EARTH SCIENCE

UNIT 8 -NOTES

WATER & CLIMATE

YOUR PLANET

YOUR INHERITANCE

YOUR LEGACY

UPDATED AND ADAPTED FROM DAVID J. MILLS 2001

GROUND WATER

I. Fresh Water & Water Budgets

A. The Earth has about **1.3 billion km^3** of water!

B. Distribution of Earth's water:

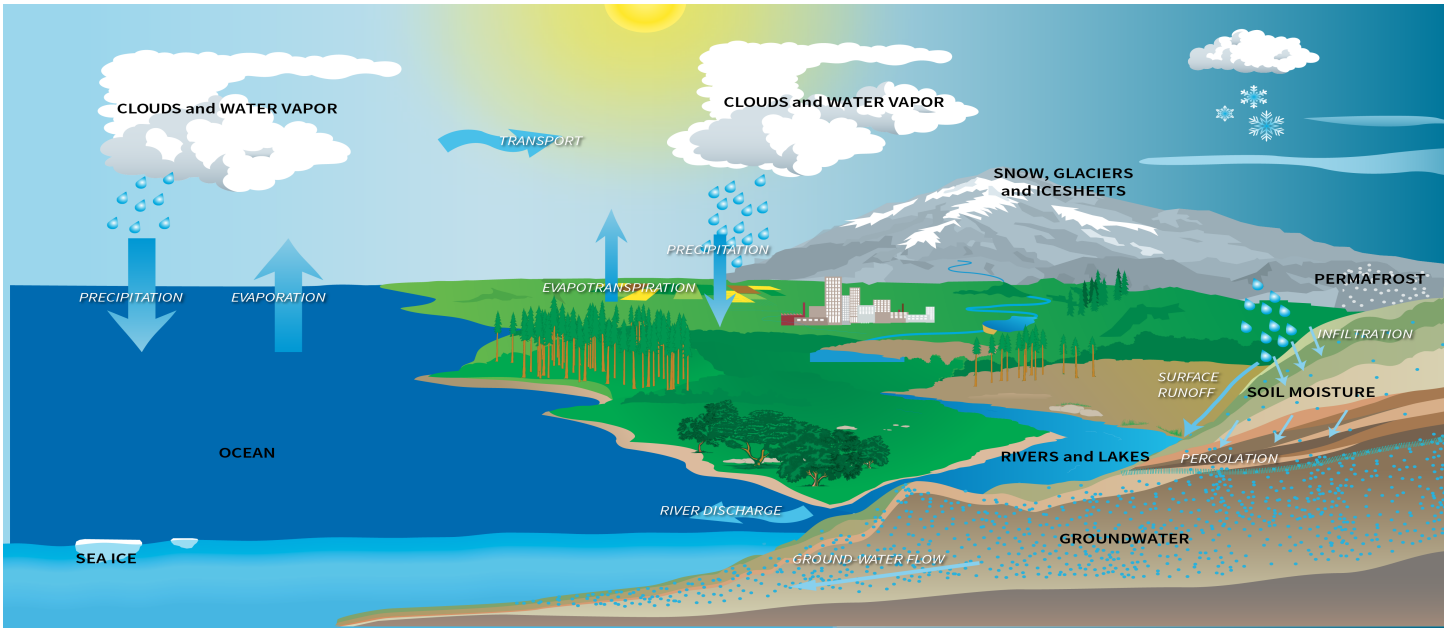
- **97%** is in the oceans as salt water
- **2%** is frozen fresh water at the Earth's poles
- **1%** is useable fresh water (98% of that is **UNDERGROUND**)

C. All the water at the Earth's surface makes up the **HYDROSPHERE**.

D. The water is constantly in motion in the hydrosphere. This movement can be traced by the **WATER CYCLE**.

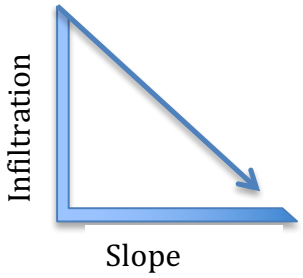
1. Important definitions to know:
   a. **CONDENSATION** - water releases energy as it goes from a gas to a liquid.
   b. **EVAPORATION** - water absorbs energy as it goes from a liquid to a gas.
   c. **TRANSPIRATION** - water vapor released from the leaves of plants.
   d. **PRECIPITATION** - water falling to Earth from the atmosphere.
   e. **RUNOFF** - water that flows across Earth's surface.

   f. **INFILTRATION** – Water that soaks into earth's surface.

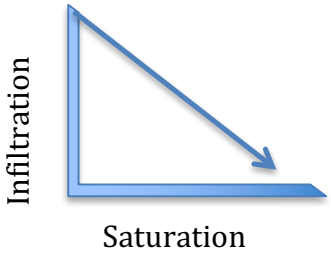


II. Water in the Ground

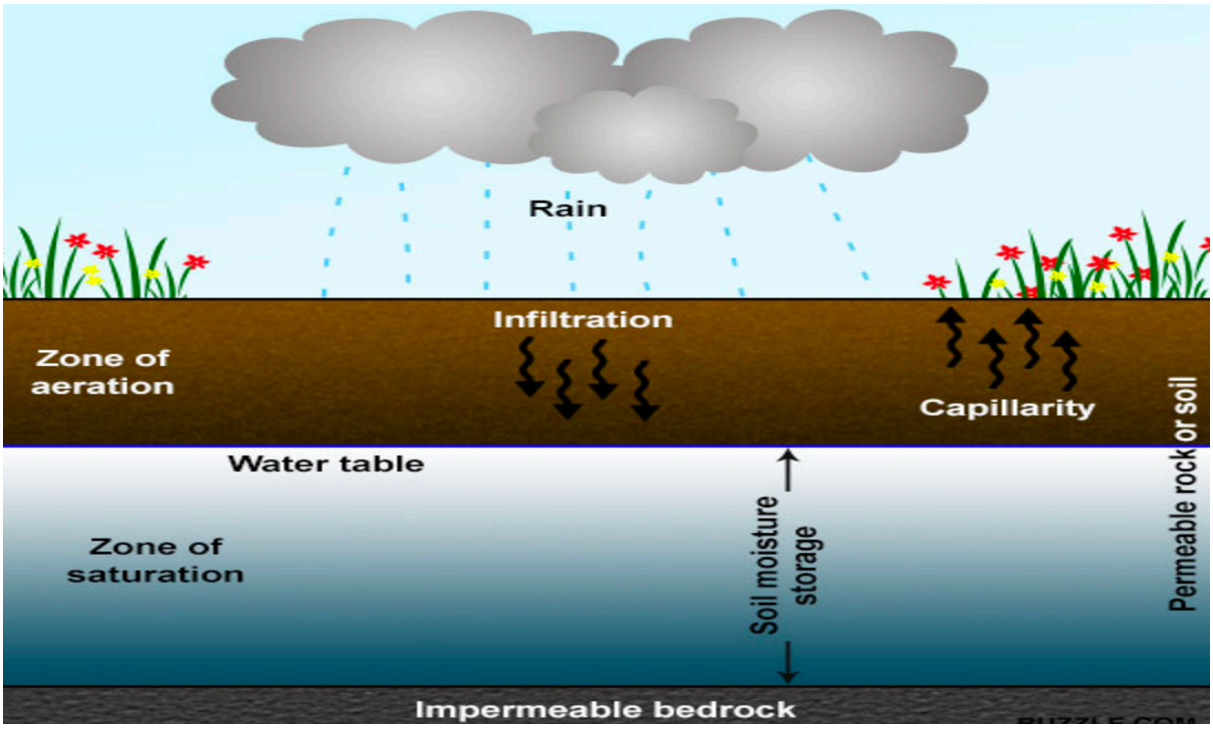
1. Infiltration depends on several variables:
   a. **SLOPE**: The **STEEPER** the slope (gradient), the **LESS** infiltration can occur.



