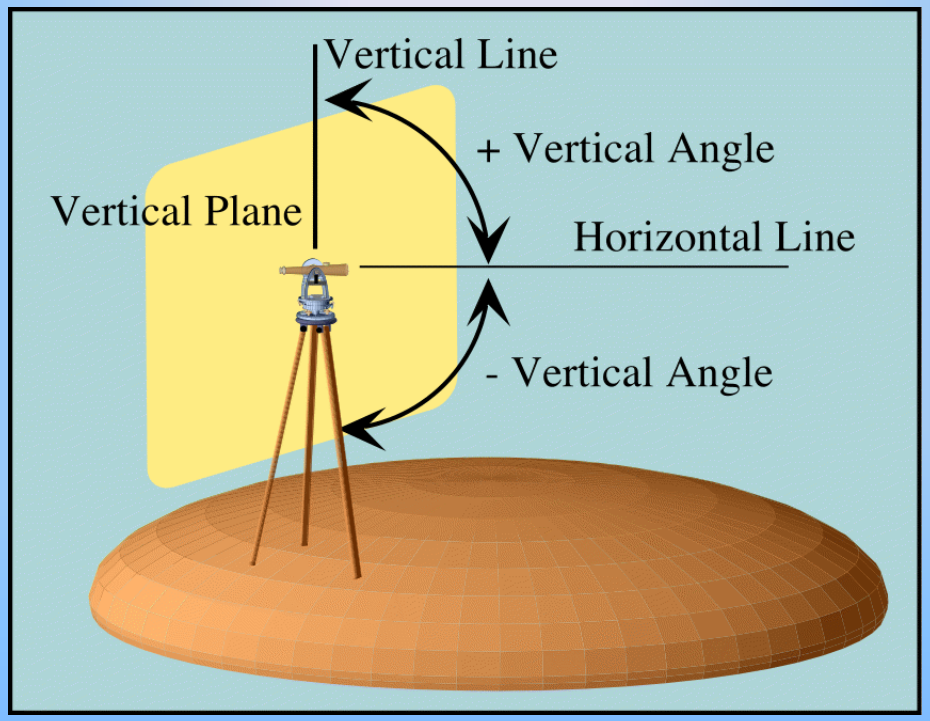
(2) Its **vertical** position has been surveyed as accurately as possible.

(3) Abbreviated "**BM**."

(4) Shown as a **triangle** with the elevation if latitude and longitude coordinates are certain.

Example: BM △6016

Bench Marks



(5) If **VABM** is next to a triangle symbol it indicates the elevation was determined by a surveying technique that used a vertical angle (hence, the letters VA).

Bench Marks

(5) If shown as by an ^{BM}X symbol with the elevation.

(6) The horizontal position has been surveyed as accurately as possible, but exact coordinates haven't been determined.

(7) Instead of a brass plate, the marker is a concrete tablet with the numbers etched onto the top (like a gravestone).

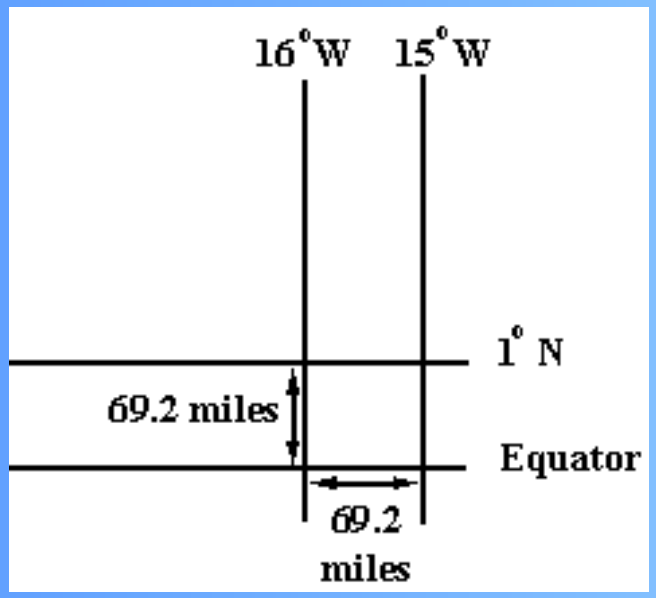
b. Recoverable Mark

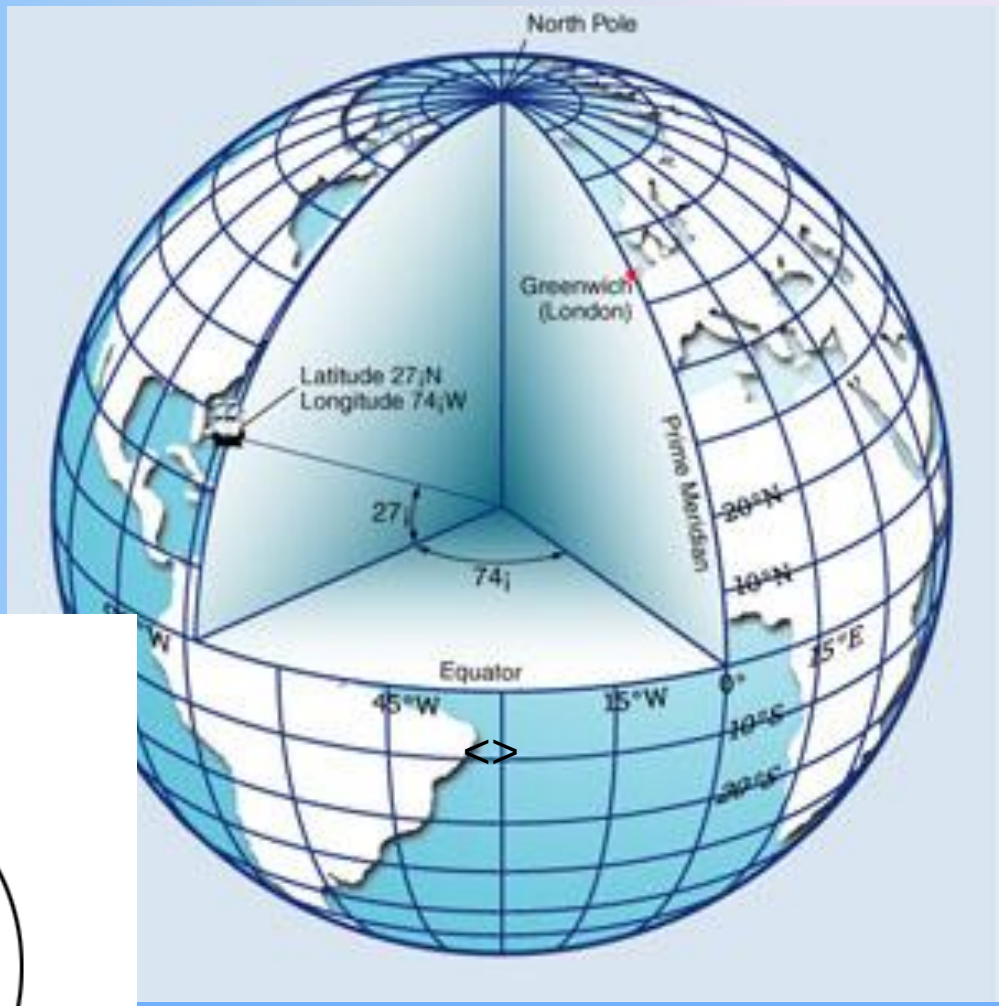
(1) Naturally occurring **landmark** whose horizontal position has been surveyed as accurately as possible.

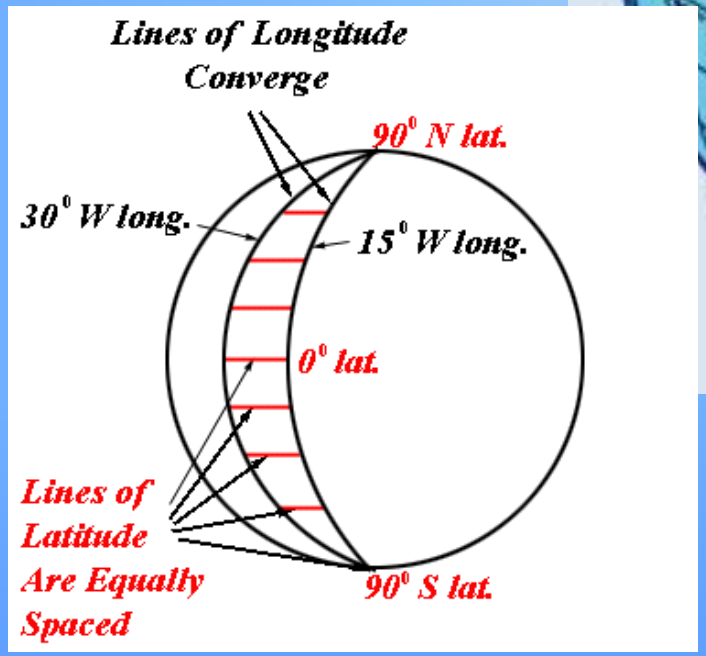
(2) Shown by an **X** symbol with the elevation.

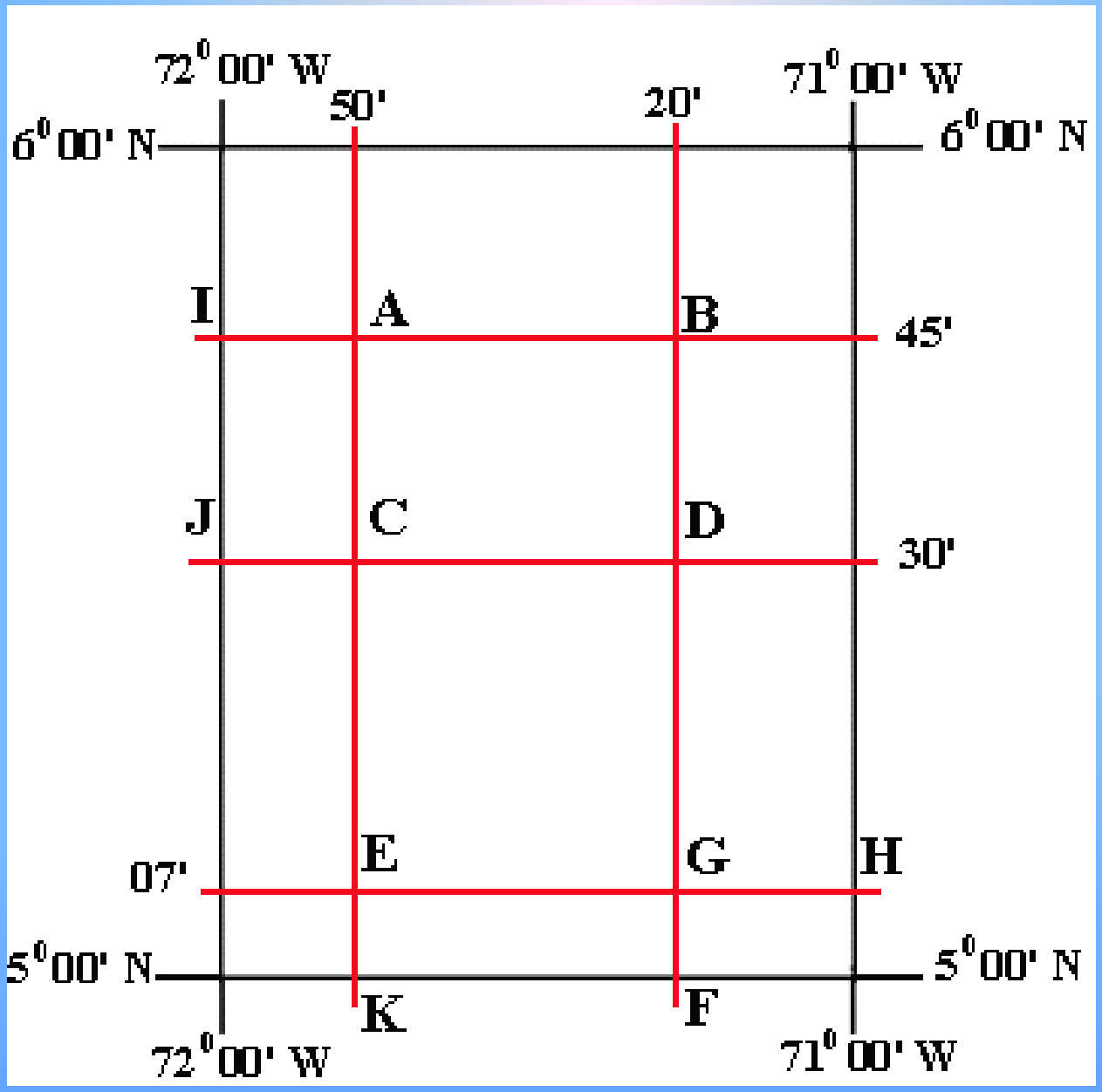
(3) Referred to as a **spot elevation**.

III. Latitude and Longitude onTopographic Maps



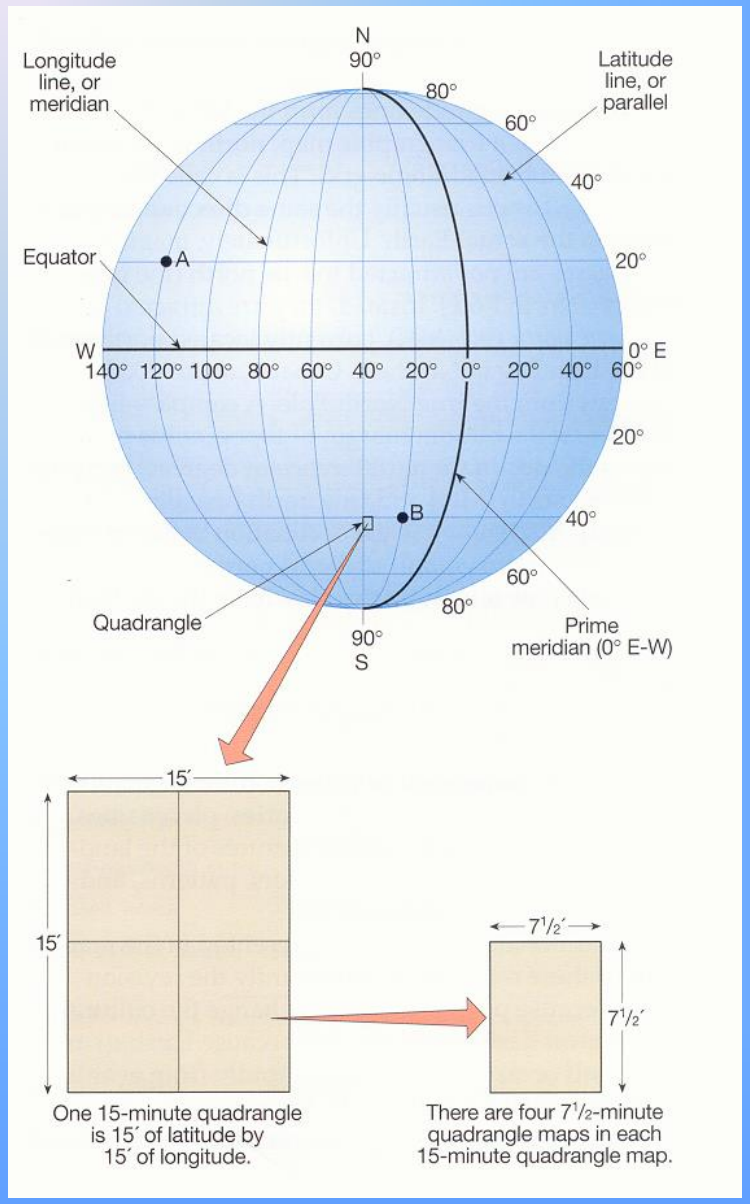




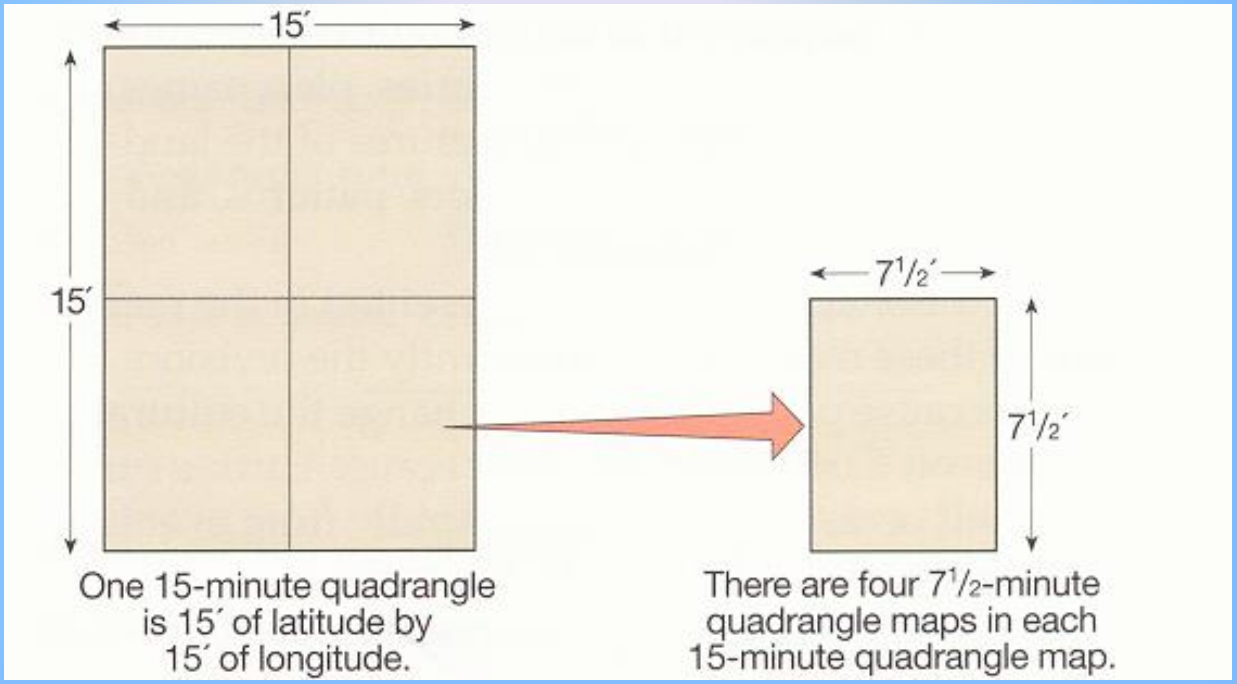

72° 00' W
50'
20'
71° 00' W
6° 00' N
6° 00' N
I
A
B
45'
J
C
D
30'
E
G
H
07'
5° 00' N
5° 00' N
K
F
72° 00' W
71° 00' W

A. Quadrangles

1. Topographic maps **rectangles** whose borders are lines of **latitude** and **longitude**.
2. Because most maps cover **small areas** of Earth's surface whole degrees aren't used.
3. Maps are published in sizes using **minutes** and **seconds** of latitude and longitude.



b. Two Common Sizes



(1) 7 ½ minute quadrangle

(a) Covers __7.5 minutes__ (7' 30") of latitude and longitude.
(b) Most common map published by the United States Geologic Survey (USGS.)

(2) 15 minute quadrangle

(a) Covers __15 minutes__ (15' 00") of latitude and longitude.
(b) Covers __four__ times the area of a 7 ½ minute quadrangle.
(c) This size is no longer published by the USGS

3. The Direction to North

(a) North is always at the _top_ of the quadrangle grid

(b) Longitude lines (meridians) form the _east_ and _west_ borders of the map.

