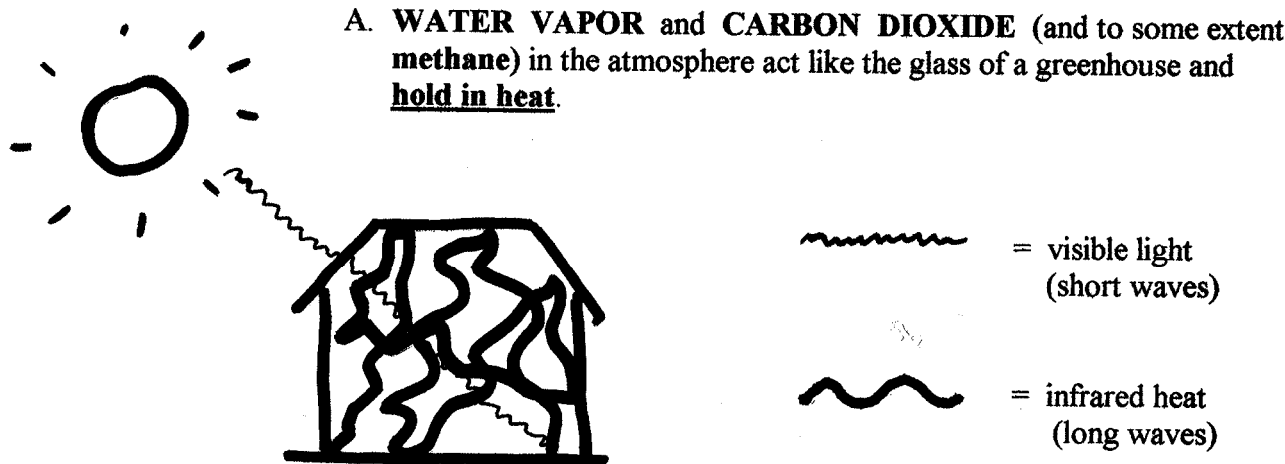


INSOLATION AND SEASONS

- I. **Insolation** - means “sunshine” (INcoming SOLAR radiaTION)
- A. The sun gives off mostly **visible light**... the earth then *reradiates* this at a **longer** wavelength.
1. “**In come the short waves, out go the long waves.”**
- Short waves = visible light
 Long waves = **Long-wave radiation**
Infrared
Ground radiation
Heat
Terrestrial radiation
- B. Nearly all the **ultraviolet radiation** (UV) from the sun is absorbed by **Ozone** gas in the Earth’s upper atmosphere.
1. The ozone hole allows more UV rays to reach the Earth’s surface, which could lead to increased skin cancer.
- C. Insolation from the sun can be reflected, refracted, scattered, or absorbed by the atmosphere.
- II. **Insolation at the earth’s surface**
- A. the **darker** and **rougher** the surface, the more insolation is absorbed.
1. Ice and snow (white and smooth) reflect most of the insolation.
- B. **Angle of Insolation** - how high the sun is above the horizon
 (also called Angle of Incidence)
1. Is always greatest at **local noon** on any given day.
 2. Is always greatest on June 21st in New York State in any given year. (But it is **NEVER** directly overhead in New York State... **sun is always toward the SOUTH at local noon**, so at noon, all shadows are the **shortest** of the whole day, and **will point to the NORTH**.)
 3. The **greater** the angle of insolation, the **more** insolation is **absorbed** by the ground (less is reflected).
- C. Water heats up/cool down **slower** than the land due to water having a **high specific heat**

III. The Greenhouse Effect



B. This may be causing **global warming** due to an increase of carbon dioxide in the atmosphere from **burning fossil fuels**.

IV. Variations of insolation

A. **Angle of insolation** - the higher this angle, the more intense the insolation.

1. As the intensity of insolation increases, so does the area's temperature.
2. The angle of insolation varies all over the earth because the earth is a sphere.

B. **Latitude** - since the earth's axis is tilted ($23\frac{1}{2}^{\circ}$) as it revolves around the sun, different latitudes have the sun directly overhead at local noon (90° angle of incidence) throughout the year.

(see Ref Tables, p. 4)

C. **Seasons** - N.Y.S. has the highest angle of insolation in the summer (June 21st) and the lowest in winter (Dec. 21st)

1. The **angle of insolation** also determines the **duration of insolation** - *length* of daylight hours. For new York State:
 - a) longest in summer (June 21st)
 - b) shortest in winter (Dec. 21st)

D. Time of day

1. The angle of insolation **increases** from dawn until local noon, then **decreases** from local noon until sunset. (Greatest at local noon, but ***never*** directly overhead in N.Y.S. Sun is always to the **SOUTH** at local noon in N. Y. State!)

- V. **Times** of maximum and minimum temperature
- A. **During the year** - have the “**lag of the seasons**” while the earth catches up to the change in the insolation (sunshine) due to seasons.
1. maximum temperature is always **AFTER** maximum insolation
 2. minimum temperature is always **AFTER** minimum insolation
- B. **During the day** - hottest part of the day is mid-afternoon, which is **AFTER** the maximum insolation at local noon.
(coldest temperature is usually just before sunrise)

VI. Radiative balance

- A. An object that gains about as much energy as it gives off, so that its **average** temperature remains the same, is said to be in **radiative balance**.
1. From year to year, the earth is **not** in radiative balance.
 2. From decade to decade, the earth appears to be **in radiative balance**.
 3. Over millions of years, the earth does **not** appear to be in radiative balance (due to the ice ages).
 - a) had 4 advances of ice during the last (Pleistocene) Ice Age.
- B. Factors affecting Earth’s **heat budget** over the past
1. Ice ages
 2. El Nino and La Nina (ocean currents)
 3. Global warming
 4. Variations in Sun’s energy output (sunspots)
 5. Variations in Earth’s tilt (26,000 year cycle)
 6. Volcanic eruptions
 7. Human factors - deforestation, urbanization, burning fossil fuels

VII. Seasons

- A. Direct cause: cycle of variations in the yearly **intensity** and **duration** of **insolation**.
- B. Three causes of this:
1. Tilt of the earth’s axis ($23\frac{1}{2}^{\circ}$)
 2. Parallelism of the earth’s axis - N. Pole **always** points toward POLARIS (N. Star)
 3. Earth’s annual revolution around the sun.