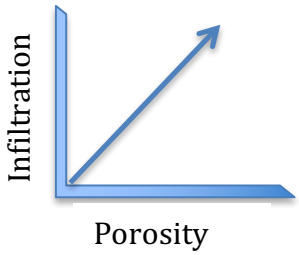
   b. **SATURATION:** How much water is already in the ground**.** The **GREATER** the saturation, the **LESS** infiltration can occur.



   c. **ZONE OF SATURATION** is the region in the ground in which **pore spaces** are filled with water.
   d. **WATER TABLE**: The interface between the zone of saturation and the zone of aeration.
   e. **INFILTRATION**: The downward movement of water through **pore spaces** of permeable rock or soil.



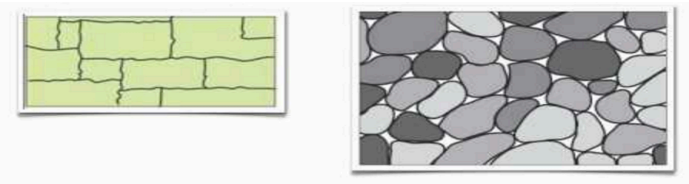
f. **POROSITY:** The percentage of open spaces between particles in a material compared to its total volume. The **GREATER** the porosity, the **MORE** infiltration can occur.



2. **Factors controlling porosity** –

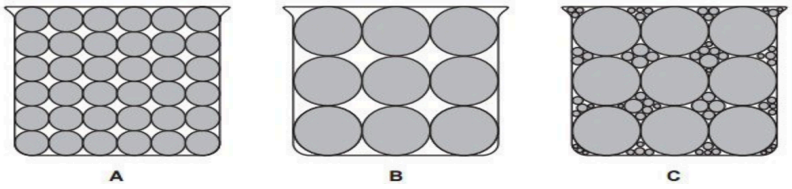
a. **PARTICLE SHAPE** –

- **Rounded particles** have **MORE** space between them, thus **MORE** porosity.
- **Angular fragments** fit into each other tighter, leaving **LESS** space for water, therefore **LESS** porosity.

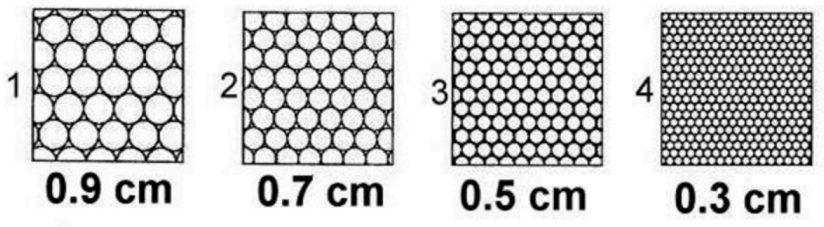


b. **SORTING** –

- **Well sorted** materials (uniform sizes) have **MORE** porosity.
- **Mixed size** materials have small rocks that fill in the pore spaces between larger particles leaving **LESS** porosity.

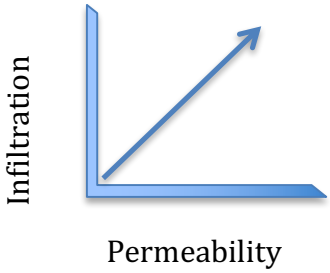


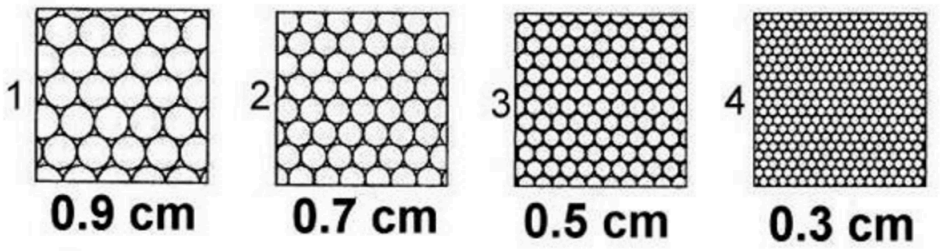
**** Porosity does not change between different samples of uniformly shape and size particles.**



(Which of the above materials has the greatest porosity? 1,2,3,4 or all the same?)

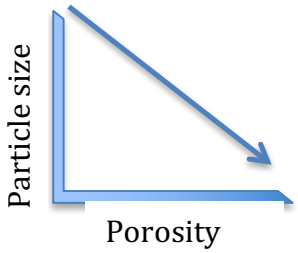
3. **PERMEABILITY**: The ability of materials to allow fluids such as water to pass through it. Rocks that do not allow water to pass through are said to be **IMPERMEABLE**. (clays). The **GREATER** the permeability, the **MORE** infiltration can occur.





(Which of the above materials has the greatest permeability? 1,2,3,4 or all the same?)

4. **CAPILLARITY**: The process by which water is drawn into openings and can rise due to the attractive force between water molecules and the surrounding earth materials. The **SMALLER** the opening in the earth materials, the **GREATER** the capillarity.



5. **VEGETATION**: The amount and type of vegetation in an area affects the amount of water that can infiltrate into the surface. The **GREATER** the vegetation, the **GREATER** infiltration will occur.

6. **LAND USE**: Roads, parking lots, and other areas covered in impermeable materials **PREVENT** infiltration and **INCREASE** runoff.

7. **RUNOFF**: Water that cannot infiltrate earth's surface due to low porosity, impermeable materials, and/or saturation, travels on the surface as runoff.