(c) They aren't parallel because meridians _converge_ toward the north.

(d) Grid North (_GN_)

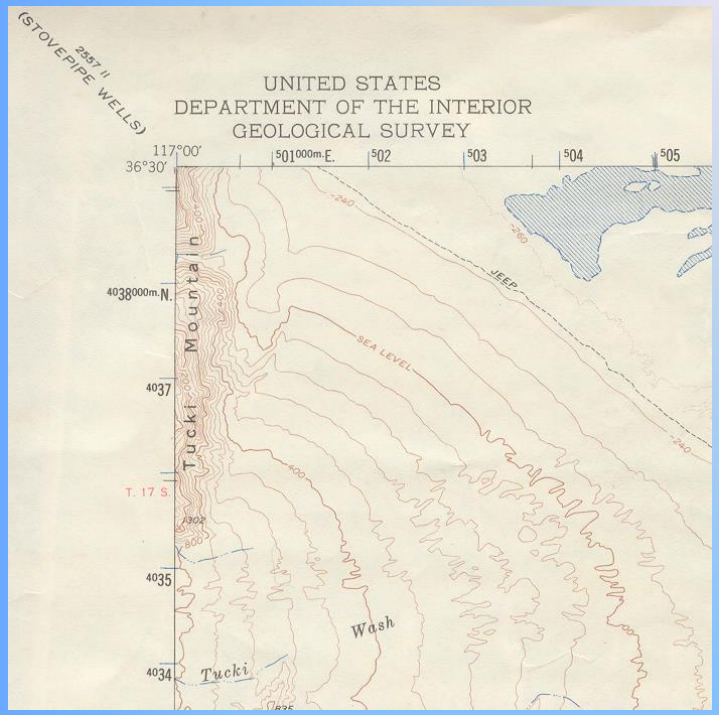
(1) At the top of the quadrangle grid.

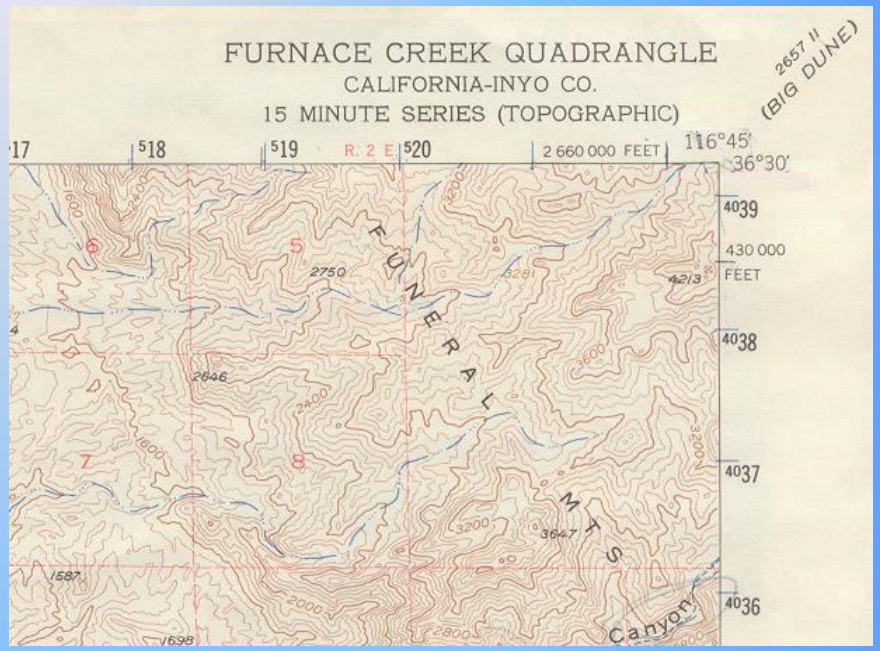
(2) Based on a grid constructed on the map.

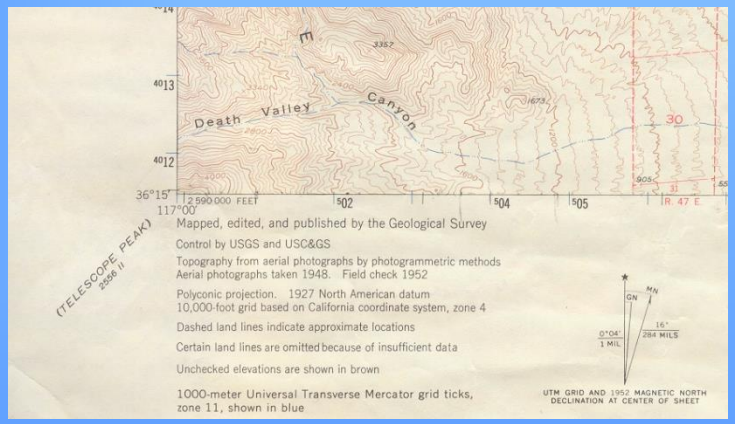
(3) About the same as true north (_geographic North Pole_) on the actual Earth

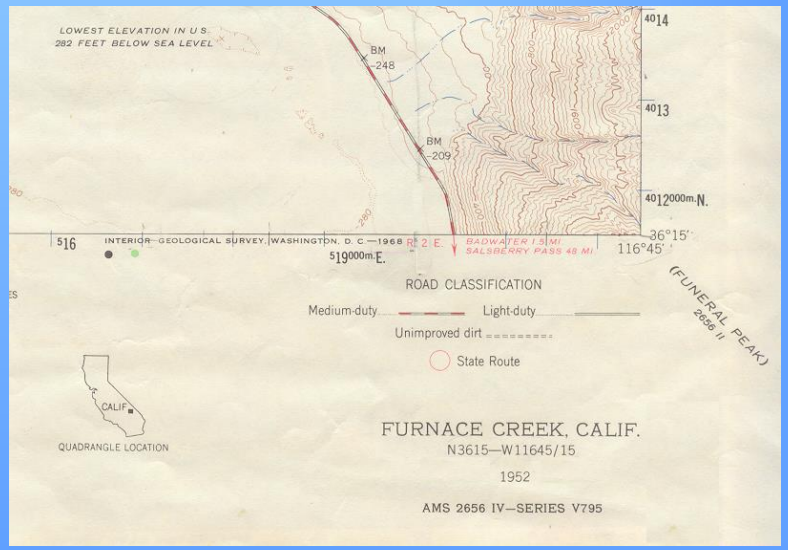
Note: The north and south borders of The map are parallels of latitude.

Using the Corners of the Map

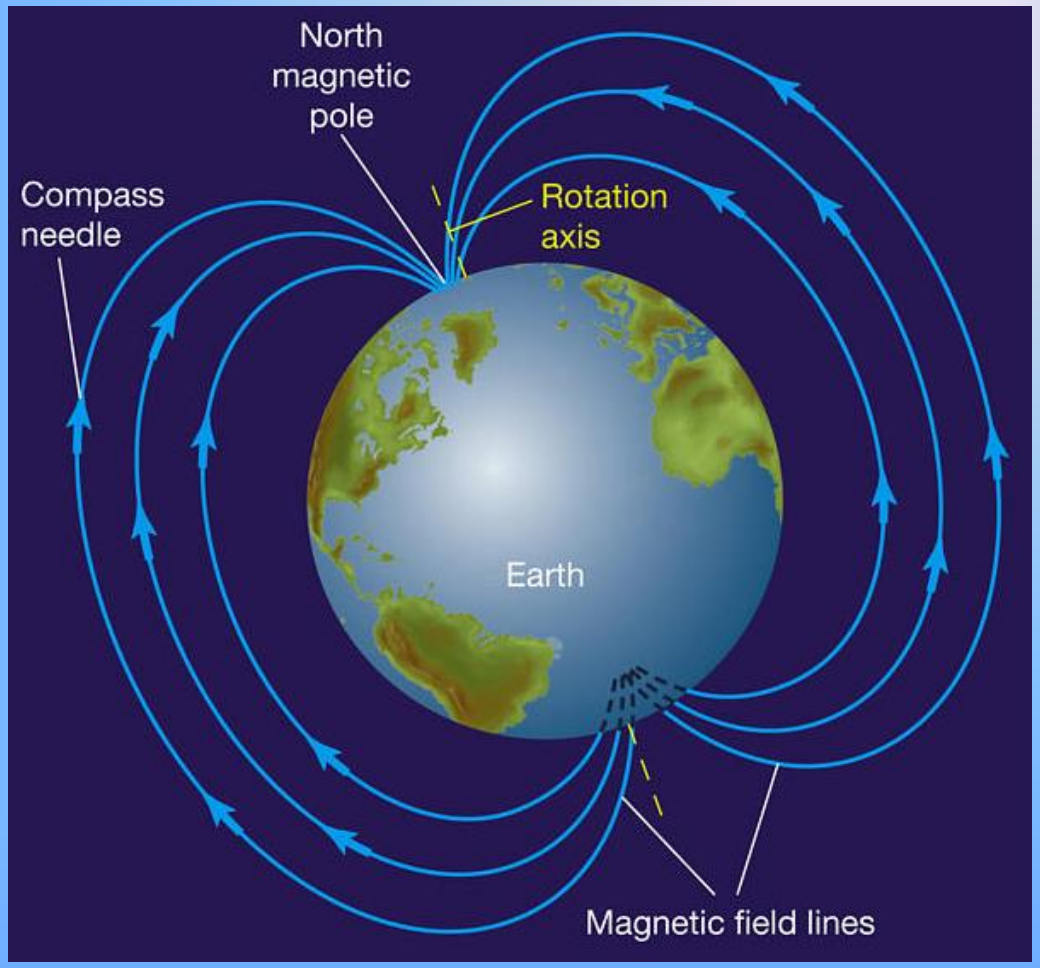








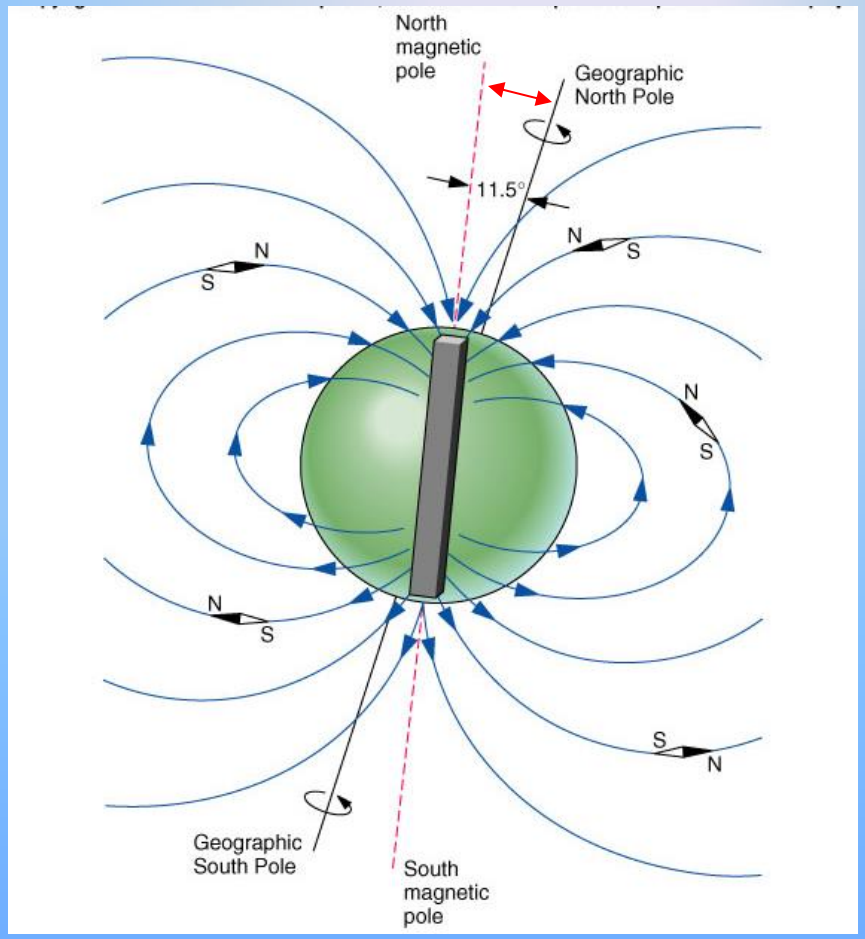
B. Magnetic North is not the same as True North



1. Magnetic North (**MN**)

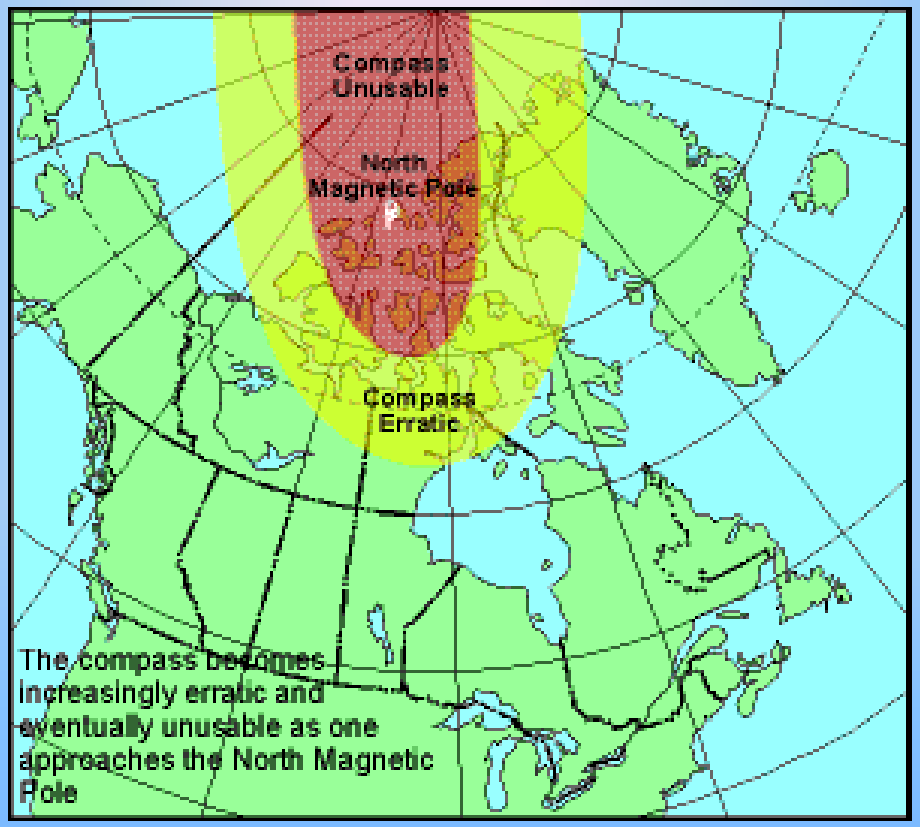
   (a) The direction in which Earth's magnetic lines of force **converge**.

b. This is **not** in the same location as true north and moves 10 to 40 km per year



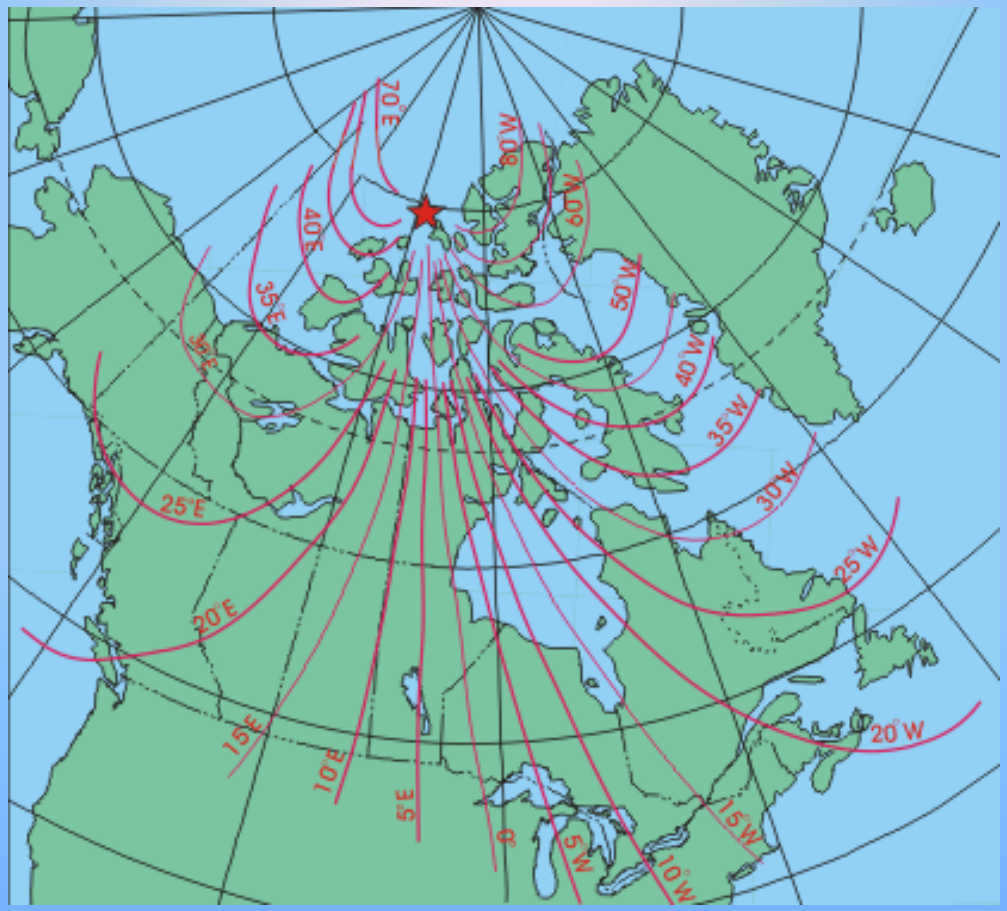
- It's currently about 1,000 km from the true North Pole, in Hudson Bay, Northern Canada (at 82.7º N, 114.4º W in 2005).

Compasses Are Unusable Near the North Pole



- The horizontal force of the magnetic field
  - Responsible for the direction in which a compass needle is oriented
  - Decreases in strength as it approaches the North Magnetic Pole, where it is zero.
- Close to the pole, an area is reached where the frictional forces in the pivot are comparable to the horizontal forces of the magnetic field.
- The compass starts to behave erratically
  - Eventually, as the horizontal force decreases even more, the compass becomes unusable

2. Magnetic Declination

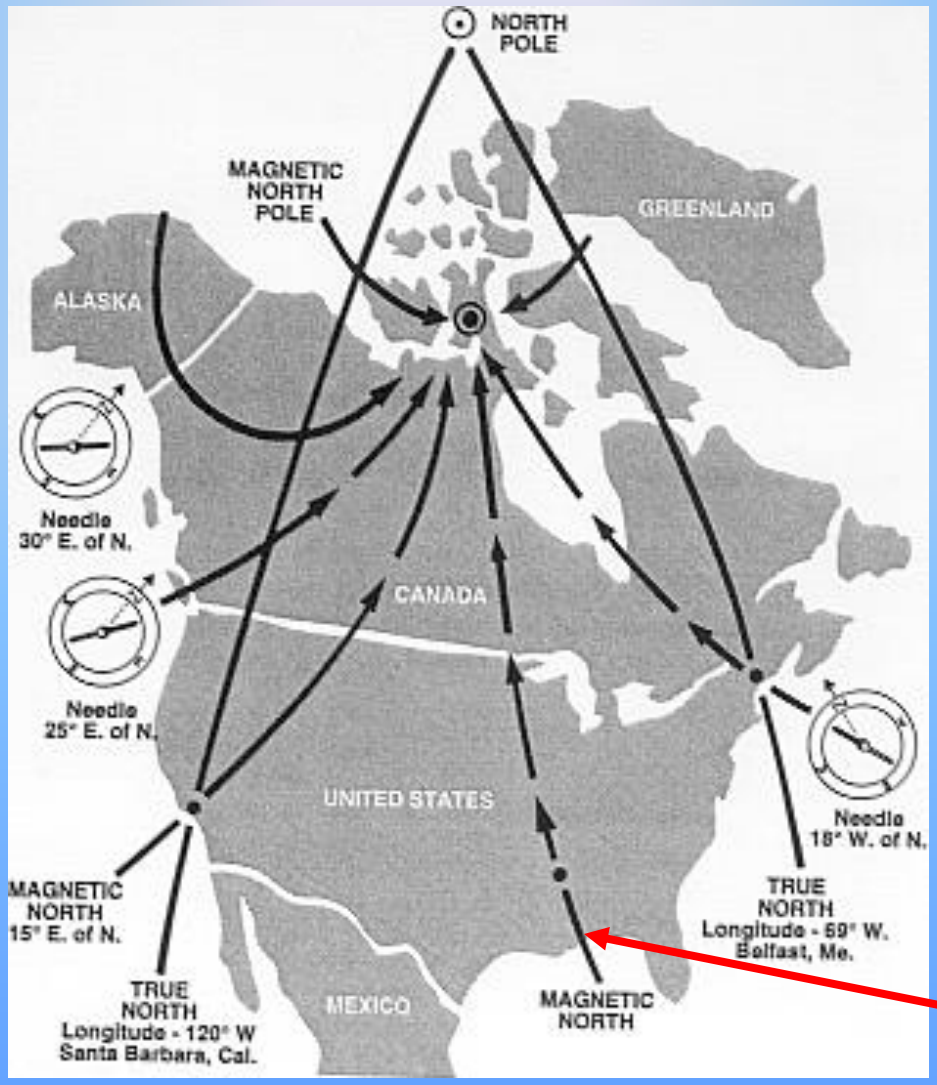


a. The **difference in degrees** between **compass north** (MN) and **true north** (shown by a star).

b. Because magnetic north is continually changing, this is good only for the year of the map.

Magnetic Declination

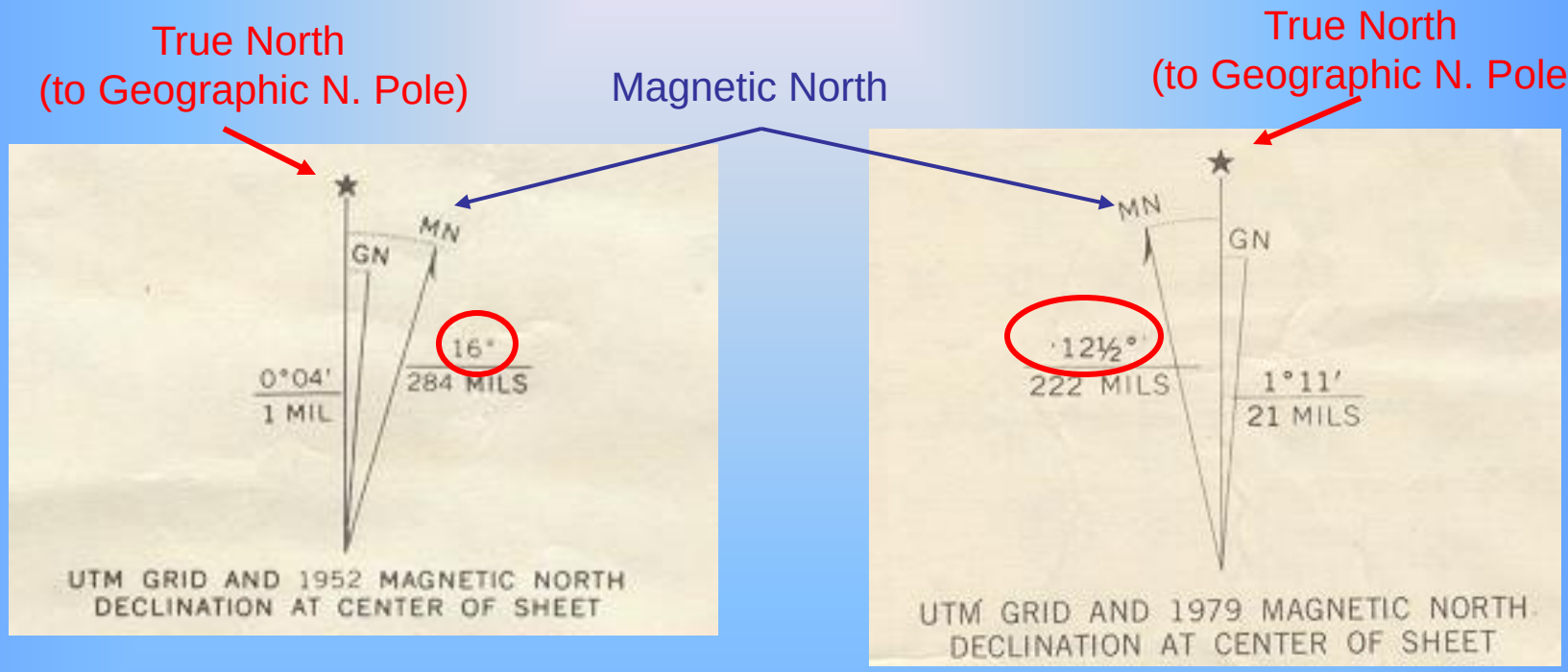
East Declination



West Declination

Agonic Line
(No Declination)
Having no angle

Finding Declination on a Map



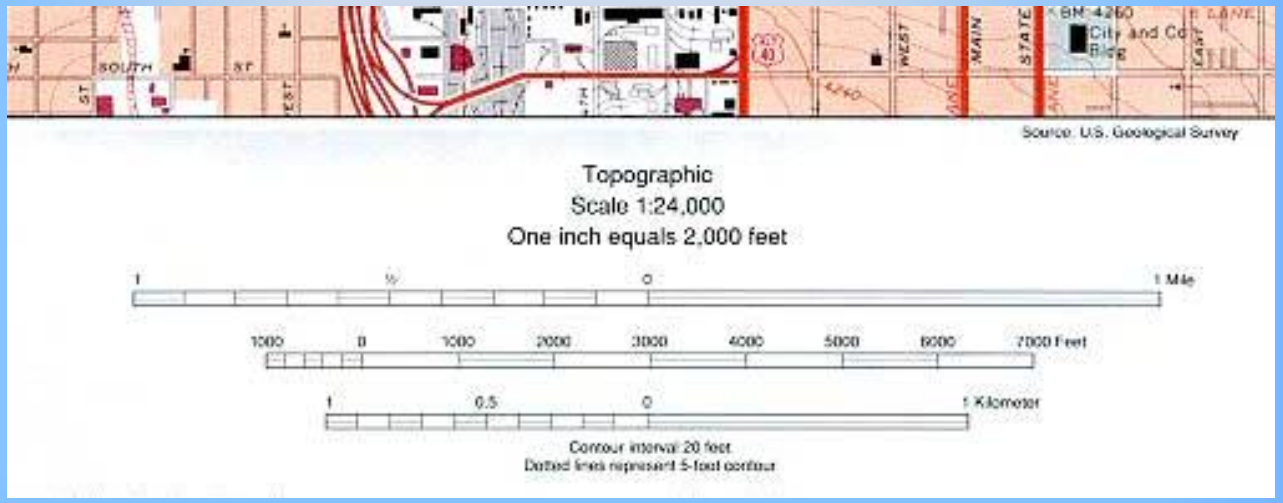
16 degrees East Declination

12 ½ West Declination

- Most maps use an angle symbol shown at the bottom of the map.
  - Use the number with only the degree symbol.
  - Ignore the other numbers. They were for military use.
- Some newer maps simply state the value.

IV. Map Scale

A. What is meant by scale?



1. Maps are **scale models**.
2. Scale is the **proportion** by which the real distance has been reduced.
3. All scales are shown on the bottom of the map

B. Ratio Scale

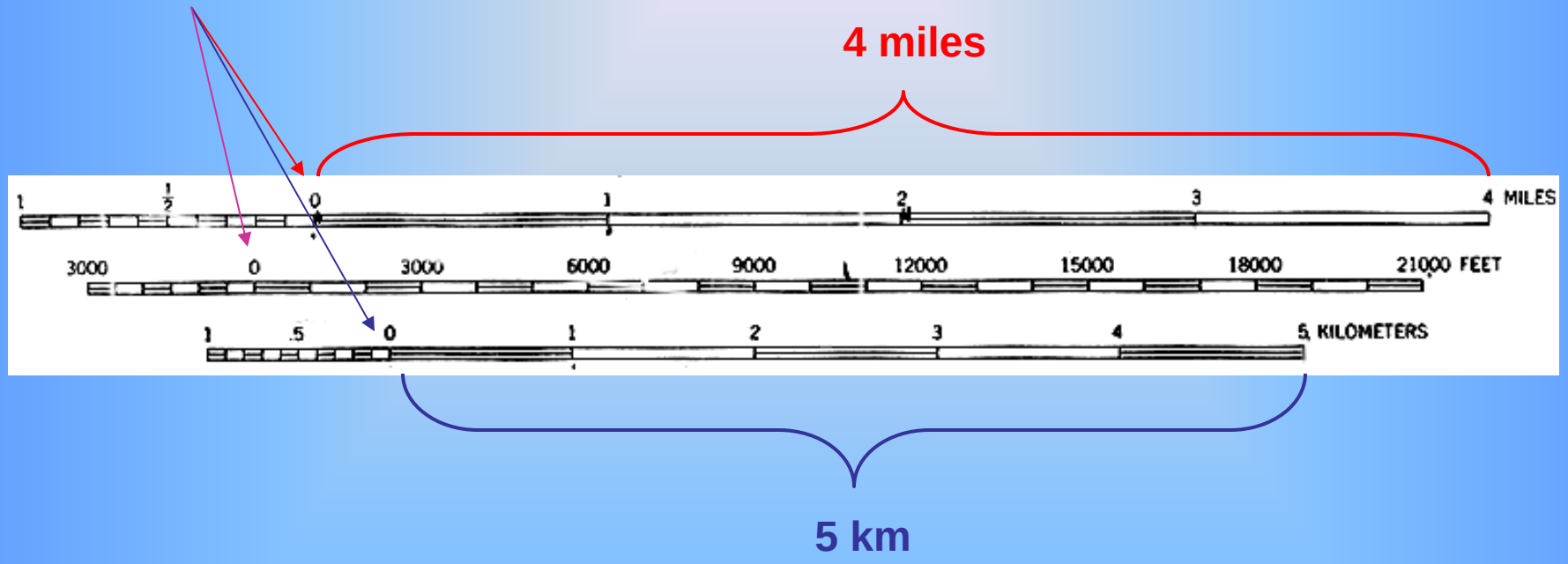
1. Expresses how much a certain distance on the map equals on the *real* Earth.
2. Units are in inches (centimeters if the contour lines are in meters).
3. Samples
   (a) 1:24,000
      (1) One inch on the map represents **24,000 inches** in *real distance* on Earth's surface.
      (2) Used on 7 ½ minute quadrangle maps
   (b) 1:62,000
      (1) Once inch on the map represents **62,000 inches** in *real distance* on Earth's surface.
      (2) Used on 15 minute quadrangle maps.
   (c) 1:100,000
      (1) One centimeter on the map represents **100,000 cm** (1 km) in *real distance* on Earth's surface.
      (2) Used on metric maps.

C. Fractional Scale

1. Indicates that map has been reduced to the **fraction of it's actual size**.
2. Ratio Scale can easily be expressed as **Fractional Scale**.
   a. 1:24,000 equals a fractional scale of 1/24,000.
   b. 1:62,000 equals a fractional scale of 1/62,000.
   c. 1:100,000 equals a fractional scale of 1/100,000.

D. Bar Scale

Note the zero mark on each scale



1. Printed in the lower margin.
2. Four types:
   (a) Miles
   (b) Feet
   (c) Kilometers (subdivided into Meters)

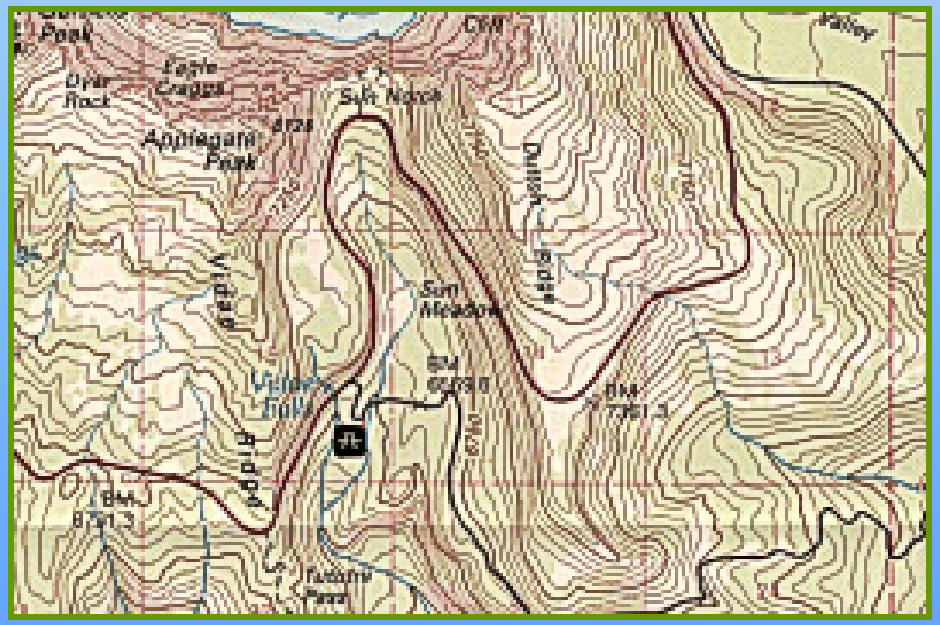
V. Map Symbols and the Use of Color page A17 Lab Book

A. Features and Symbols

1. Shown as points, lines, or areas, depending on their size and extent.
2. Individual houses may be shown as small black squares. For larger buildings, the actual shapes are mapped.
3. In densely built-up areas, most individual buildings are omitted and an area tint is shown. On some maps, post offices, churches, city halls, and other landmark buildings are shown within the tinted area.
4. Various point symbols are used to depict features such as buildings, campgrounds, springs, water tanks, mines, survey control points, and wells. Names of places and features are shown in a color corresponding to the type of feature. Many features are identified by labels, such as "Substation" or "Golf Course".

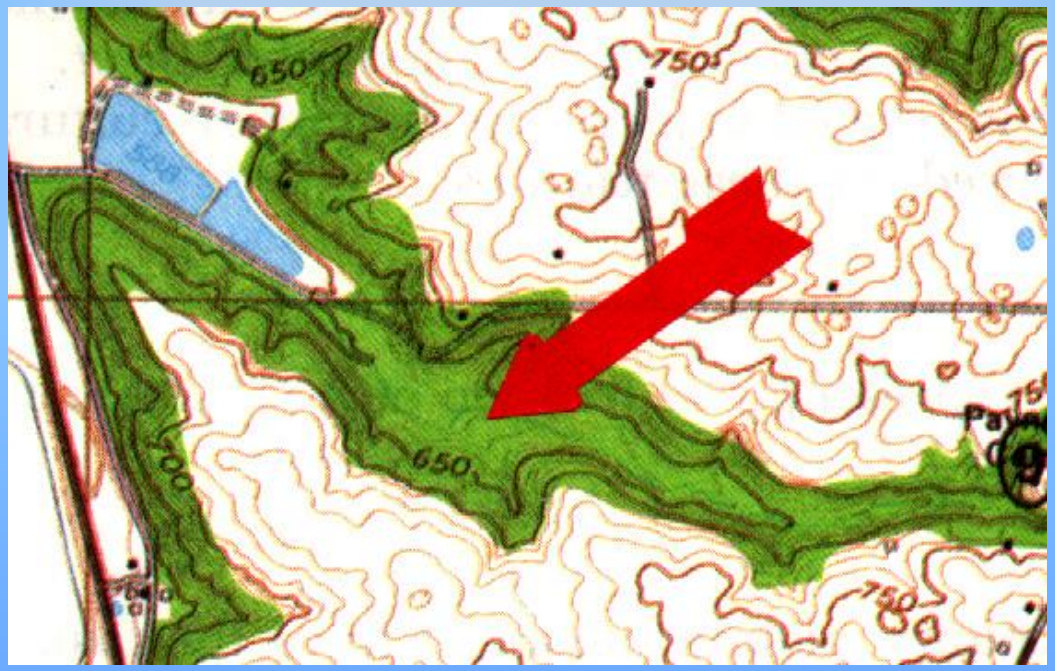
B. Color

1. The used colors usually indicate similar classes of information.
2. Colors used:
   a. **Brown**: Contour lines



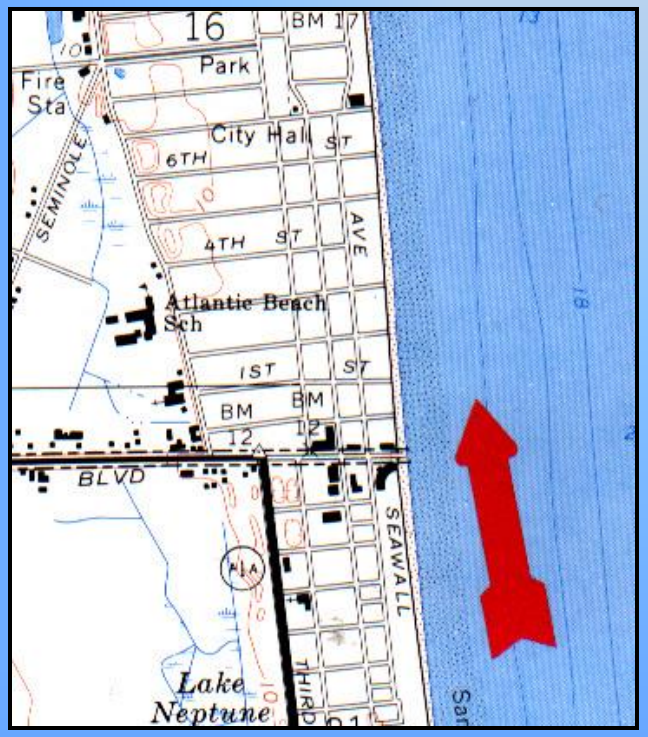
Use of Color on Topographic Maps

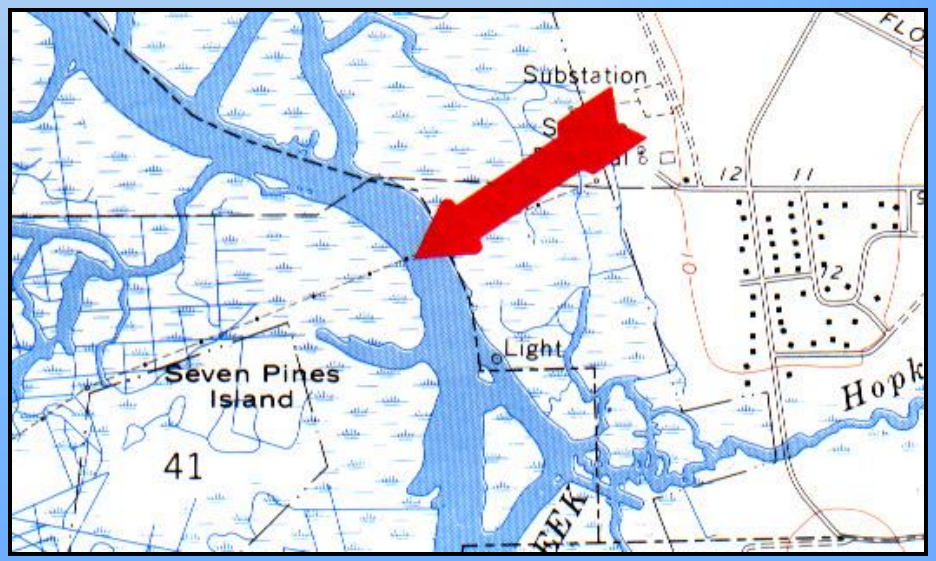
b. **Green**: Vegetation (e.g., woods, orchards, and vineyards)



Use of Color on Topographic Maps

c. **Blue** : Water features such as lakes, swamps, rivers, and drainage





Blue is also used for the contours of a glacier (Ice is water.)