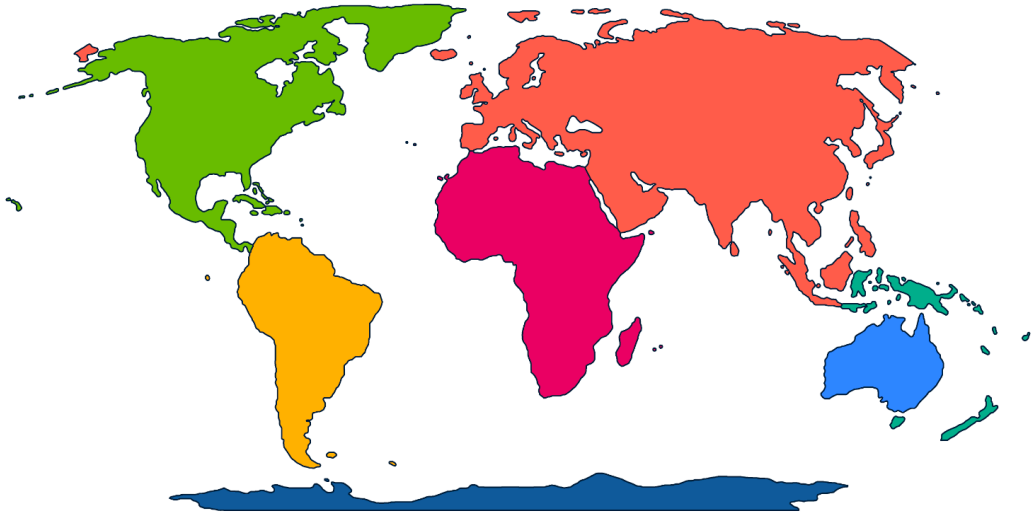
a. Runoff can occur when:

i. Rate of precipitation **EXCEEDS** rate of infiltration.
ii. **SATURATION** of pore spaces
iii. **SLOPE** of surface is too great to allow infiltration
iv. Water on the surface has not **EVAPORATED**.

b. Runoff causes surface **FLOODING** and increased **STREAM DISCHARGE**.

8. We can describe the income and use of water in a region. We use a **WATER BUDGET** to do this.

a. **RECHARGE** - moisture soaks into the soil and refills the aquifer. (fall, winter)
b. **SURPLUS** - When rainfall is greater than the need for moisture and the ground water supply is filled. (spring)
c. **USAGE** - Time when water need is greater than rainfall.
d. **DEFICIT** - Time when need is greater than rainfall and ground water storage is empty.



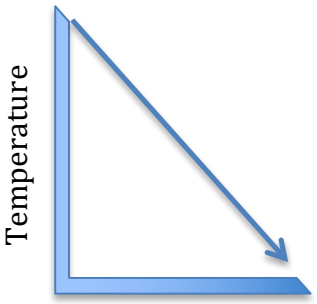
III. Climate: **LONG TERM WEATHER; COMPOSITE WEATHER; AVERAGE WEATHER**.

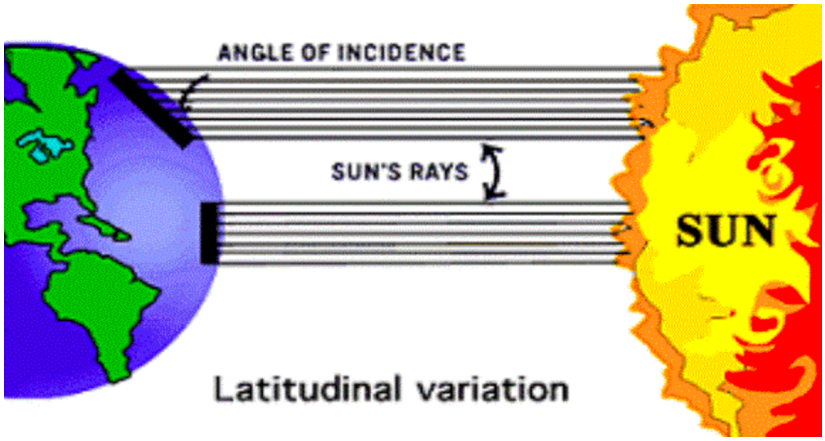
A. **TEMPERATURE FACTORS**:

1. **LATITUDE**:

A. **AVERAGE YEARLY TEMPERATURE**

a.

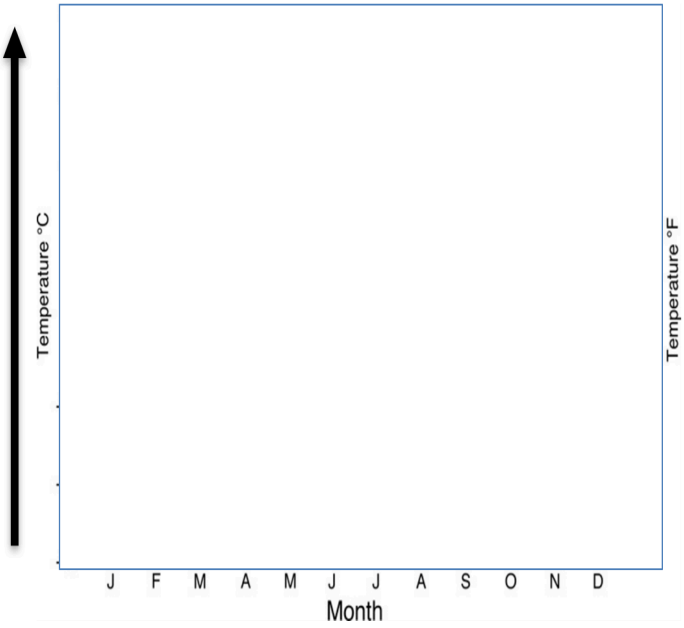




b. As latitude **INCREASES**, Average yearly temperature **DECREASES**.

Latitude

Latitude



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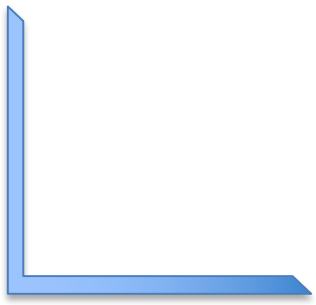
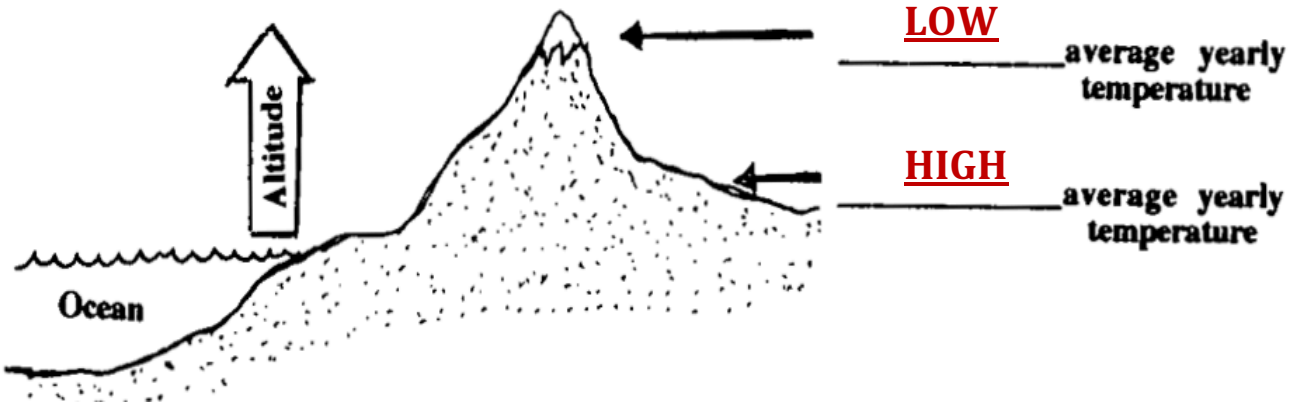


B. Average Yearly Temperature vs. Yearly Temperature Range

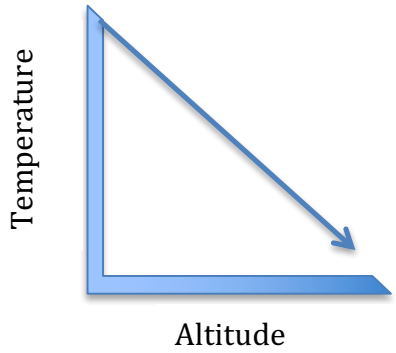
	Average Yearly Temperature	Yearly Temperature Range
Valdivia, Chile	53° F	16°F (from 46° to 62° F)
Peking , China	53° F	55°F (from 24° to 79° F)

2. ALTITUDE :

a.