Use of Color on Topographic Maps

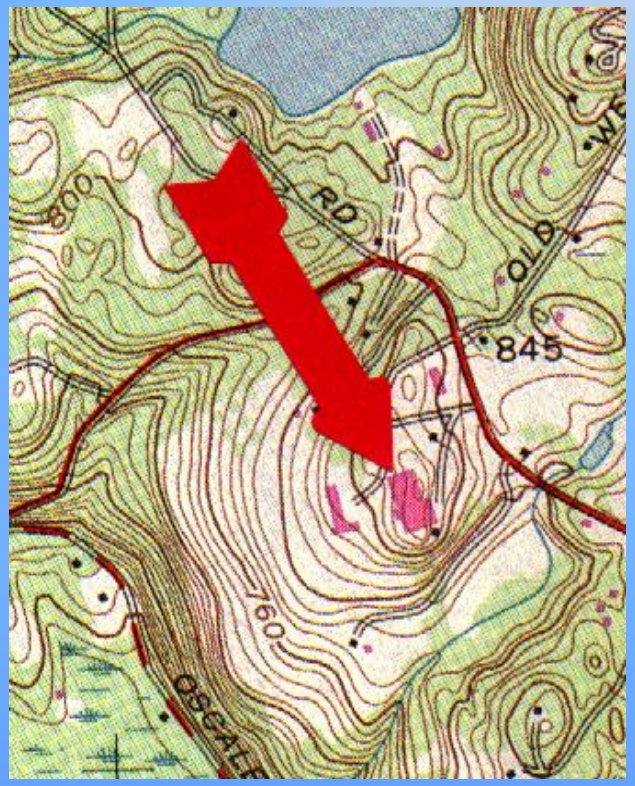
d. **Red**: Classifies cultural features ("man-made"), such as populated areas, main roads, and boundaries

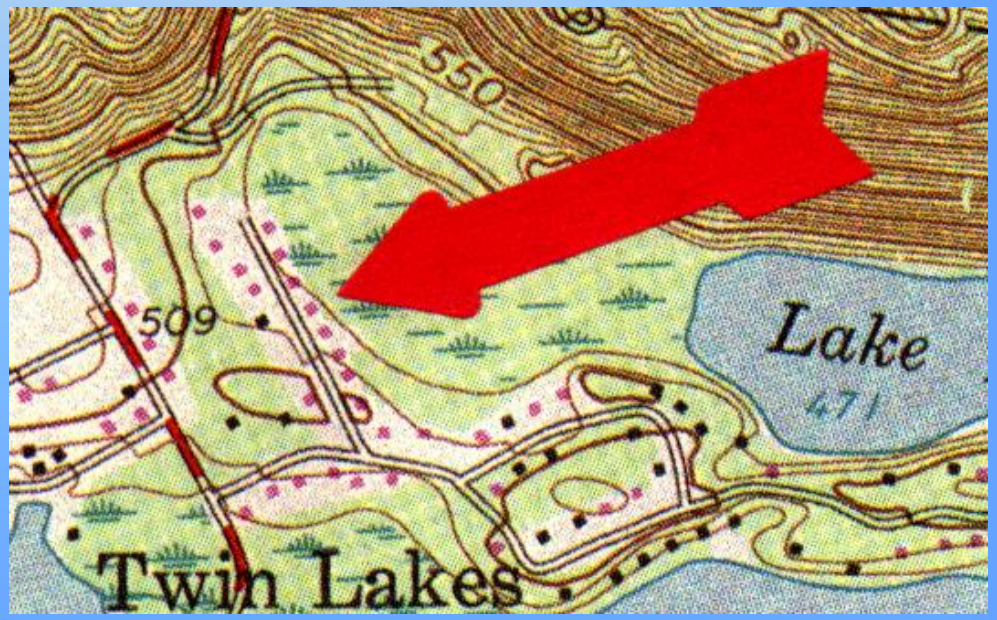
Use of Color on Topographic Maps

e. **Black** Cultural features (e.g., buildings, roads, railroads, mines, towers, etc.)

Use of Color on Topographic Maps

f. **Purple**: At one time, purple was used as a revision color to show all feature changes. Currently, purple is not used in the USGS revision program, but purple features are still present on many existing maps.

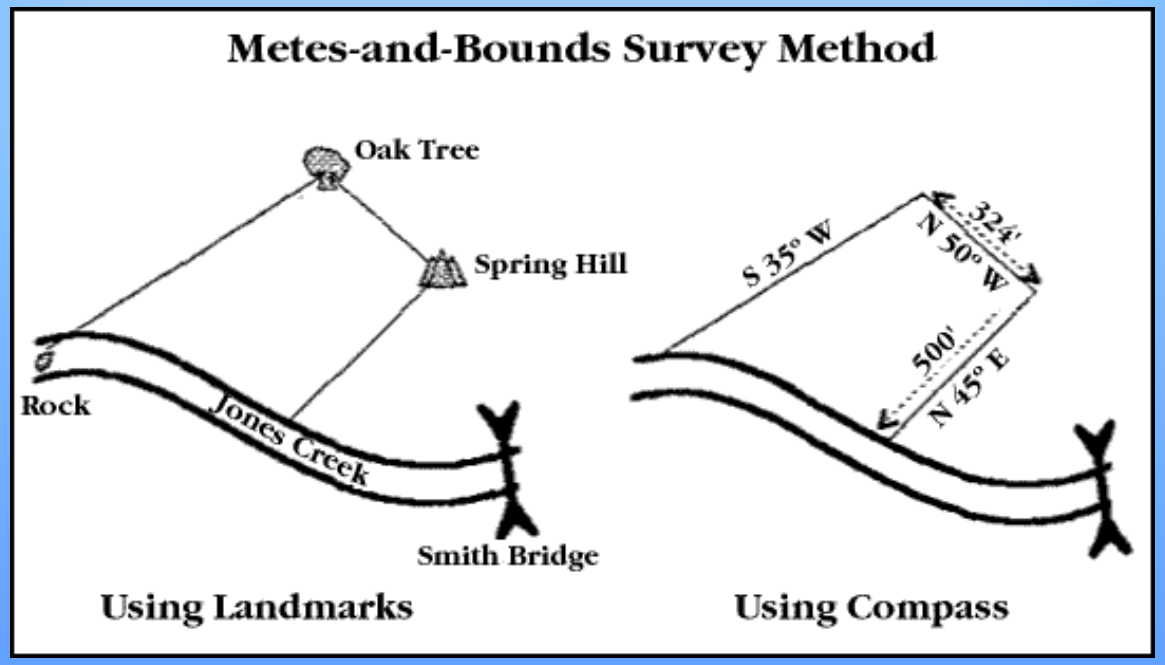




- **Start Lab 1-6**

VI. Public Land Survey System (PLS)

- In the original 13 colonies, land grants and property lines were laid out on the basis of “metes and bounds.”
  - This used landmarks and directions
  - It proved inadequate because some objects used to mark boundaries were not permanent (e.g., trees, boulders) and some, such as mountains, were too large to make accurate surveying possible.
  - Also, the resulting divisions had irregular boundaries

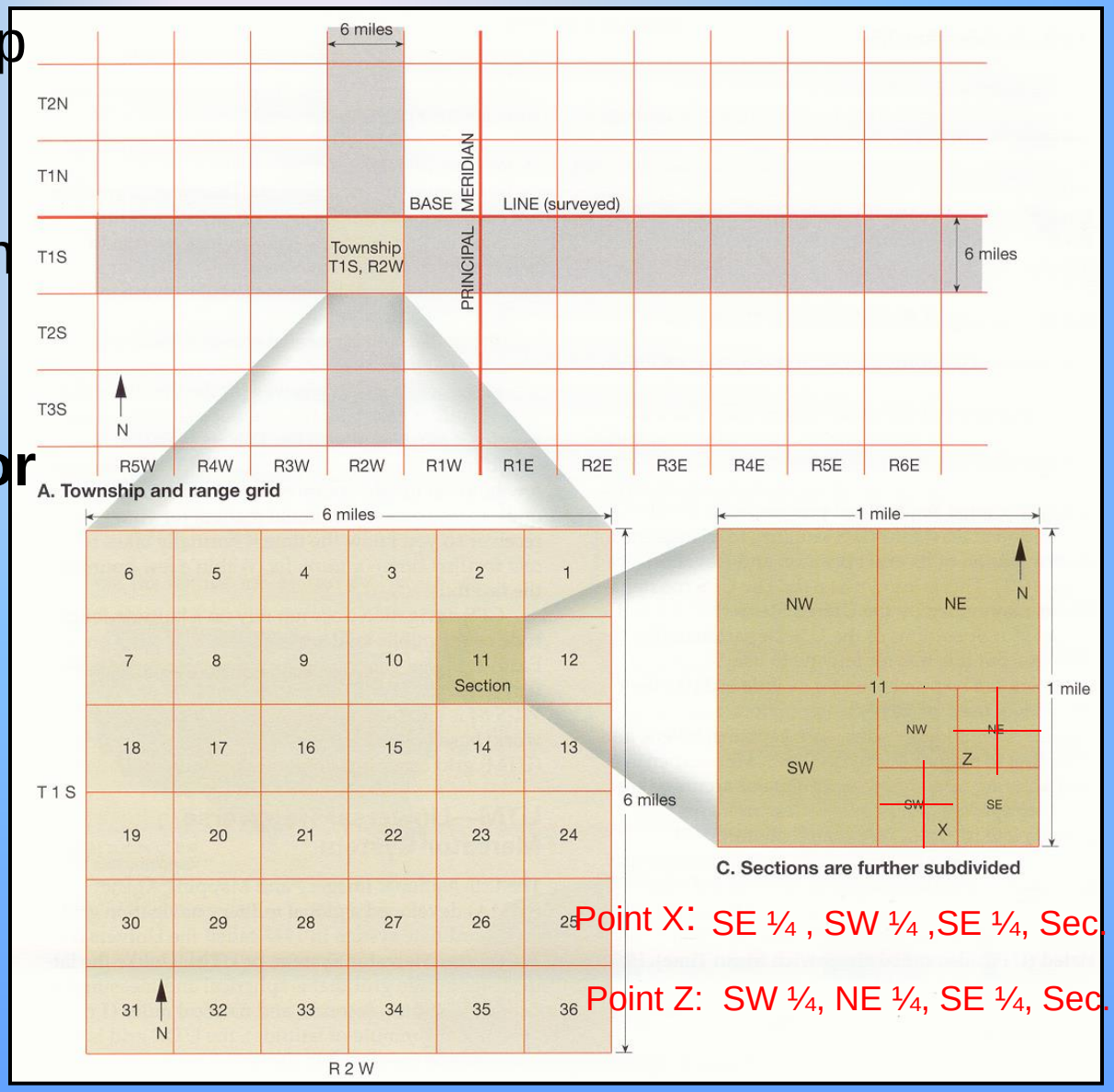


Public Land Survey System

- The United States Public Land Survey System (PLS) was instituted in 1785 when lands west of the Appalachians were being settled because a more accurate system was necessary.
- Except for the original 13 states and a few other states, all states are covered by this system.

PLS (Township and Range)

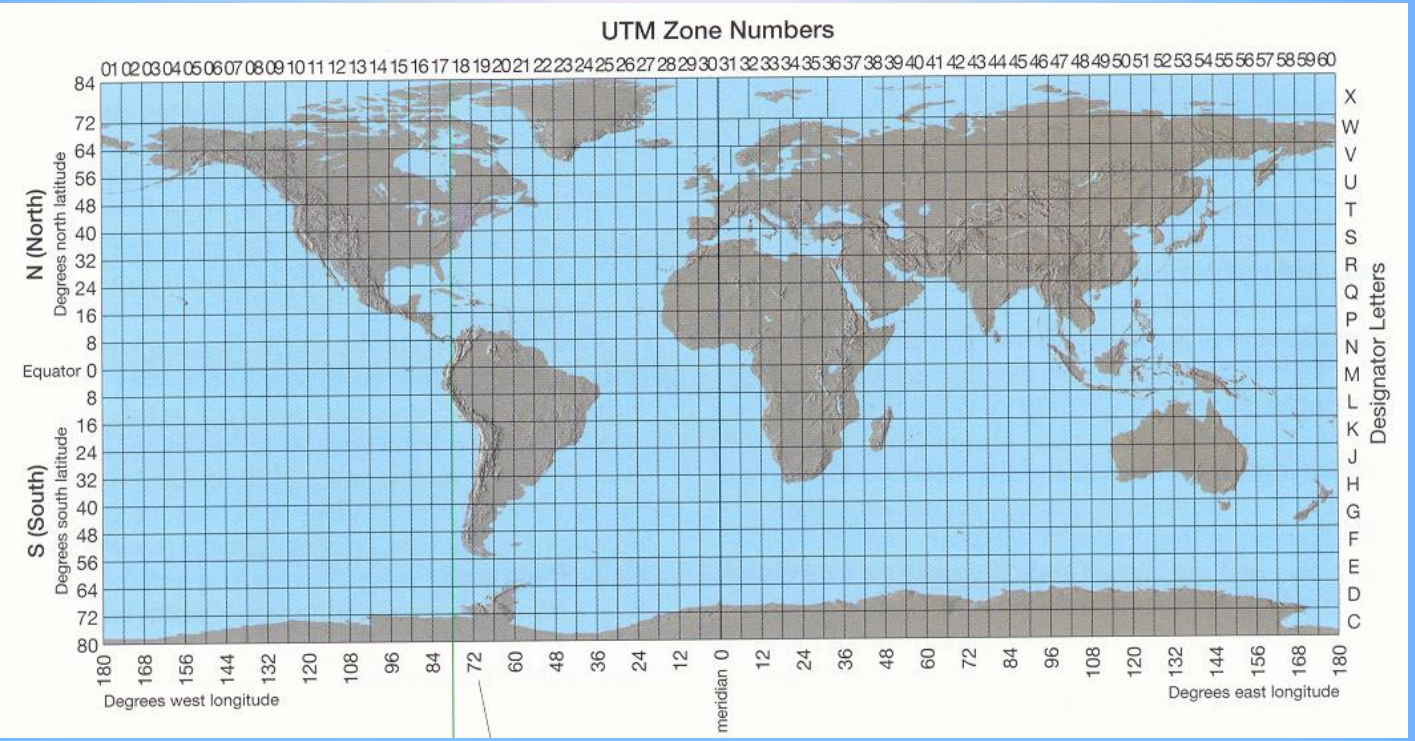
These Township and Range Lines, crossing each other form squares which are called **"Townships" or "Government Townships,"** which are six miles square.



Point X: SE ¼ , SW ¼ ,SE ¼, Sec. 11, T1S, R2W

Point Z: SW ¼, NE ¼, SE ¼, Sec. 11, T1S,R2W

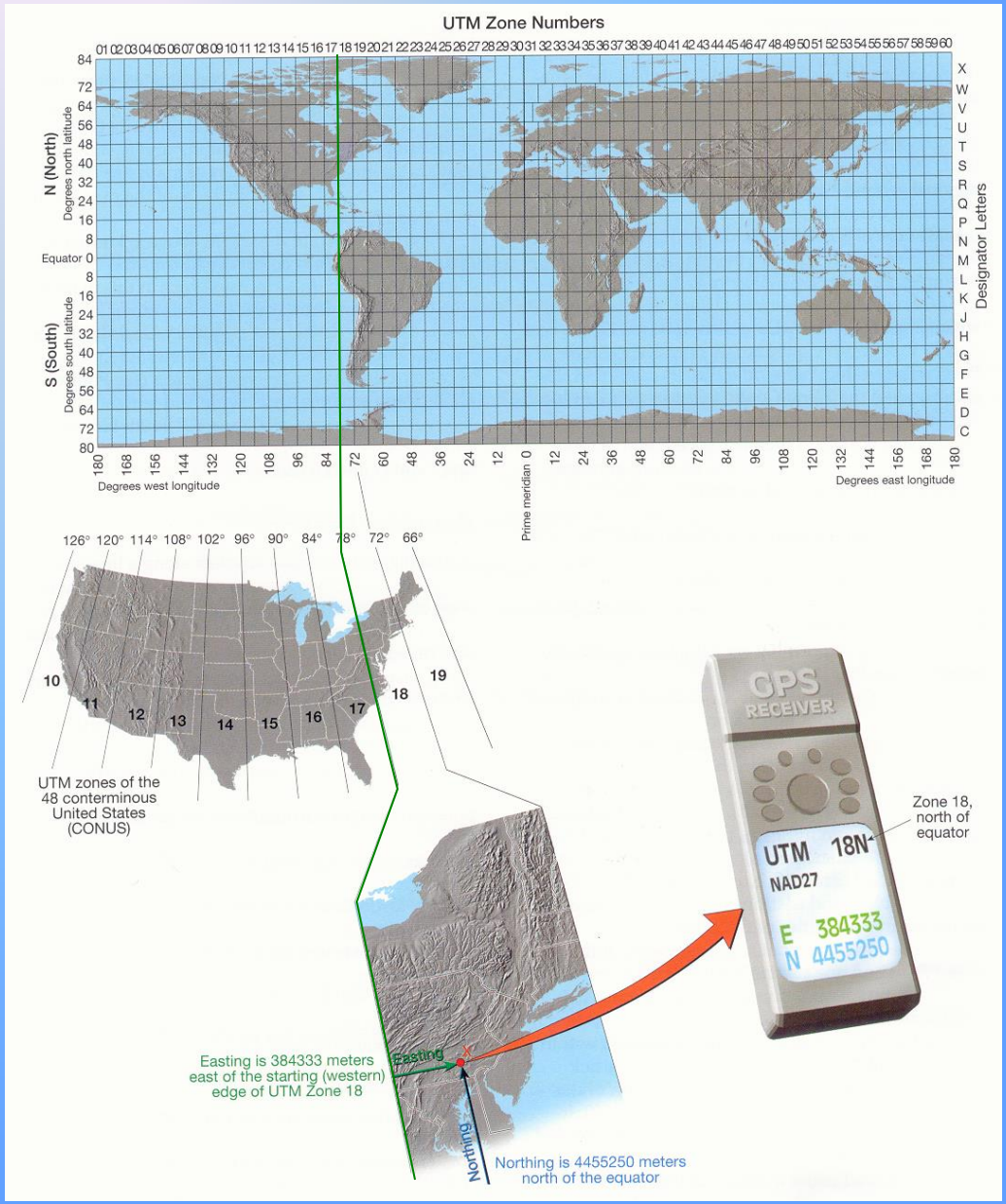
VII: Universal Transverse Mercator System (UTM)



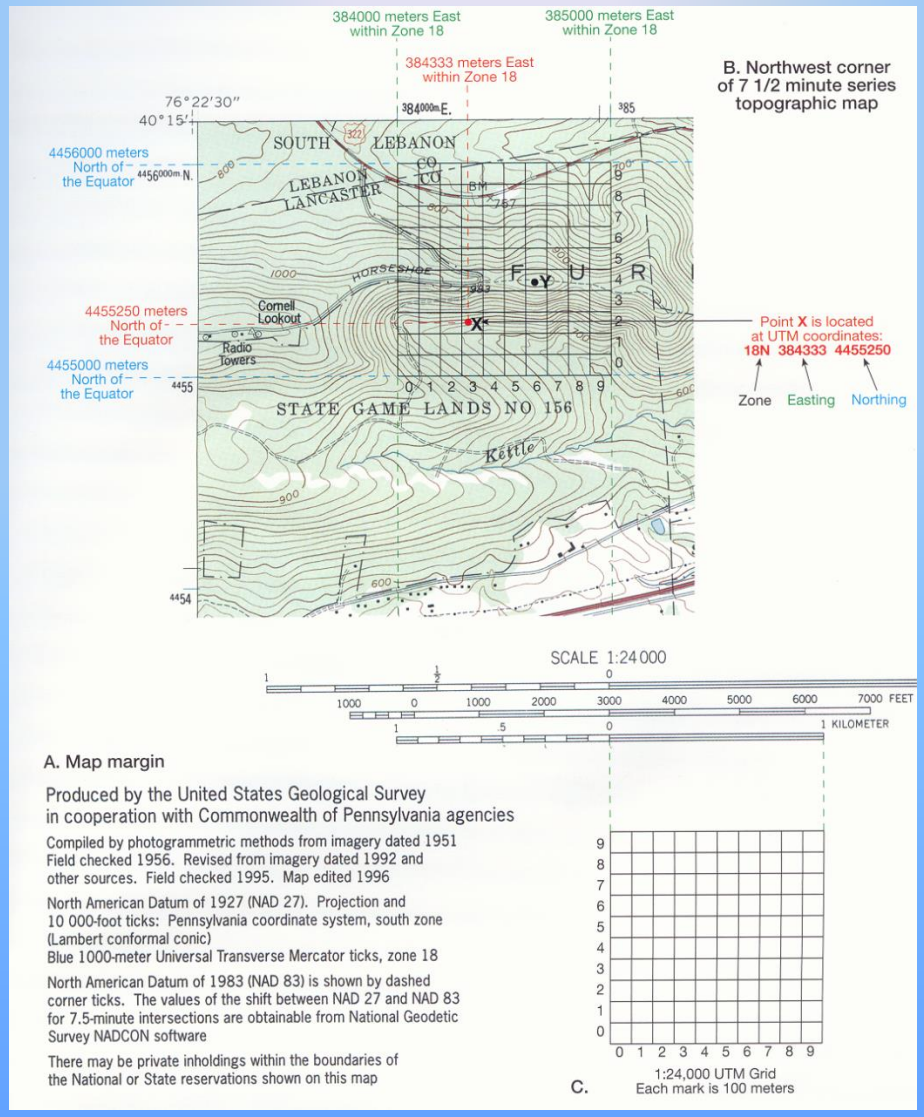
- **Rectangular and Measured in decimal-based metric units (meters)**
- Global military grid and coordinate system
- Developed in 1947 by the U.S. National Imagery and Mapping Agency (NIMA)
- **Zones**
  - 60 North-South strips of longitude
  - Each is 6 degrees of longitude wide
  - Consecutively numbered from
    - Zone 01 between 174º and 180º east longitude at the east margin
    - Zone 60 at the west margin (between 168º west and 180º)

Eastings and Northings

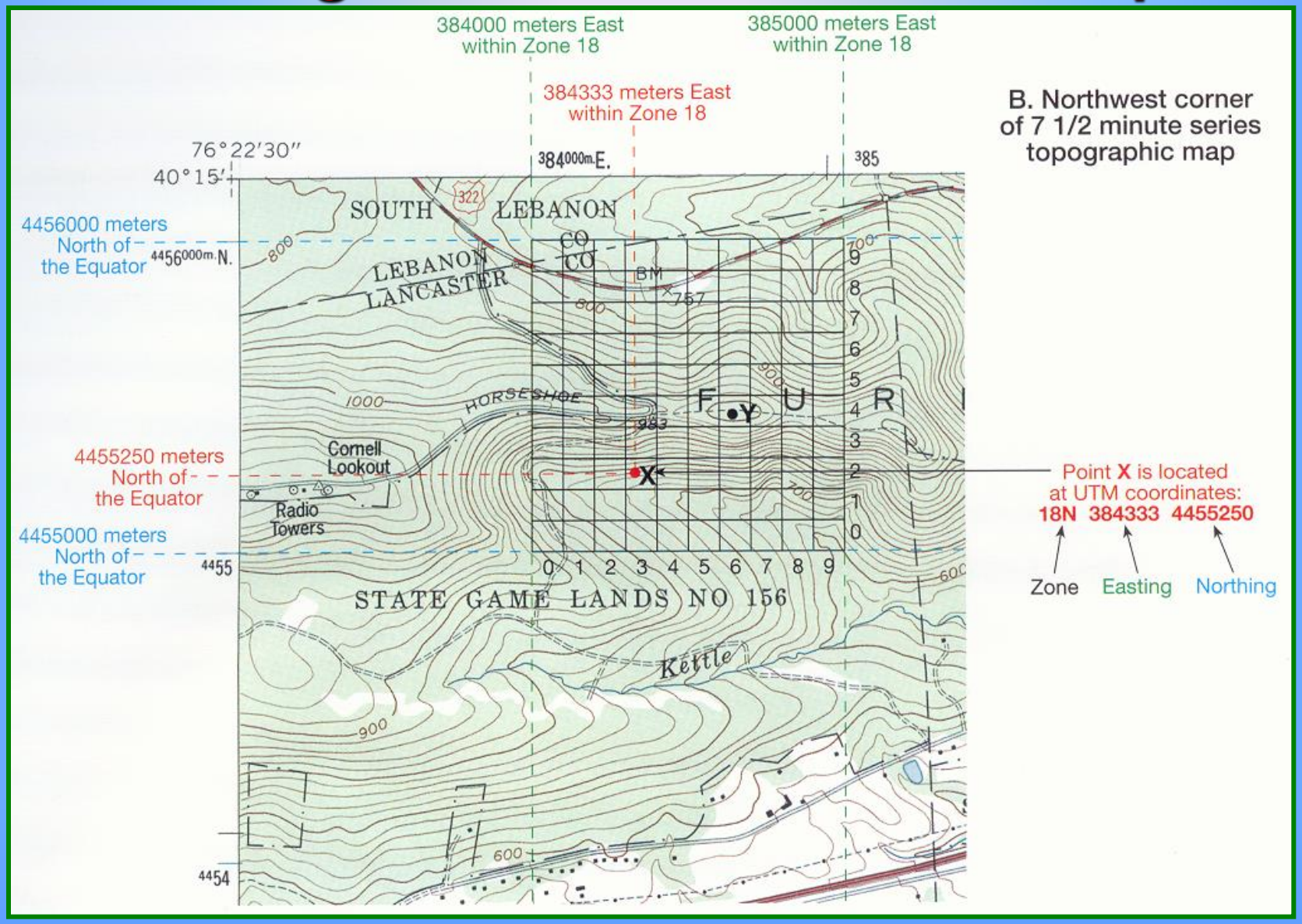
- **Easting Coordinate**
- Location of a point within a zone
- Measured from west to east in meters
- Tick for **eastings** written on maps are printed in **green**.



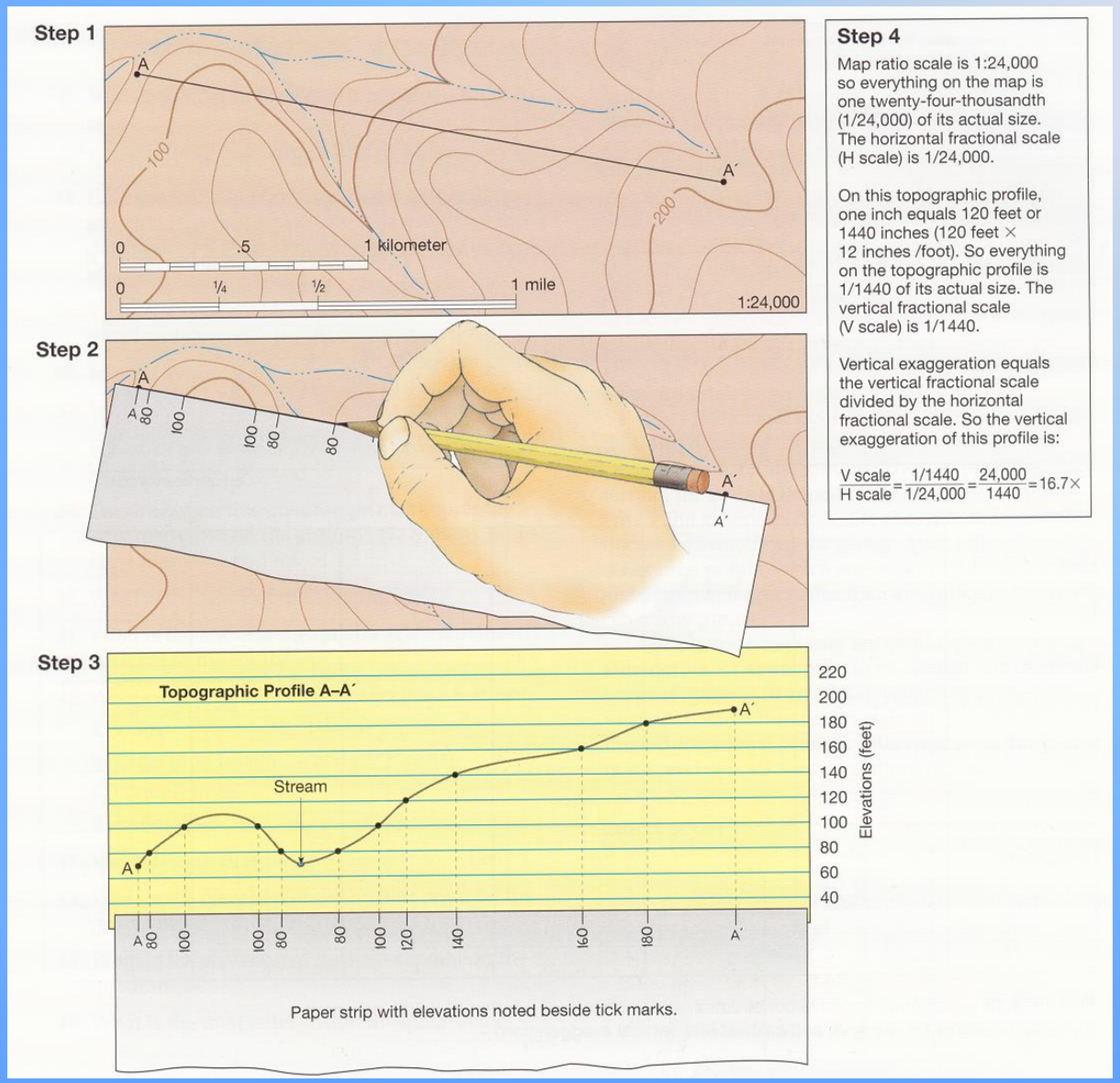
Reading UTM Coordinates on Maps



Reading UTM Coordinates on Maps



Construction of a Profile and Vertical Exaggeration



- The End!

Lab 1-6 Topographic Maps

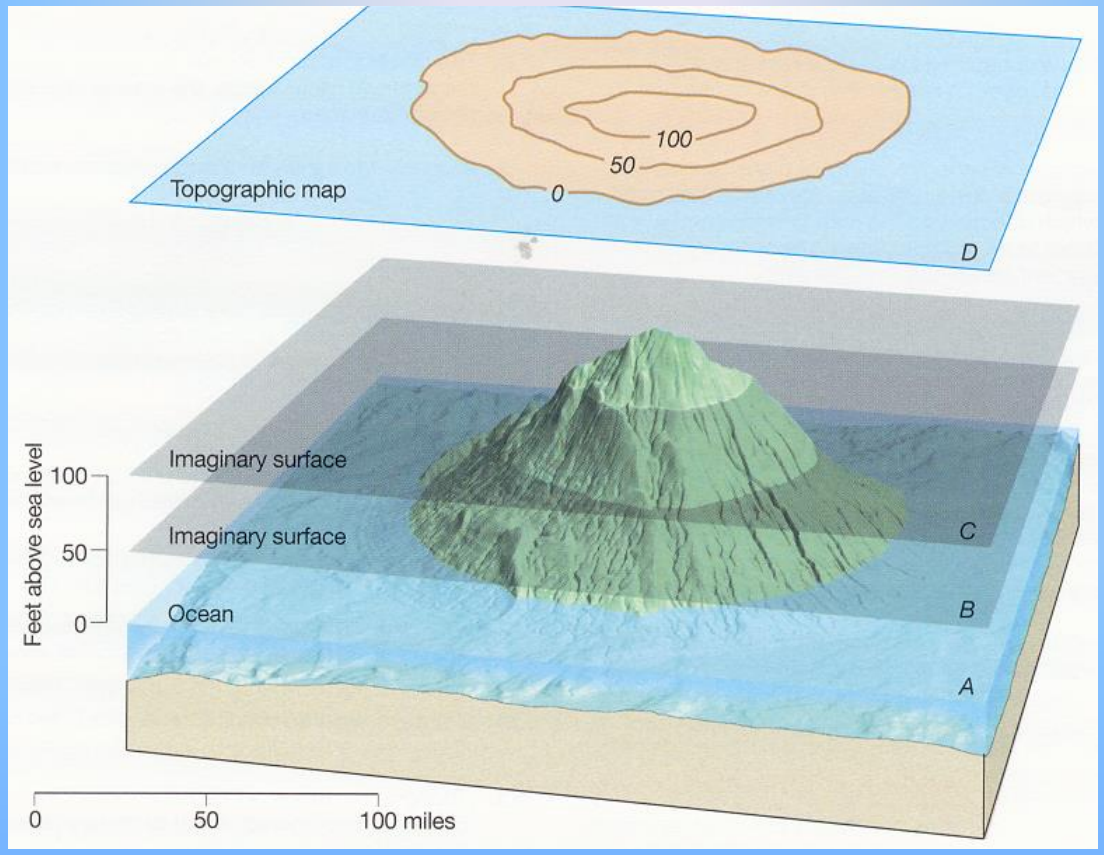
Get ready for the lab questions.

so lets review…

What did we talk about yesterday?

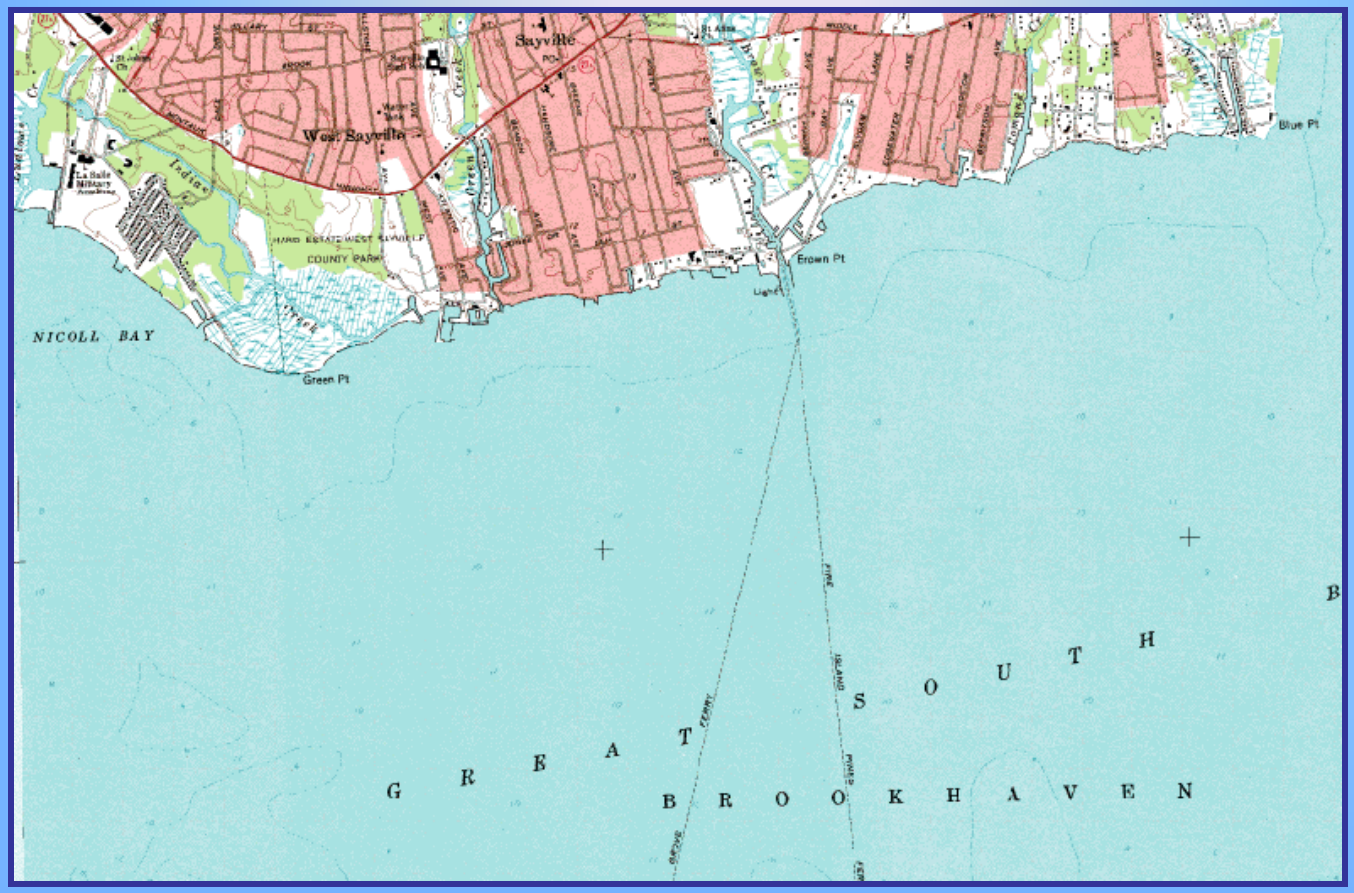
☺

II. Representing Elevation



A. Contour Lines
   1. Connect points of **equal elevation** with respect to **sea level**
   2. Represent **vertical** distance (altitude can also be used).
   3. Contour lines are plotted in **brown**.