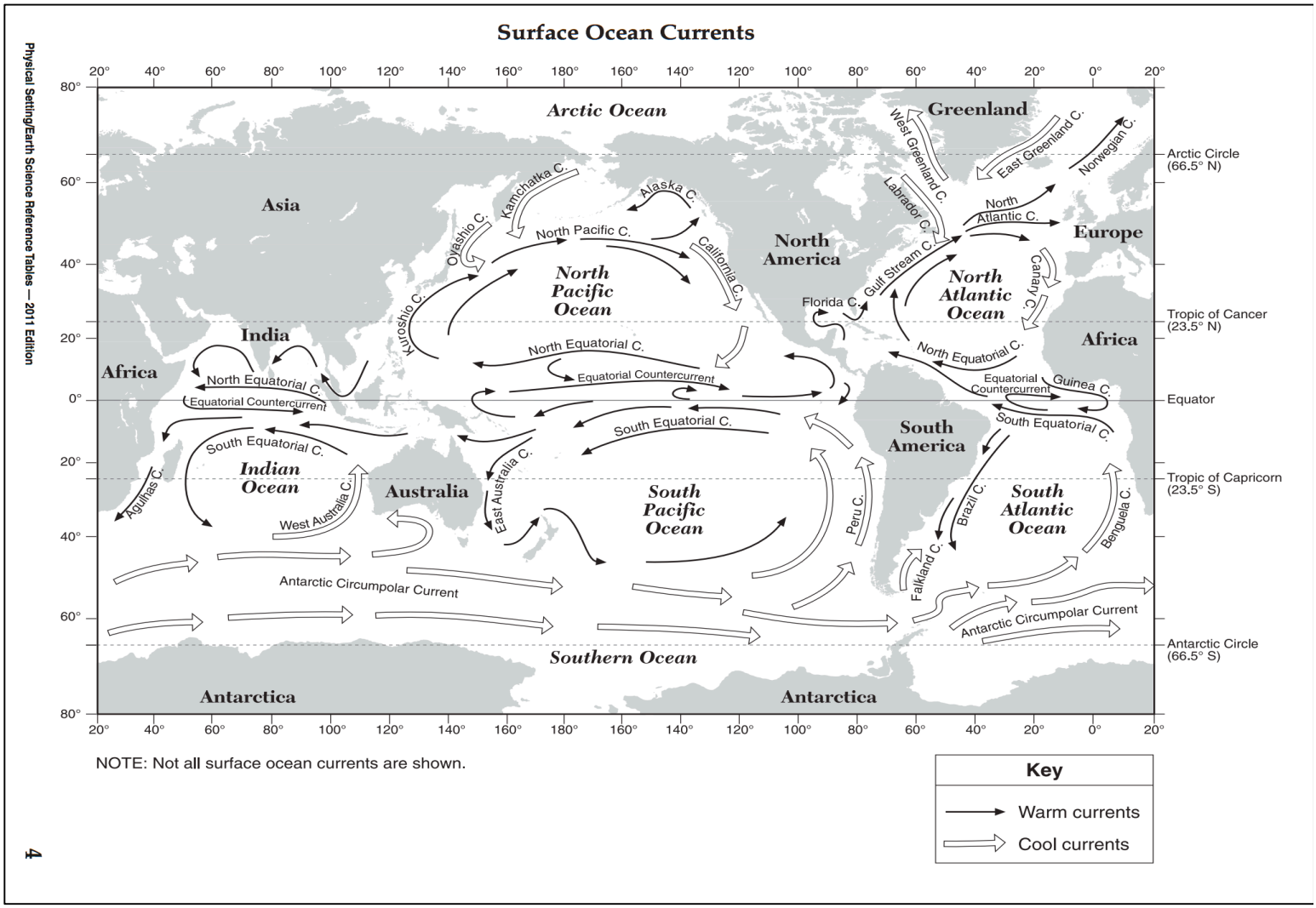


3. As altitude **INCREASES**, average yearly temperature **DECREASES**.



C. **OCEAN CURRENTS**

a. Ocean currents may make the climate of a coastal region **WARMER** or **COLDER** than normal for its latitude.



b. Warmer or Colder

Due to ocean currents, the

(1) East coast of North America is **WARMER** than normal.
(2) West coast of North America is **COOLER** than normal.
(3) East coast of South America is **WARMER** than normal.
(4) West coast of South America is **COOLER** than normal.
(5) West coast of Africa and Europe is **COOLER** than normal.'
(6) Northwestern Europe (Iceland, Great Britain, and Scandinavia) is **WARMER** than normal.

D. **MARINE vs. CONTINENTAL**

1. Sea or land locations affect temperature ranges. Since land gains and loses heat much more quickly than water. Land areas tend to have **WARMER** summers and **COOLER** winters. Coastal areas near the ocean have **COOLER** summers and **MILDER / WARMER** winters.

2. Coastal areas have marine climates with a **SMALL** yearly temperature range. Continental interior (land areas) have continental climates with a **LARGER** yearly temperature range.