3. Bathymetric contours



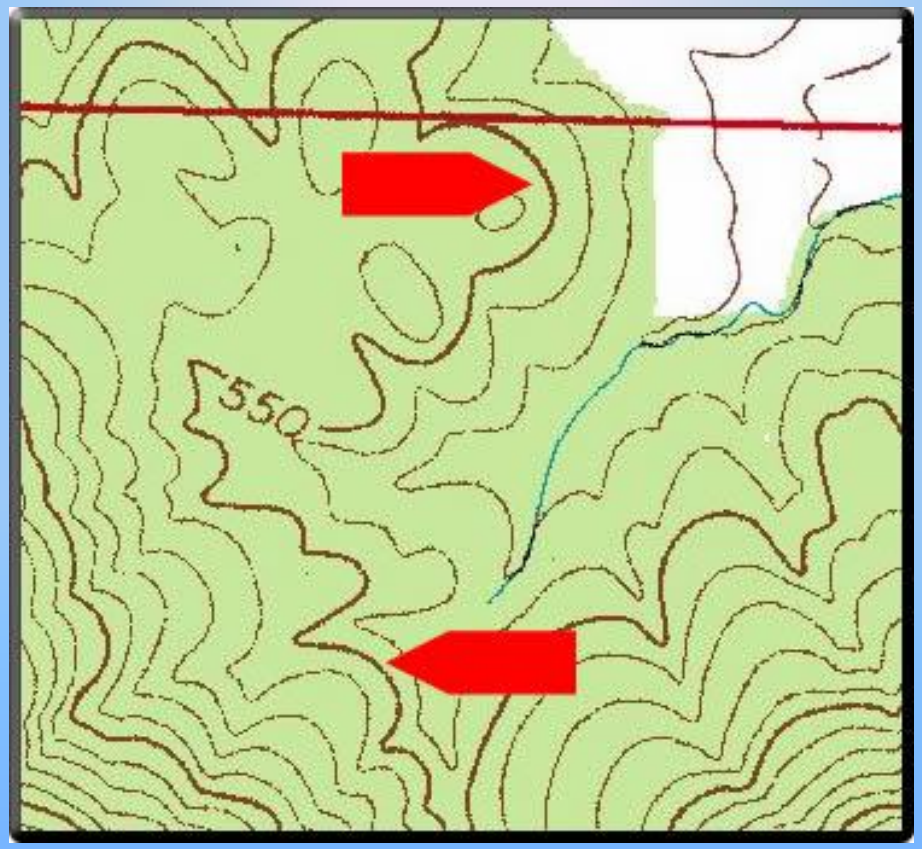
a. Show the shape and slope of the **ocean bottom** surface **(Depth !)**

b. Shown in **blue** **or** **black**, depending on their location.

Crater Lake

- Bathymetric contours are also used for lakes and other bodies of water.

4. Index Contours



a. _____ brown lines with elevations printed on them.

b. Usually every _____ line.

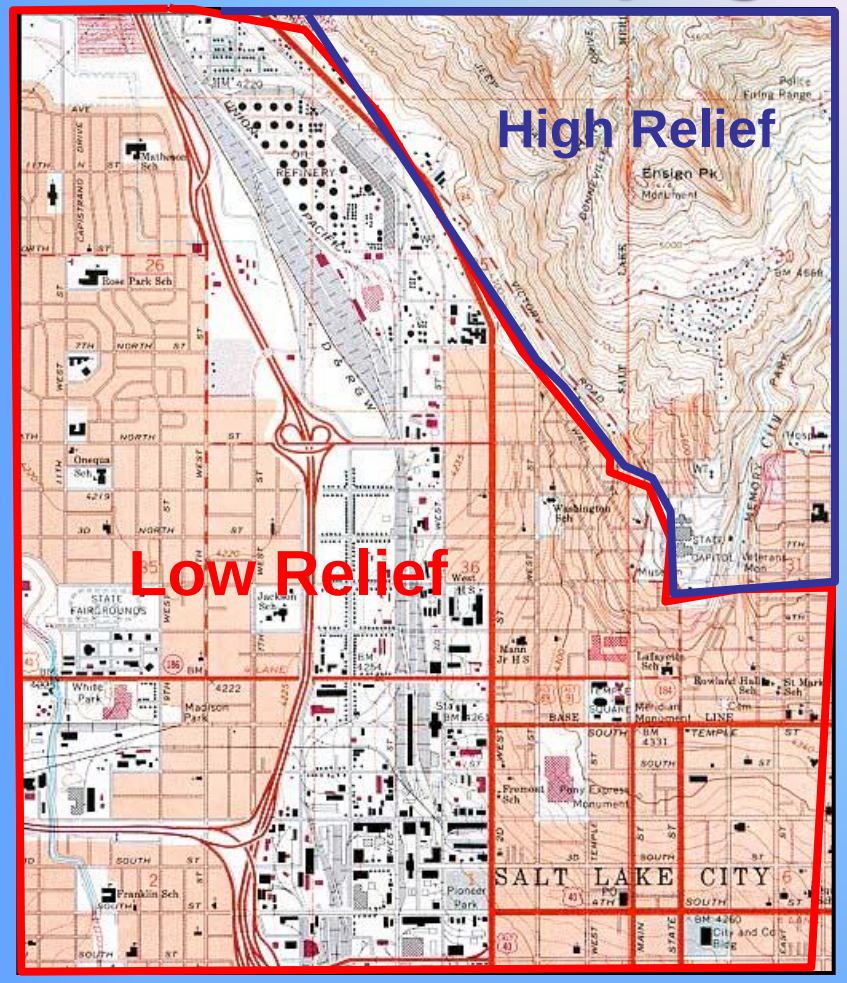
c. Not used if the map area has low _____.

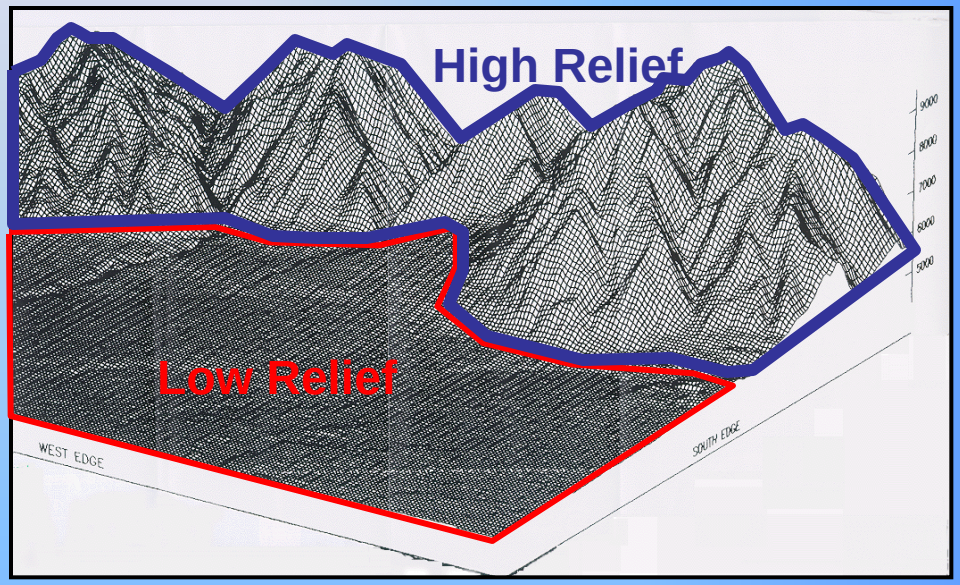
Dark

fifth

relief

Topographic Relief





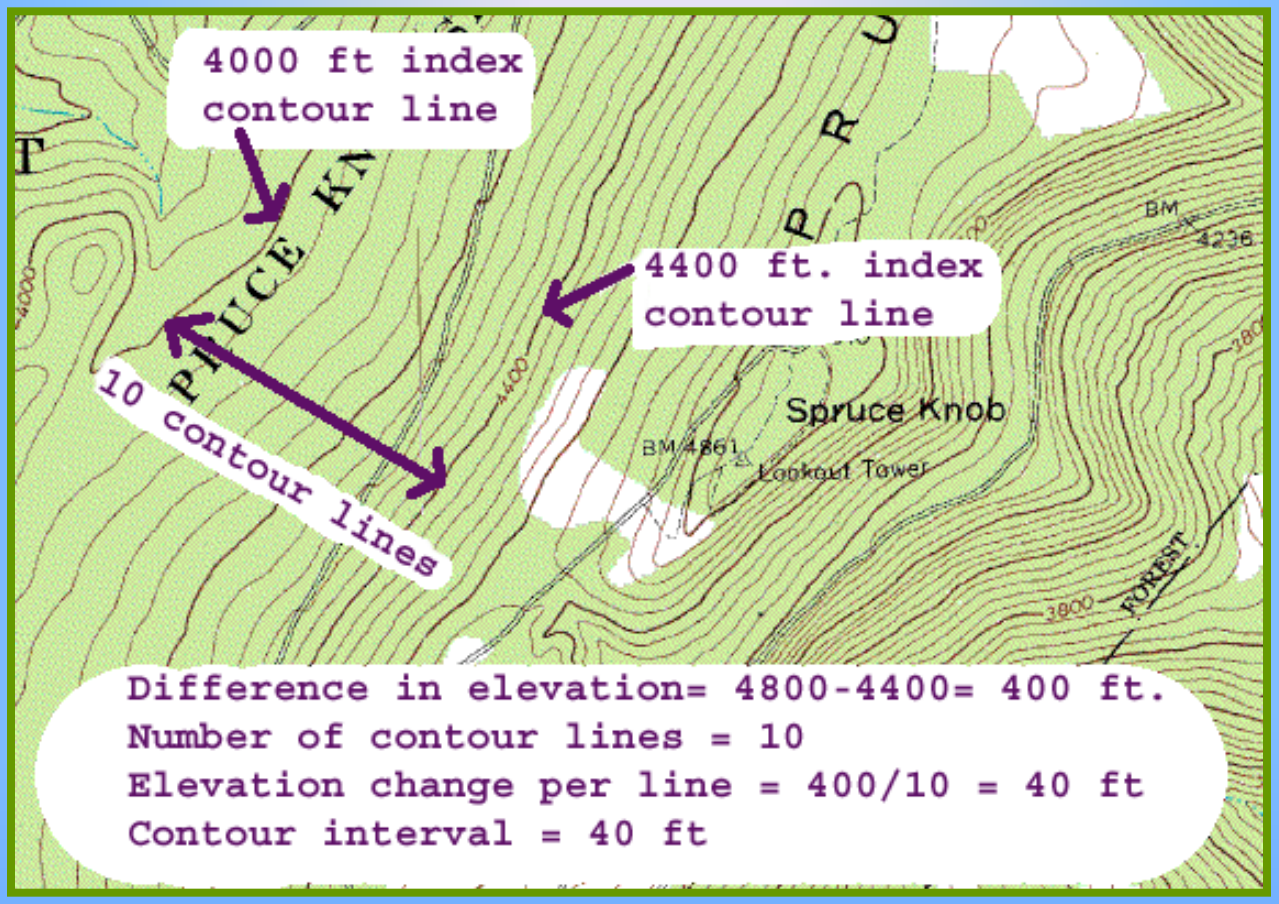
Digital Relief Map of Salt Lake City

(1) Relief is the difference between the **highest** and **lowest** elevation.

(2) A region with low relief will be relatively **flat**.

(3) In areas with low relief, few contour lines will be required and all will be labeled

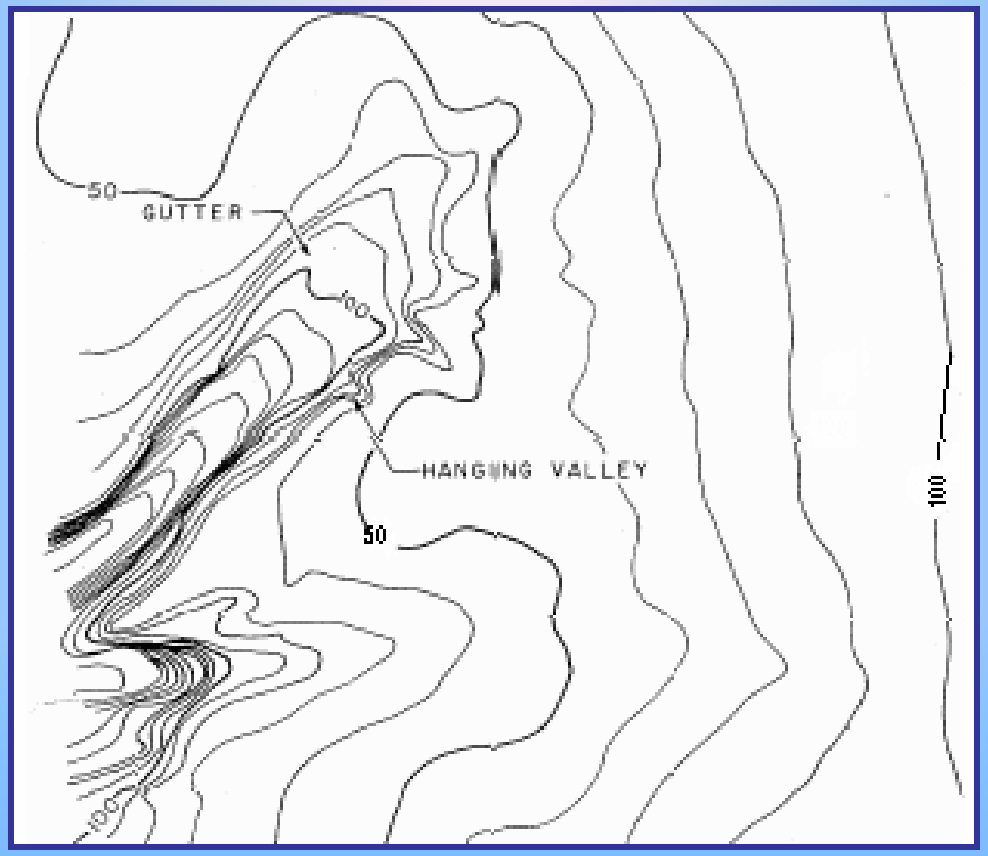
6. The Contour Interval



a. The difference in elevation between two **consecutive** contour lines.

b. Specified on the bottom margin of a map as either **feet** or **meters**.

Determine the Contour Interval



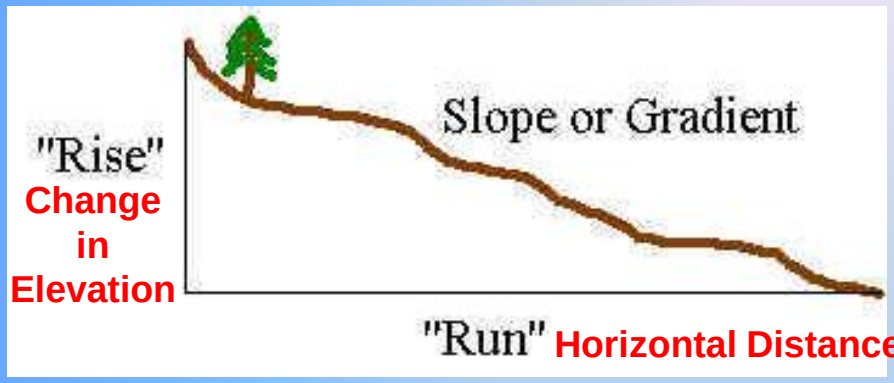
Elevations are in meters

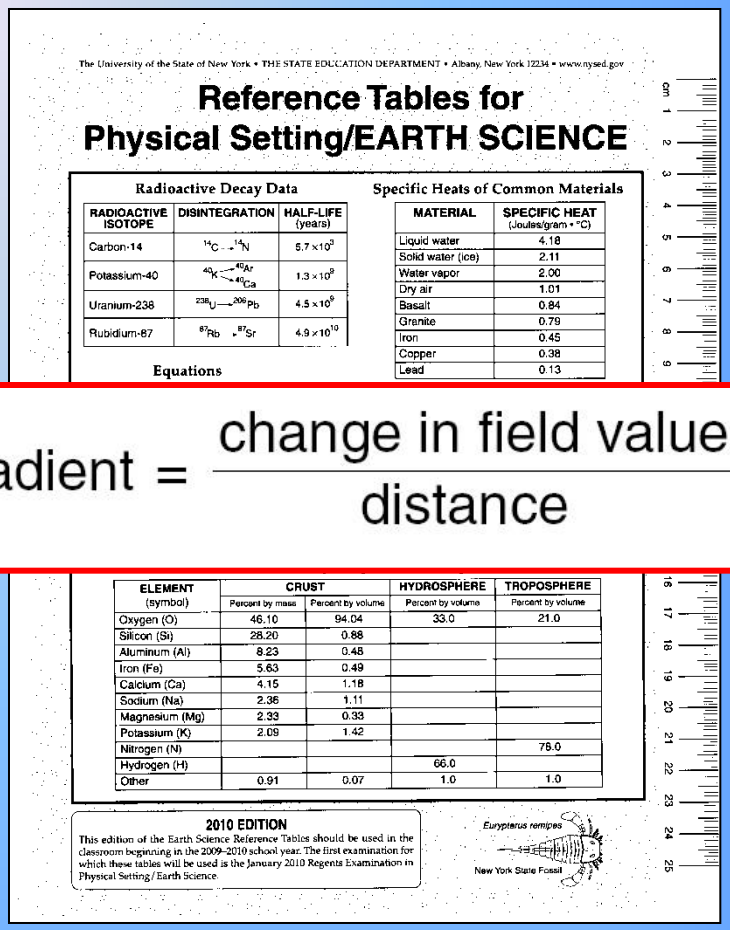
c. Maps use the smallest contour interval that will allow easy readability and provide as much detail as possible.

(2) **Large** intervals are used if there is a high relief.

(3) **Small** intervals are used for low relief.

d. Gradient (Slope)




The University of the State of New York • THE STATE EDUCATION DEPARTMENT • Albany, New York 12234 • www.nysed.gov

Reference Tables for Physical Setting/EARTH SCIENCE

Radioactive Decay Data

RADIOACTIVE ISOTOPE	DISINTEGRATION	HALF-LIFE (years)
Carbon-14	$^{14}C \rightarrow {}^{14}N$	5.7×10^3
Potassium-40	$^{40}K \rightarrow {}^{40}Ar$, $^{40}K \rightarrow {}^{40}Ca$	1.3×10^9
Uranium-238	$^{238}U \rightarrow {}^{206}Pb$	4.5×10^9
Rubidium-87	$^{87}Rb \rightarrow {}^{87}Sr$	4.9×10^{10}

Specific Heats of Common Materials

MATERIAL	SPECIFIC HEAT (Joules/gram • °C)
Liquid water	4.18
Solid water (ice)	2.11
Water vapor	2.00
Dry air	1.01
Basalt	0.84
Granite	0.79
Iron	0.45
Copper	0.38
Lead	0.13

Equations

ELEMENT (symbol)	CRUST Percent by mass	CRUST Percent by volume	HYDROSPHERE Percent by volume	TROPOSPHERE Percent by volume
Oxygen (O)	46.10	94.04	33.0	21.0
Silicon (Si)	28.20	0.88		
Aluminum (Al)	8.23	0.48		
Iron (Fe)	5.63	0.49		
Calcium (Ca)	4.15	1.18		
Sodium (Na)	2.36	1.11		
Magnesium (Mg)	2.33	0.33		
Potassium (K)	2.09	1.42		
Nitrogen (N)				78.0
Hydrogen (H)			66.0	
Other	0.91	0.07	1.0	1.0

2010 EDITION

This edition of the Earth Science Reference Tables should be used in the classroom beginning in the 2009–2010 school year. The first examination for which these tables will be used is the January 2010 Regents Examination in Physical Setting / Earth Science.

Eurypterus remipes

New York State Fossil

Change in field value = Change in elevation

Distance = Horizontal distance

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

Gradient is sometimes called:
Rise* over *Run

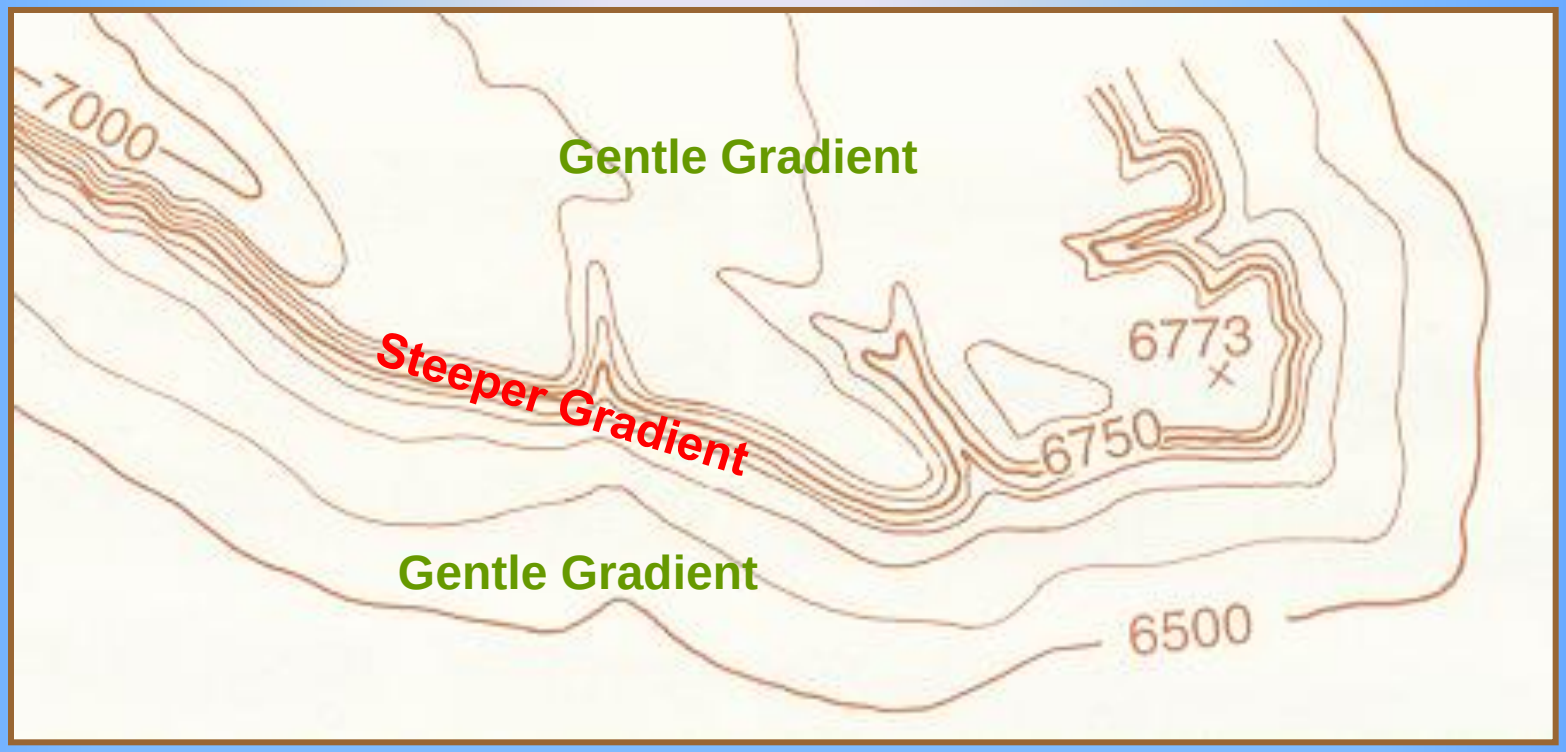
(1) Gradient is a measure of the **steepness** of a slope.

(2) Gradient is determined by finding the **change in elevation** over a **horizontal** distance. Expressed as:

(a) Feet per mile

(b) Meters per kilometer (for metric maps)

Gradient

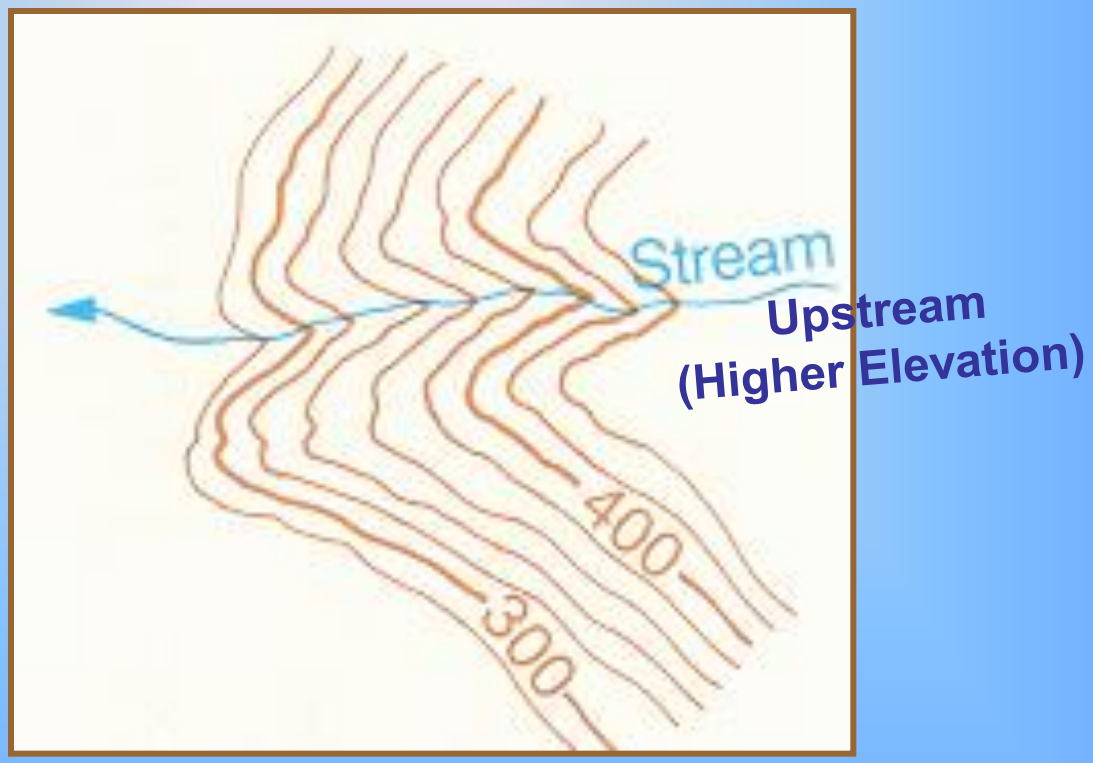


(3) Can be inferred by the **spacing** of the contour lines.

(a) A steeper gradient will be shown by **closely spaced** contour lines.

(b) The more gentle the gradient, the **farther apart** the contour lines will be spaced.

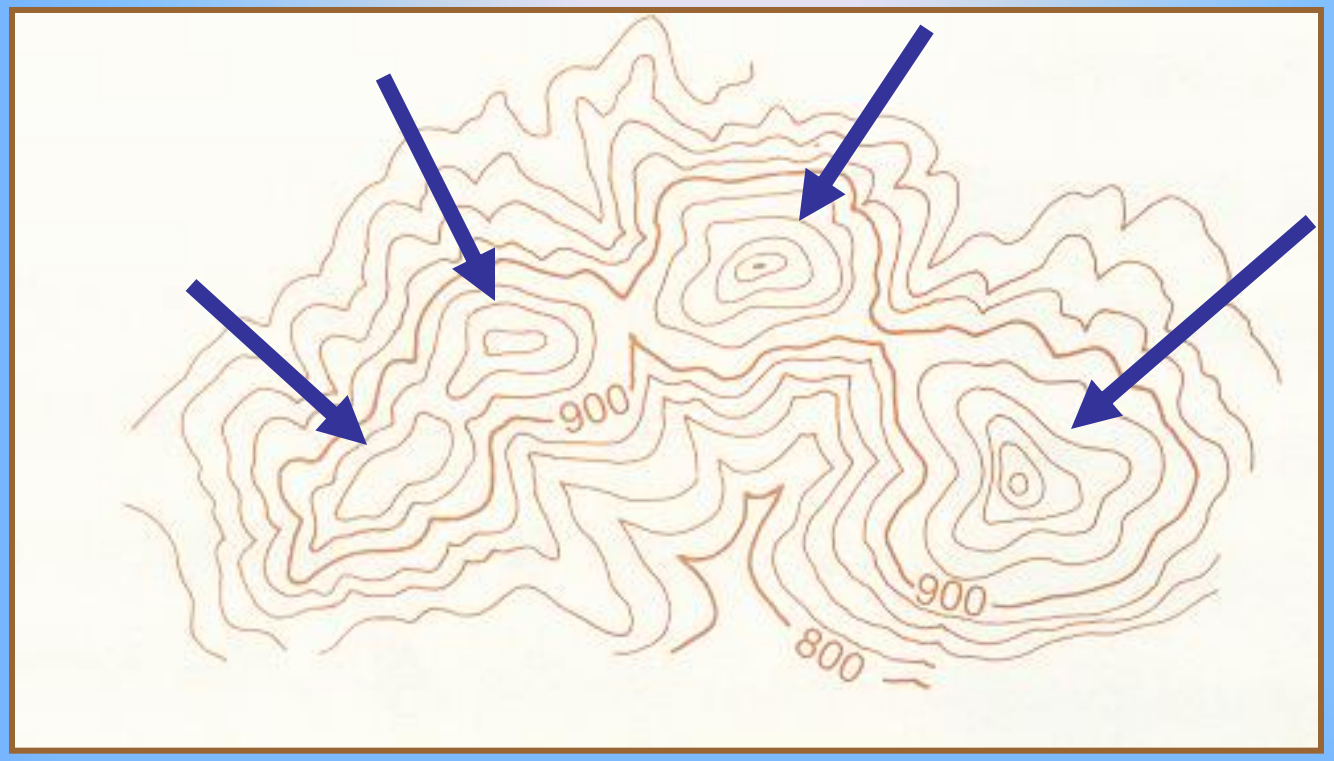
e. Stream Valleys



(1) Contour lines form a **V Pattern** when crossing a stream.

(2) The apex of the V always points **upstream** towards the **higher** elevation.

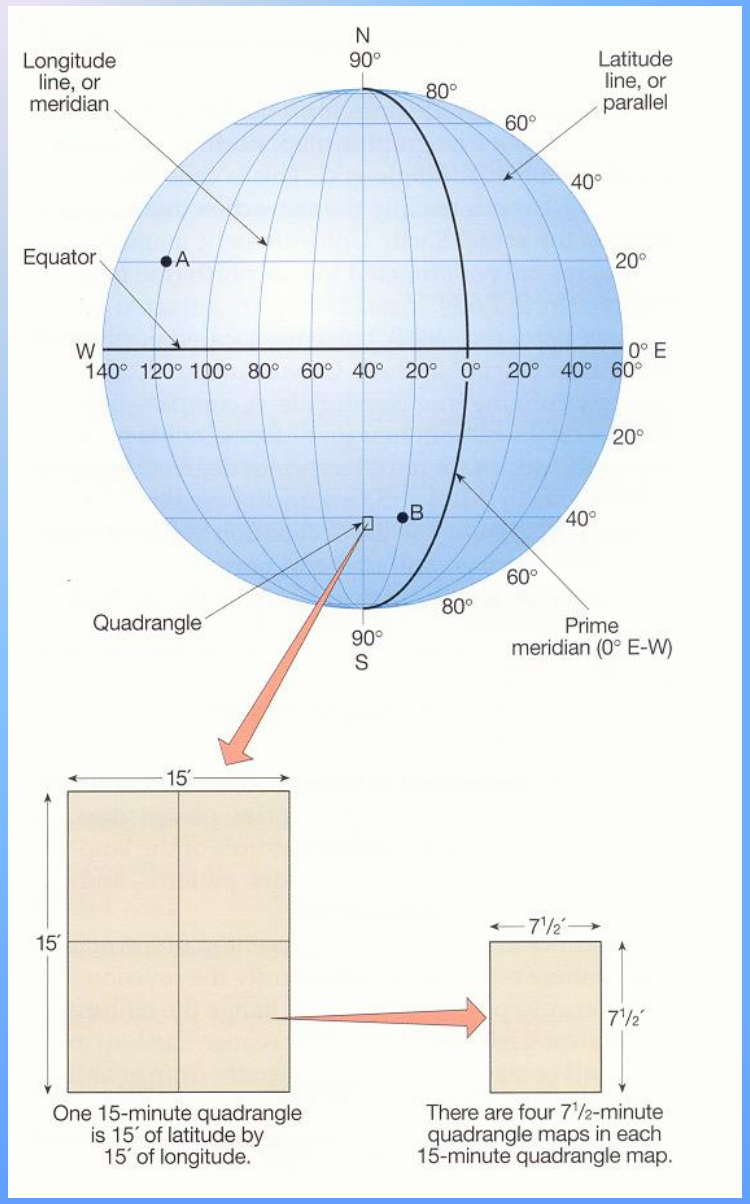
Hills



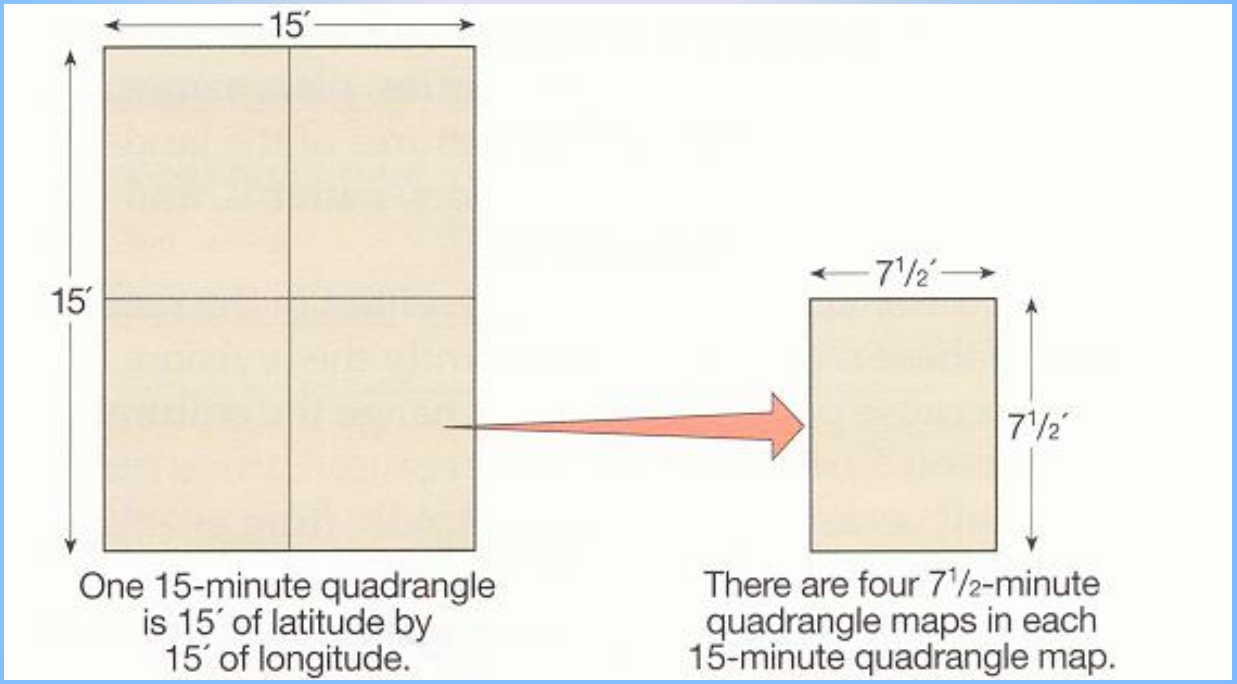
f. A concentric series of circular close contour lines represents a __hill__.

A. Quadrangles

1. Topographic maps **rectangles** whose borders are lines of **latitude** and **longitude**.
2. Because most maps cover **small areas** of Earth's surface whole degrees aren't used.
3. Maps are published in sizes using **minutes** and **seconds** of latitude and longitude.



b. Two Common Sizes



(1) 7 ½ minute quadrangle

(a) Covers __7.5 minutes__ (7' 30") of latitude and longitude.
(b) Most common map published by the United States Geologic Survey (USGS.)

(2) 15 minute quadrangle

(a) Covers __15 minutes__ (15' 00") of latitude and longitude.
(b) Covers __four__ times the area of a 7 ½ minute quadrangle.
(c) This size is no longer published by the USGS

3. The Direction to North

(a) North is always at the _top_ of the quadrangle grid

(b) Longitude lines (meridians) form the _east_ and _west_ borders of the map.

(c) They aren't parallel because meridians _converge_ toward the north.

(d) Grid North (_GN_)

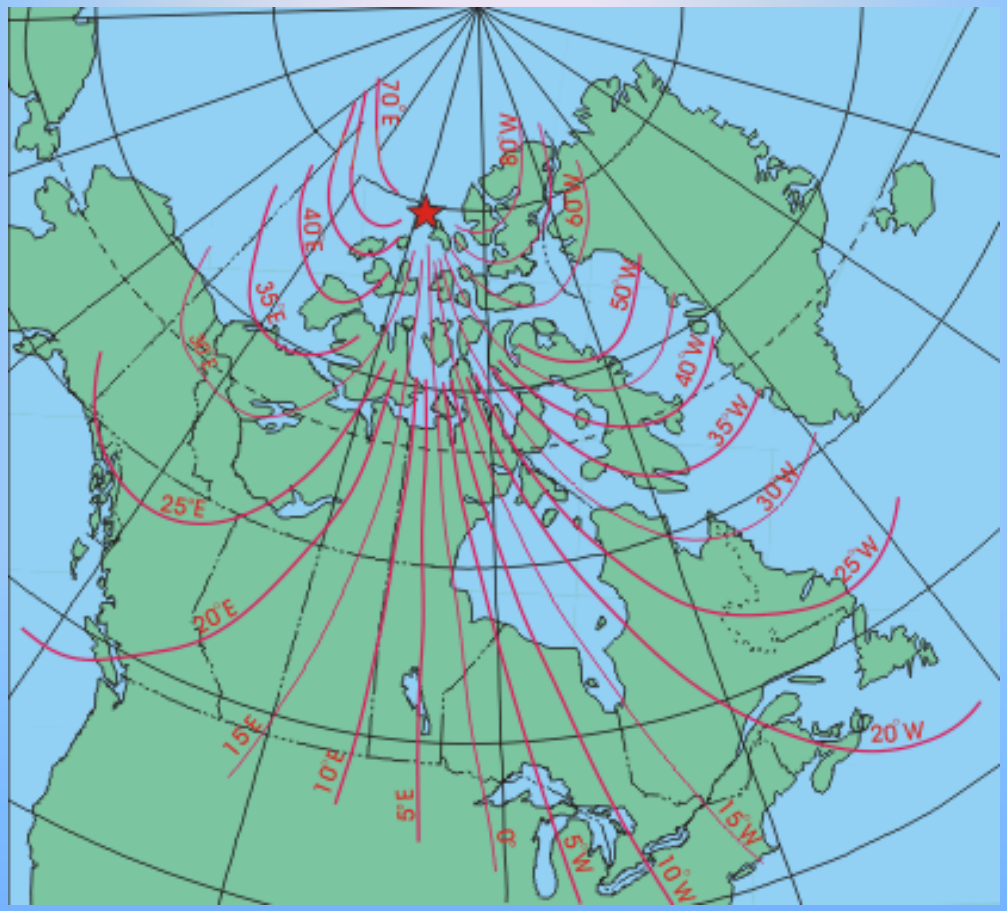
(1) At the top of the quadrangle grid.