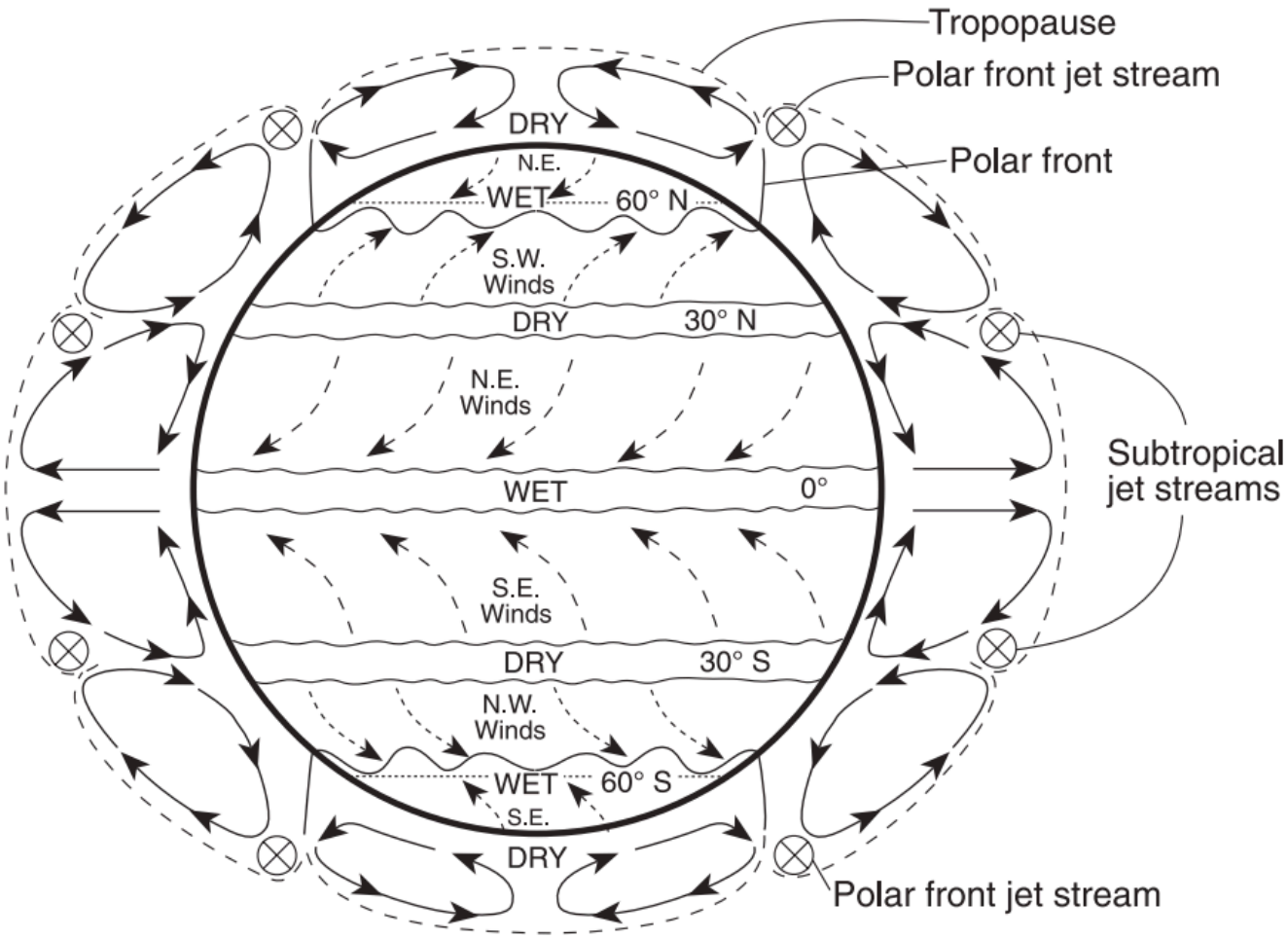
a. Location X: **CONTINENTAL** climate; **GREATER** yearly temperature range

b. Location Y: **MARINE** climate; **SMALLER** yearly temperature range

E. RAINFALL FACTORS:

1. Latitude

a. Uneven heating of the earth produces global wind belts and pressure belts. These pressure belts determine the wetness or dryness of a particular location. Low pressure regions occur where air is rising. As air rises, it expands, cools to the dew point temperature, and water vapor condenses creating clouds and precipitation. Thus, low pressure regions are areas of rainfall (wetness) and high pressure regions are areas that lack rainfall (dryness)

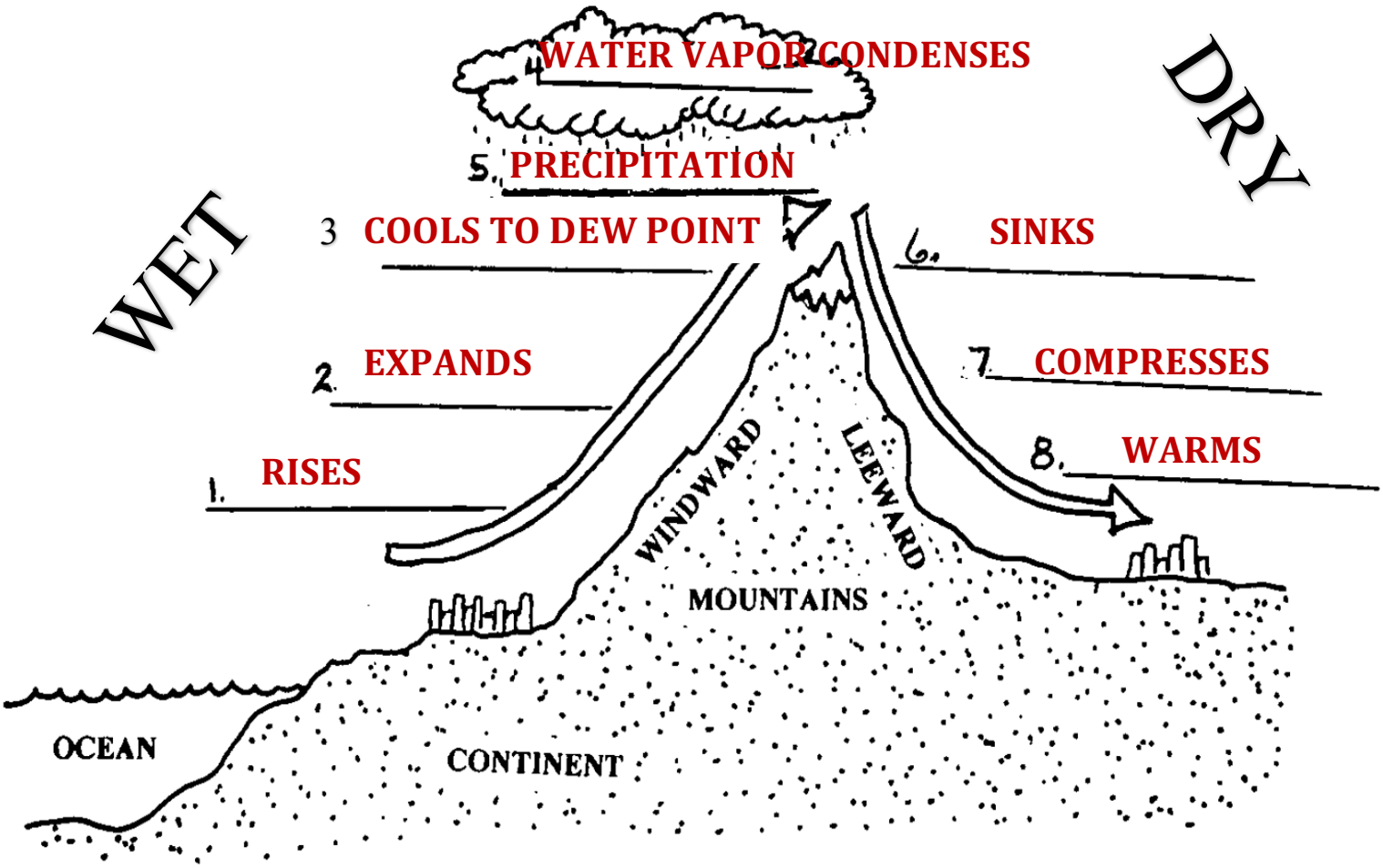


b. What latitudes are areas of rainfall / wetness? **0^0 (EQUATOR), 60^0 N, 60^0S**

c. What latitudes are areas that lack rainfall / dryness? **30^0 N, 30^0 S (Horse Latitudes), 90^0S, 90^0N**

F. MOUNTAINS: The Orographic Effect

a



b. Windward vs. leeward

(1) Rainfall occurs on the WINDWARD side of the mountain where air is RISING.

(2) It is dry on the LEEWARD side of the mountain where air is SINKING.

3. DISTANCE FROM THE SEA and PREVAILING WINDS

Nearness to the ocean is no guarantee of rainfall. Where prevailing winds blow from the ocean, the areas closest to the ocean generally receive more rain. Prevailing winds that blow from the interior of a continent bring less rain to a region.

G. Climate and Seasons:

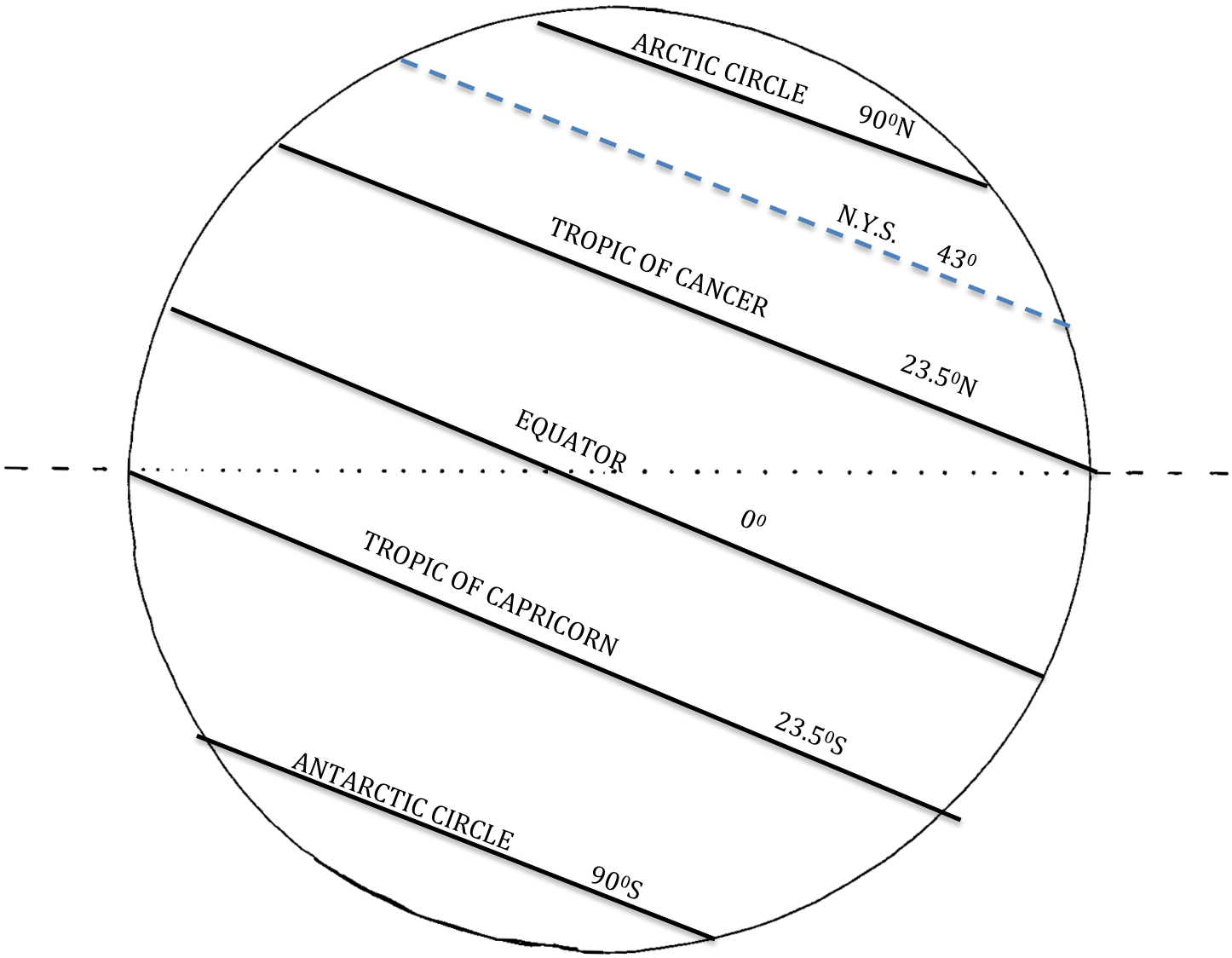
1. SEASONS:

A. CAUSED BY:

i. **EARTH REVOLVES AROUND THE SUN**

ii. **EARTH IS TILTED / INCLINED ON ITS AXIS 23.5^0**.

iii. **EARTH'S AXIS IS ALWAYS POINTING IN THE SAME DIRECTION**.



H. **INSOLATION** = **IN**coming **SOL**ar radi**ATION**

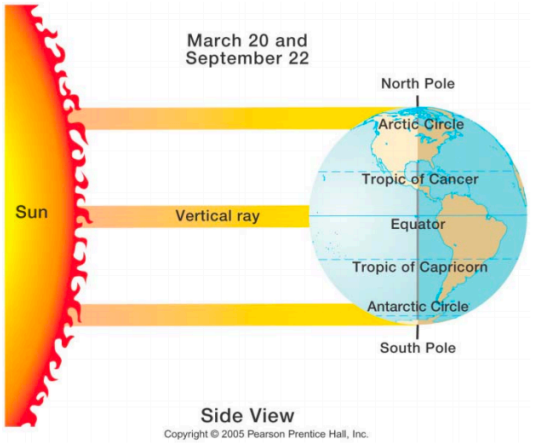
1. We have **SEASONS** because the earth rotates tilted **23.5^0 ON ITS AXIS** as it travels around the sun.

2. **AXIS OF ROTATION**: An imaginary line going from the **NORTH POLE** to the **SOUTH POLE**.

3. Due to the **TILT**, the direct rays of the sun are concentrated on different areas of earth depending on where the earth is in is revolution around the sun.

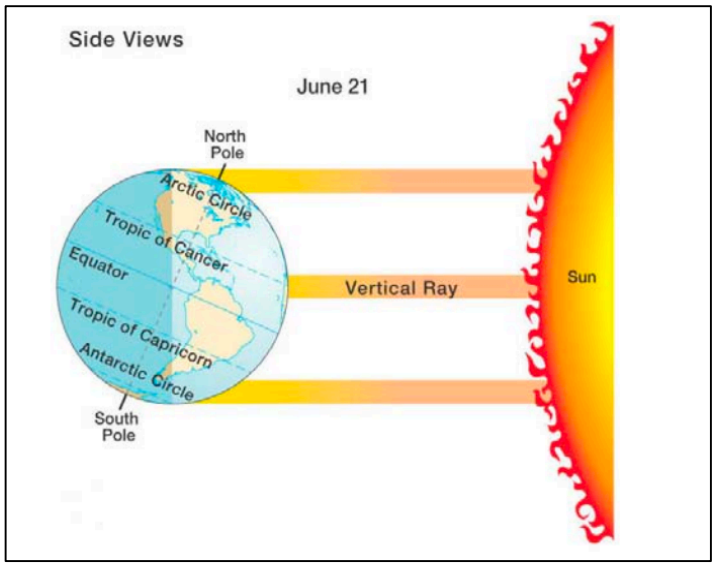
4. The tilt also determines the number of hours of daylight and darkness at different times of the year.