(2) Based on a grid constructed on the map.

(3) About the same as true north (_geographic North Pole_) on the actual Earth

Note: The north and south borders of The map are parallels of latitude.

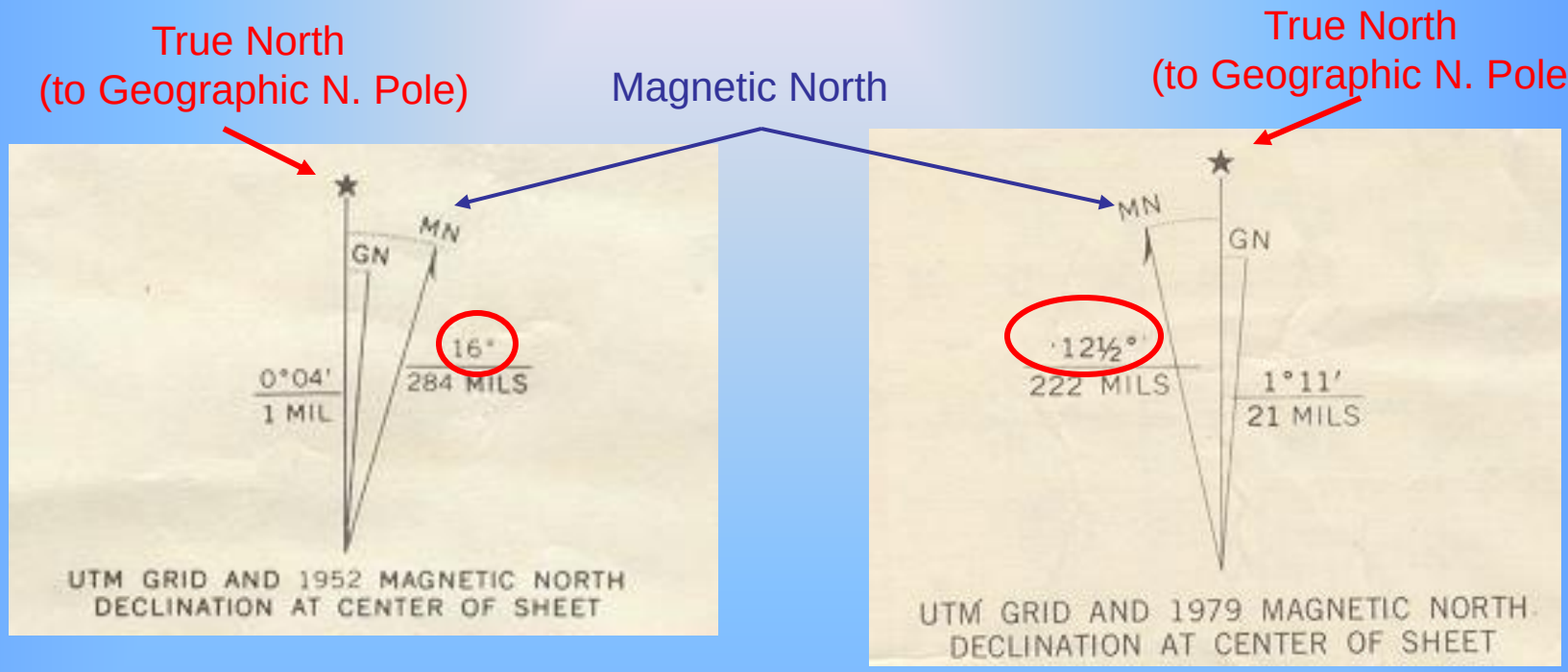
2. Magnetic Declination



a. The **difference in degrees** between **compass north** (MN) and **true north** (shown by a star).

b. Because magnetic north is continually changing, this is good only for the year of the map.

Finding Declination on a Map



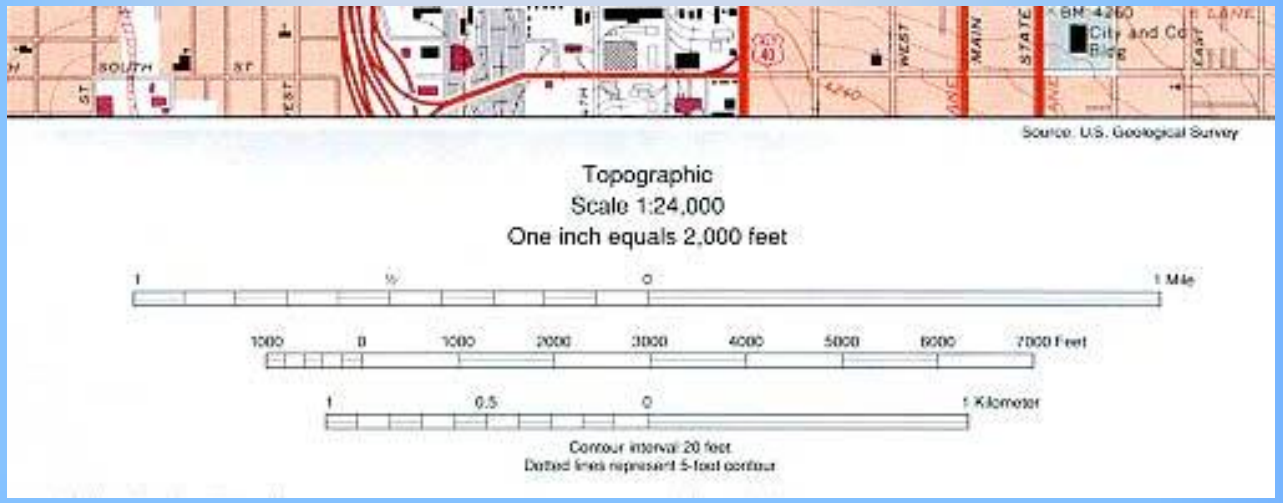
16 degrees East Declination

12 ½ West Declination

- Most maps use an angle symbol shown at the bottom of the map.
  - Use the number with only the degree symbol.
  - Ignore the other numbers. They were for military use.
- Some newer maps simply state the value.

IV. Map Scale

A. What is meant by scale?



1. Maps are **scale models**.
2. Scale is the **proportion** by which the real distance has been reduced.
3. All scales are shown on the bottom of the map

B. Ratio Scale

1. Expresses how much a certain distance on the map equals on the *real* Earth.
2. Units are in inches (centimeters if the contour lines are in meters).
3. Samples
   (a) 1:24,000
      (1) One inch on the map represents **24,000 inches** in *real distance* on Earth's surface.
      (2) Used on 7 ½ minute quadrangle maps
   (b) 1:62,000
      (1) Once inch on the map represents **62,000 inches** in *real distance* on Earth's surface.
      (2) Used on 15 minute quadrangle maps.
   (c) 1:100,000
      (1) One centimeter on the map represents **100,000 cm** (1 km) in *real distance* on Earth's surface.
      (2) Used on metric maps.

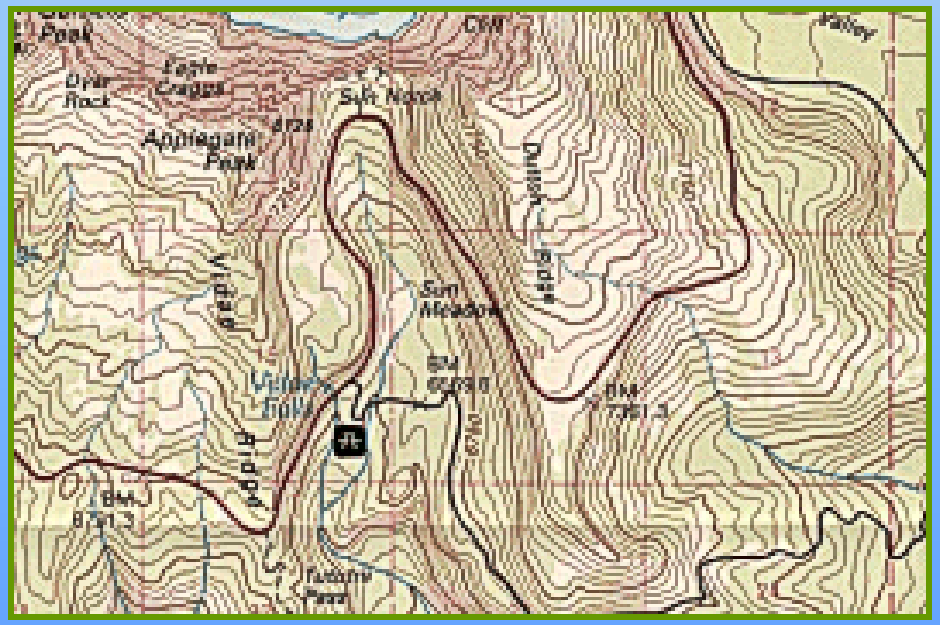
V. Map Symbols and the Use of Color page A17 Lab Book

A. Features and Symbols

1. Shown as points, lines, or areas, depending on their size and extent.
2. Individual houses may be shown as small black squares. For larger buildings, the actual shapes are mapped.
3. In densely built-up areas, most individual buildings are omitted and an area tint is shown. On some maps, post offices, churches, city halls, and other landmark buildings are shown within the tinted area.
4. Various point symbols are used to depict features such as buildings, campgrounds, springs, water tanks, mines, survey control points, and wells. Names of places and features are shown in a color corresponding to the type of feature. Many features are identified by labels, such as "Substation" or "Golf Course".

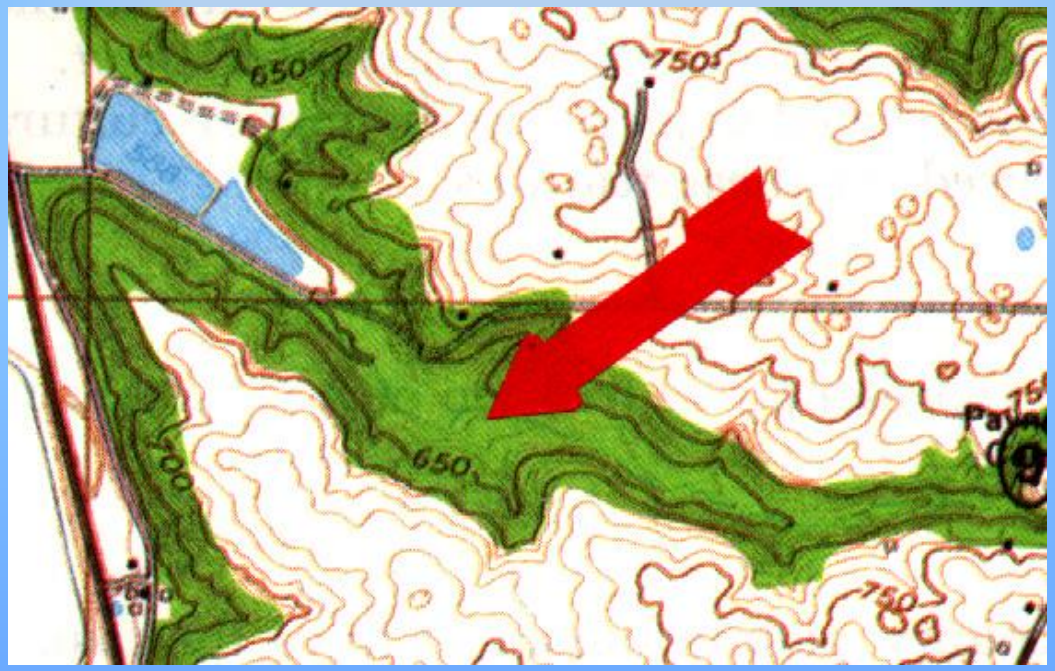
B. Color

1. The used colors usually indicate similar classes of information.
2. Colors used:
   a. **Brown**: Contour lines



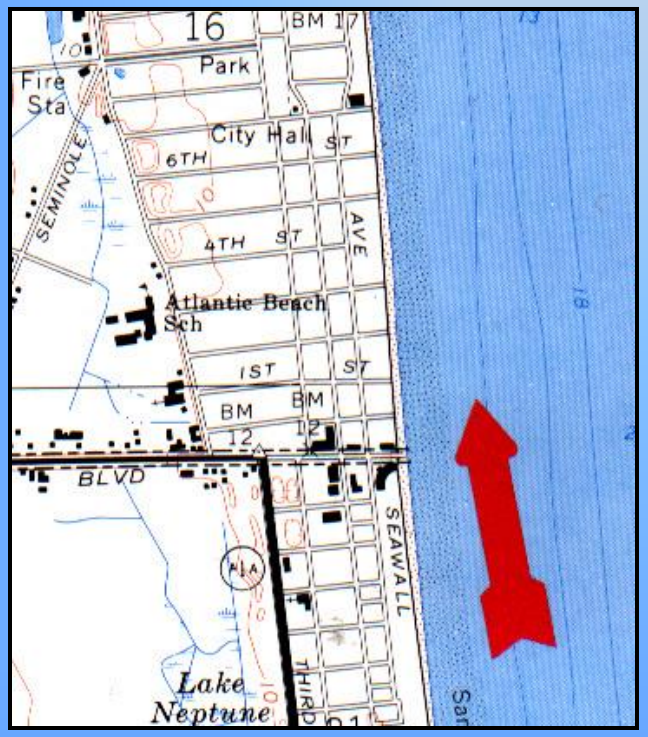
Use of Color on Topographic Maps

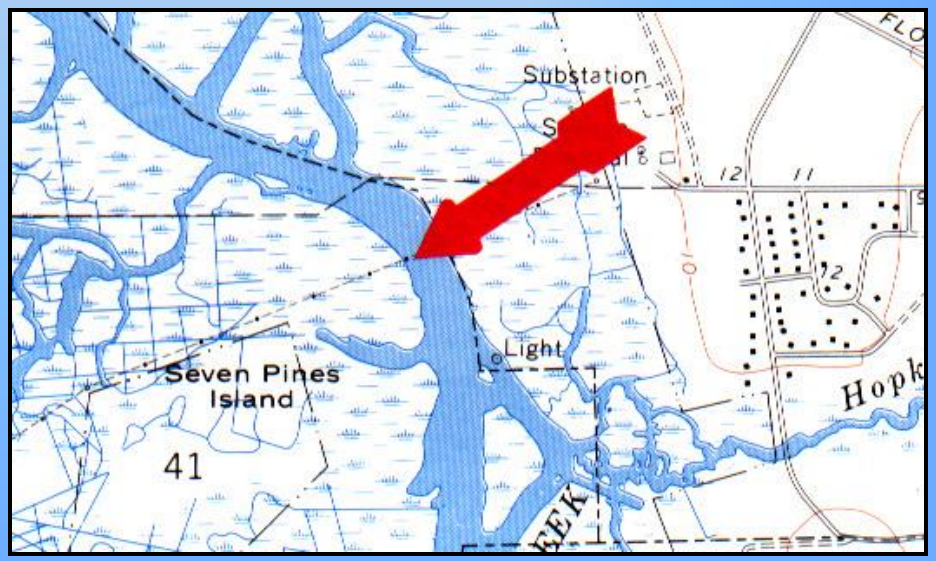
b. **Green**: Vegetation (e.g., woods, orchards, and vineyards)



Use of Color on Topographic Maps

c. **Blue** : Water features such as lakes, swamps, rivers, and drainage





Blue is also used for the contours of a glacier (Ice is water.)

Use of Color on Topographic Maps

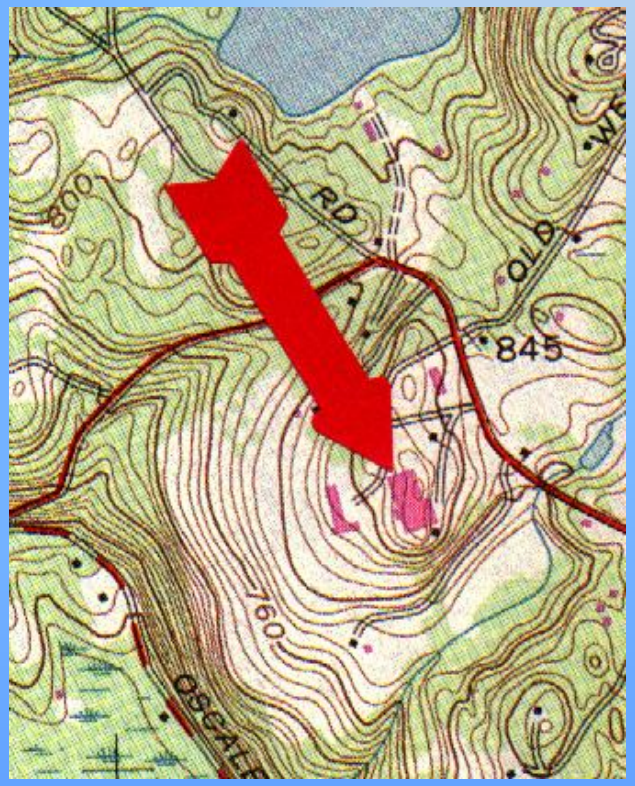
d. **Red**: Classifies cultural features ("man-made"), such as populated areas, main roads, and boundaries

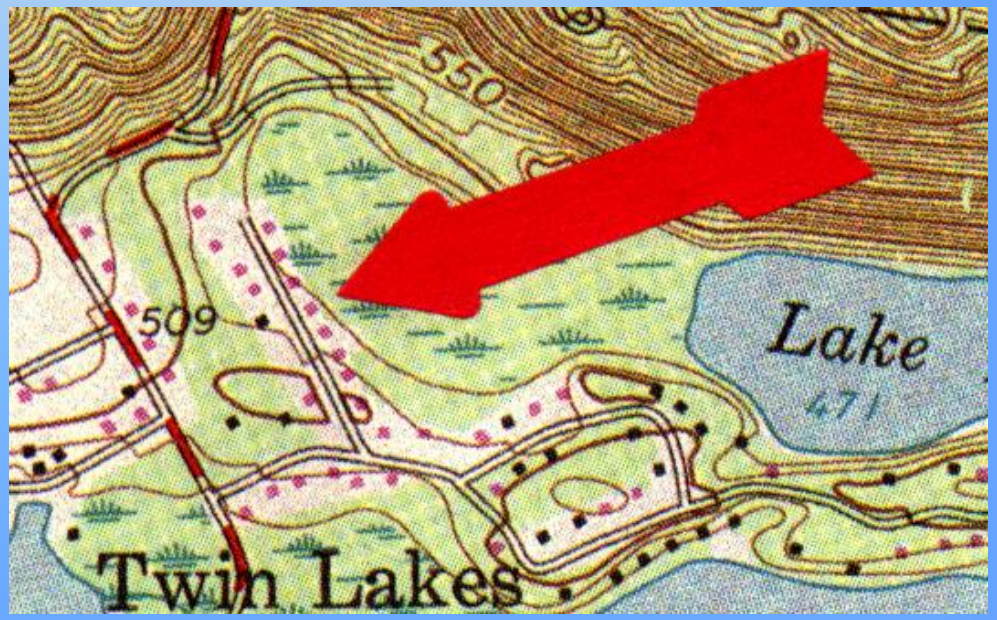
Use of Color on Topographic Maps

e. **Black** Cultural features (e.g., buildings, roads, railroads, mines, towers, etc.)

Use of Color on Topographic Maps

f. **Purple**: At one time, purple was used as a revision color to show all feature changes. Currently, purple is not used in the USGS revision program, but purple features are still present on many existing maps.





- **Start Lab 1-6**