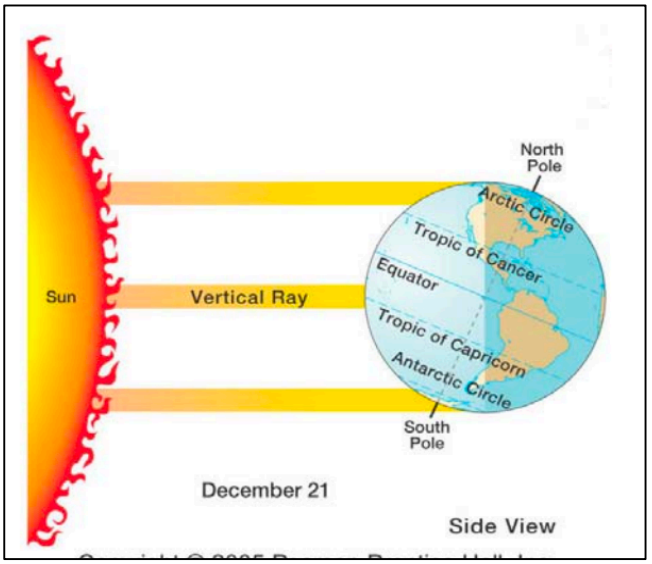
5. On the first day of Spring (**MARCH 21^{TH}**) and the first day of Autumn (**SEPTEMBER 22**), the sun's direct rays are directly on the **EQUATOR**. These are called the **EQUINOXES** (EQUI = "equal", NOX = "night"). On the Spring (**VERNAL**) and **AUTUMNAL** equinoxes, there are exactly **12 HOURS** of daylight and **12 HOURS** of darkness.



6. On the first day of **SUMMER**, (The Summer **SOLSTICE** on **JUNE 21ST**), the earth is slightly **FARTHER** from the sun in the Northern Hemisphere. However, because the northern hemisphere is tilted **TOWARD** the sun, the sun's **DIRECT RAYS** are at **23.5^{0}N** on the **TROPIC OF CANCER** in the Northern hemisphere and we have **SUMMER**.

    a. Due to the tilt, the sun has a **LONGER** path on the northern side of the earth on the **SUMMER** Solstice, and the northern hemisphere experiences **LONGER** hours of daylight (approximately **15 HOURS**) and **FEWER** hours of dark (approximately **9 HOURS**).
    b. The tilt of the earth keeps the **NORTH POLE** tilted **TOWARDS** the sun all day, giving he north Pole 24 hours of daylight during the summer in the northern hemisphere.

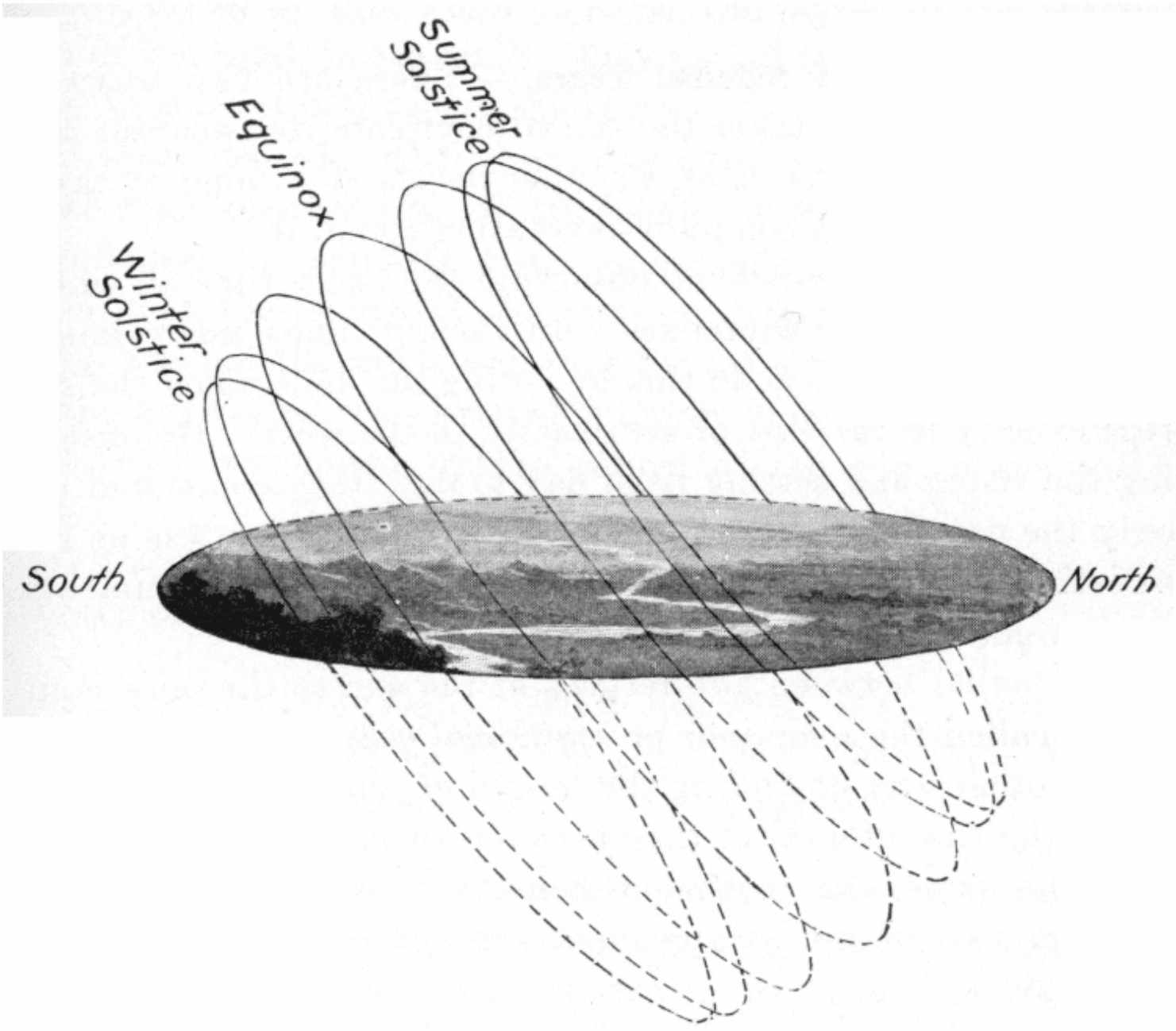




7. On the first day of **WINTER**, (The Winter **SOLSTICE** on **DECEMBER 21ST**), the earth is slightly **CLOSER** to the sun in the Northern Hemisphere. However, because the northern hemisphere is tilted **AWAY** from the sun, the sun's **DIRECT RAYS** are at **23.5^{0}S** on the **TROPIC OF CAPRICORN** in the Southern hemisphere and we have **WINTER**.

    a. Due to the tilt, the sun has a **SHORTER** path on the northern side of the earth on the **WINTER** Solstice, and the northern hemisphere experiences **SHORTER** hours of daylight (approximately **9 HOURS**) and **LONGER** hours of dark (approximately **15 HOURS**).

8.



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SEASON	NAME	DATE	DIRECT RAYS OF SUN	ANGLE OF SUN / INTENSITY OF INOLATION	LATITUDE	HOURS OF DAYLIGHT	HOURS OF DARKNESS	HOURS DAY AT NORTH POLE	HOURS DAY AT SOUTH POLE
SUMMER	SOLSTICE	JUNE 21	TROPIC OF CANCER	HIGH / HIGH	23.5^0N	16	8	24	0
AUTUMN (FALL)	EQUINOX	SEPTEMBER 21	EQUATOR	MEDIUM / MEDIUM	0^0	12	12	12	12
WINTER	SOLSTICE	DECEMBER 21	TROPIC OF CAPRICORN	LOW / LOW	23.5^0S	8	16	0	24
SPRING	EQUINOX	MARCH 21	EQUATOR	MEDIUM / MEDIUM	0^0	12	12	12	12

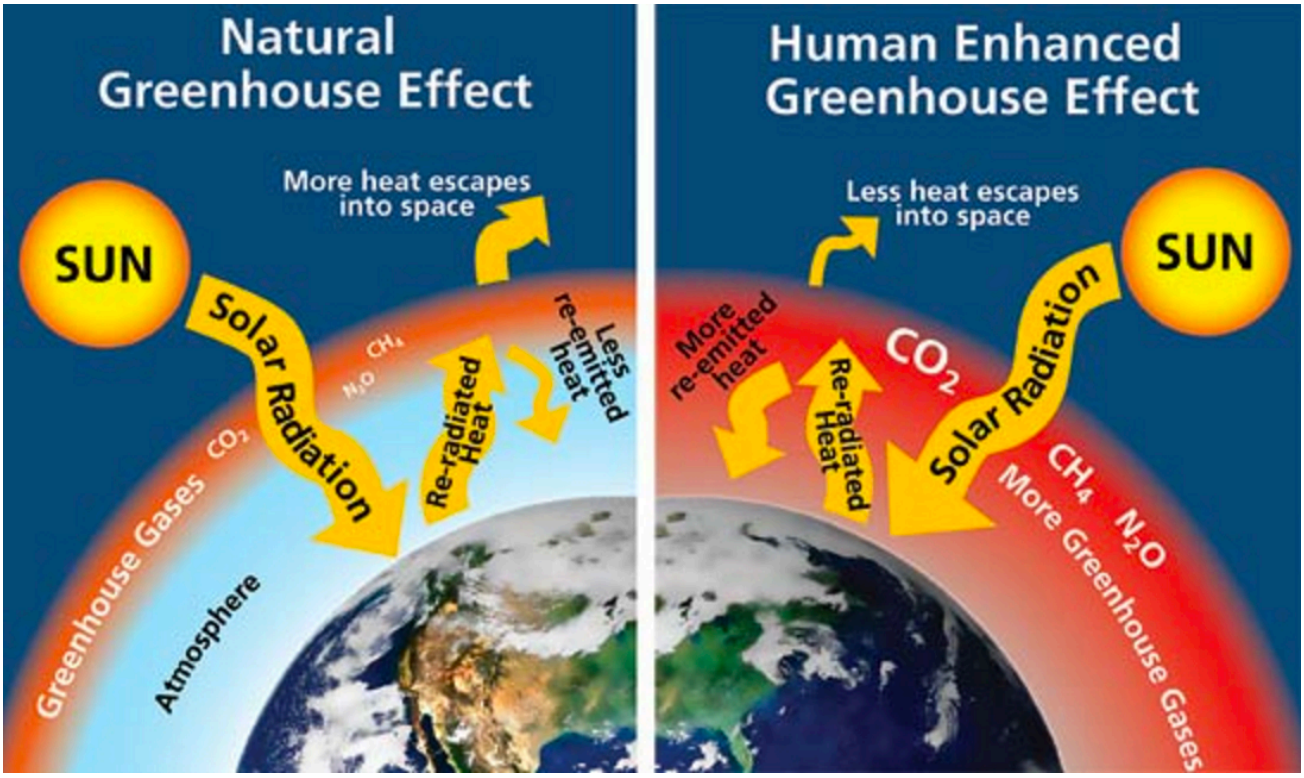
IV. **GLOBAL WARMING**

A. What is Global Warming?

a. Global Warming is the **INCREASE** of Earth's average surface temperature due to effect of **GREENHOUSE GASES**, such as carbon dioxide emissions from burning fossil fuels or from deforestation, which trap heat that would otherwise escape from Earth. This is a type of **GREENHOUSE EFFECT**.

B. **GREENHOUSE EFFECT**: **THE PROCESS THAT ALLOWS SHORT WAVE ENERGY TO BE TRANSMITTED THROUGH THE ATMOSPHERE TO THE EARTHS SURFACE BUT WHICH REFLECTS AND TRAPS THE RE-RADIATED LONGWAVE INFRARED ENERGY**.

a. Greenhouse Gasses:
   i. **WATER VAPOR**
   ii. **CARBON DIOXIDE**
   iii. **METHANE**
   iv. **NITROUS OXIDE**
   v. **OZONE**



UNIT 8 EXAM TOPICS

Ground Water
- **Porosity**
- **Permeability**
- **Capillarity**
- **Zone of Aeration**
- **Water Table**
- **Zone of Saturation**

Water Cycle
- **Evaporation**
- **Transpiration**
- **Condensation**
- **Precipitation**
- **Runoff**
- **Infiltration**

Climate Change
- **Greenhouse Effect**
- **Global Warming**
- **El Nino**

Insolation
- **Shadows**
- **Duration of insolation**
- **Seasons**
- **Latitude of direct rays**
- **Dates and tilt**
- **Suns path**

Celestial sphere
- **23.5 degree change**
- **color and texture**

Climatic Factors
- **Marine vs Continental**
- **Planetary Winds**
- **Ocean Currents**
- **Orographic Effect**
- **Latitude vs temperature an Precipitations**
- **Elevation**
- **Warm air rises**
- **Less dense, etc.**

UNIT 8 EXAM VOCABULARY

Angle of Incidence
Capillarity
Climate
El Nino
Global Warming
Greenhouse Gasses
Ground Water
Heat Budget
Hydrologic Cycle
Ice Ages
Infiltrate
Insolation
Ozone
Permeability
Porosity
Prevailing Winds
Runoff
Sorted
Stream Discharge
Transpiration
Unsorted
Water Cycle
Water Retention
Water Table