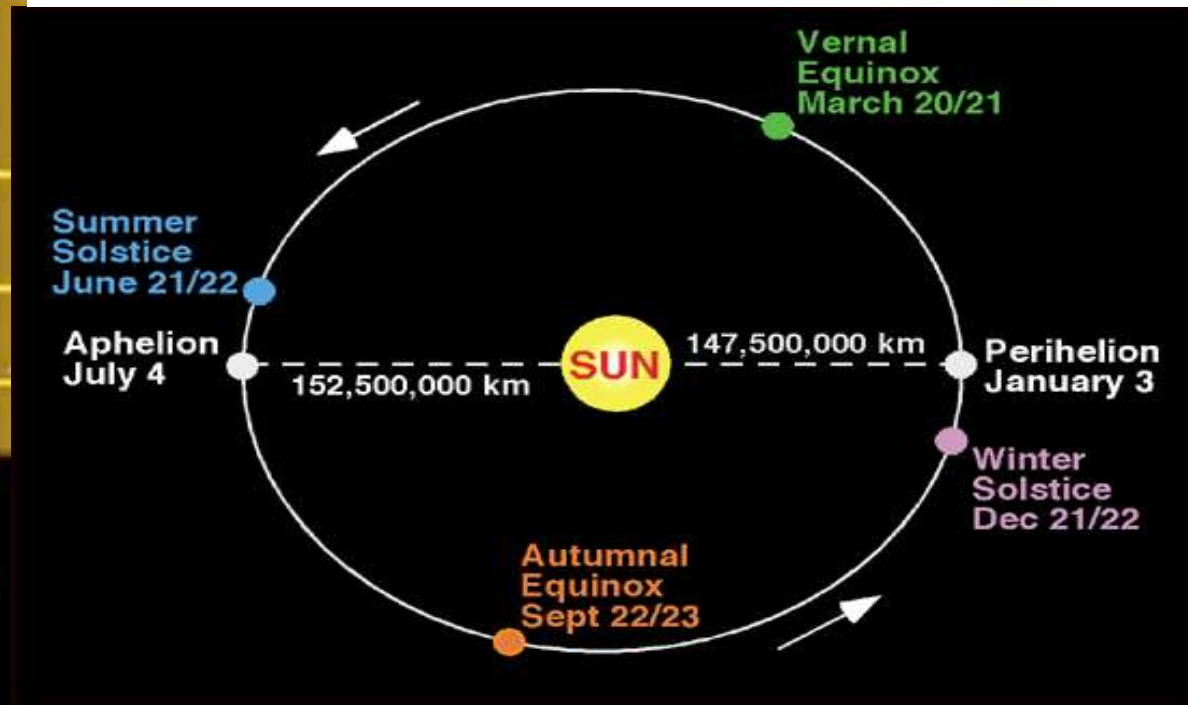
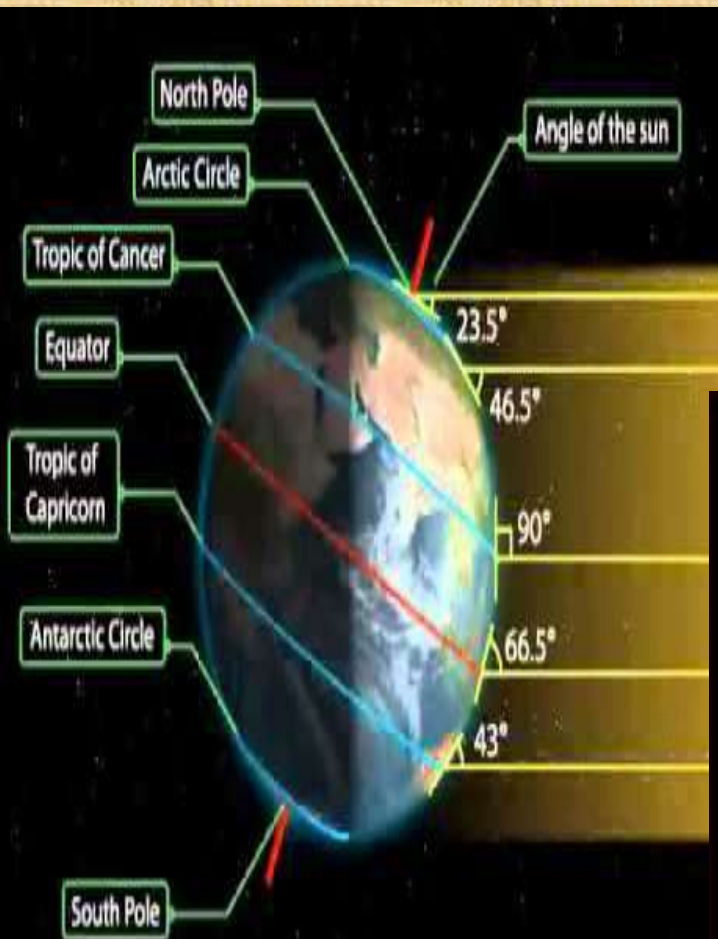
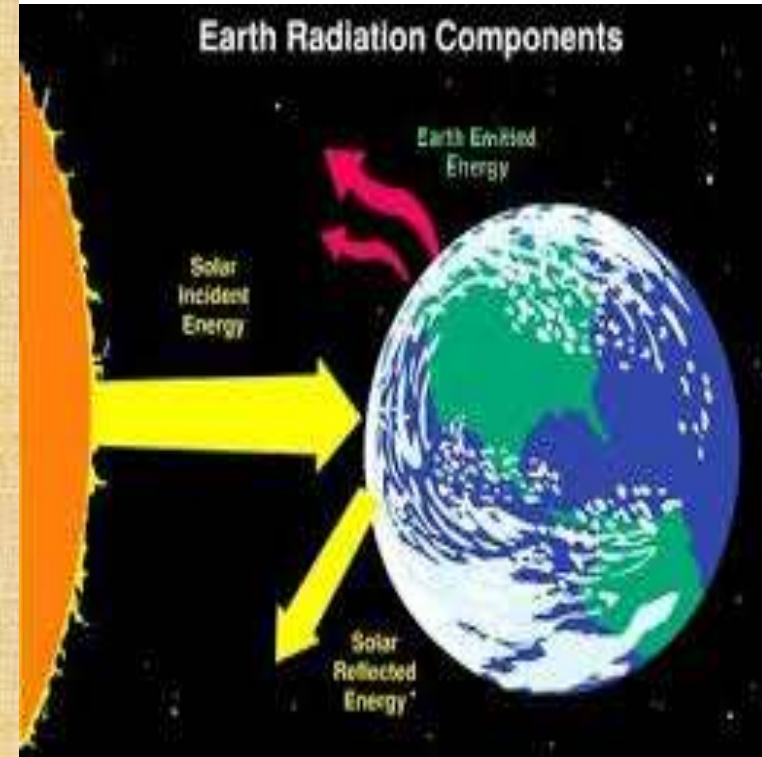
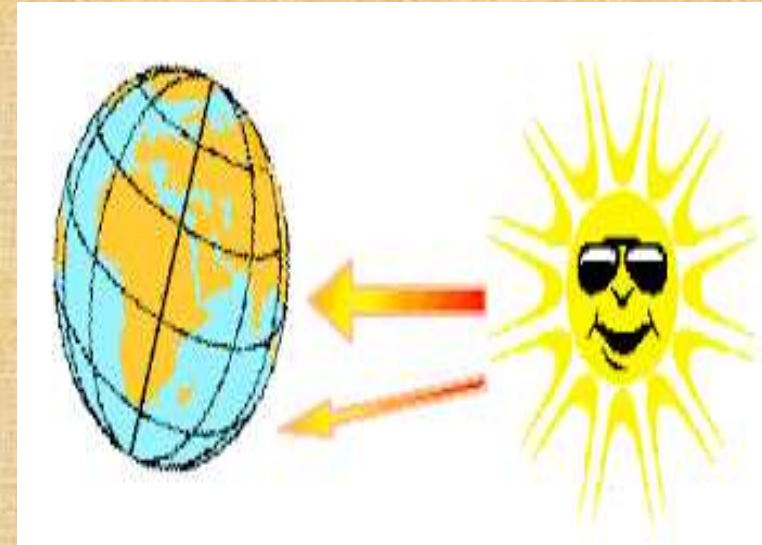


SOLAR RADIATION, HEAT BALANCE AND TEMPERATURE



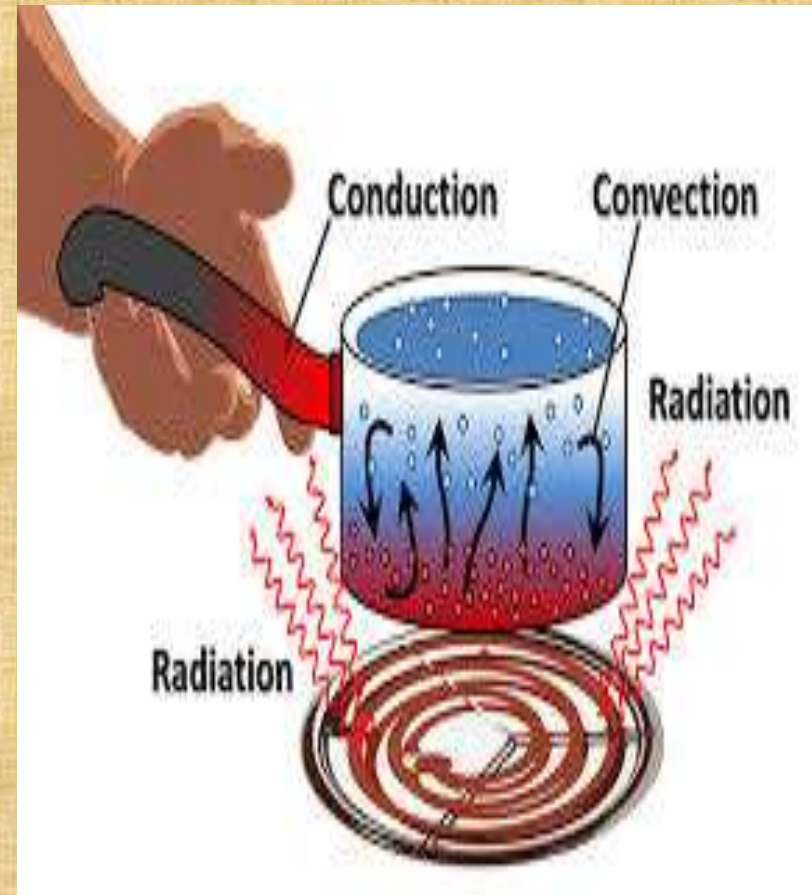
INTRODUCTION

- Earth receives almost all of its energy from sun. The energy in Sun is produced from nuclear reactions(nuclear fission and fusion).
- The earth in turn radiates back to space the energy received from sun.
- **SOLAR RADIATION:** The radiation emitted from sun in form of short wave is called as Solar Radiation.
- **INSOLATION:** The energy received by Earth from incoming solar radiation is called as insolation. On average Earth receives around 1.94 calories per square kilometer per minute at the top of its atmosphere. It is called as solar constant..
- **TERRESTRIAL RADIATION:** These incoming short wave solar radiation are absorbed by atmosphere, heats it up and it is also reflected back into space in the form of long wave radiation. This type of energy which heats up the atmosphere is called Terrestrial radiation.



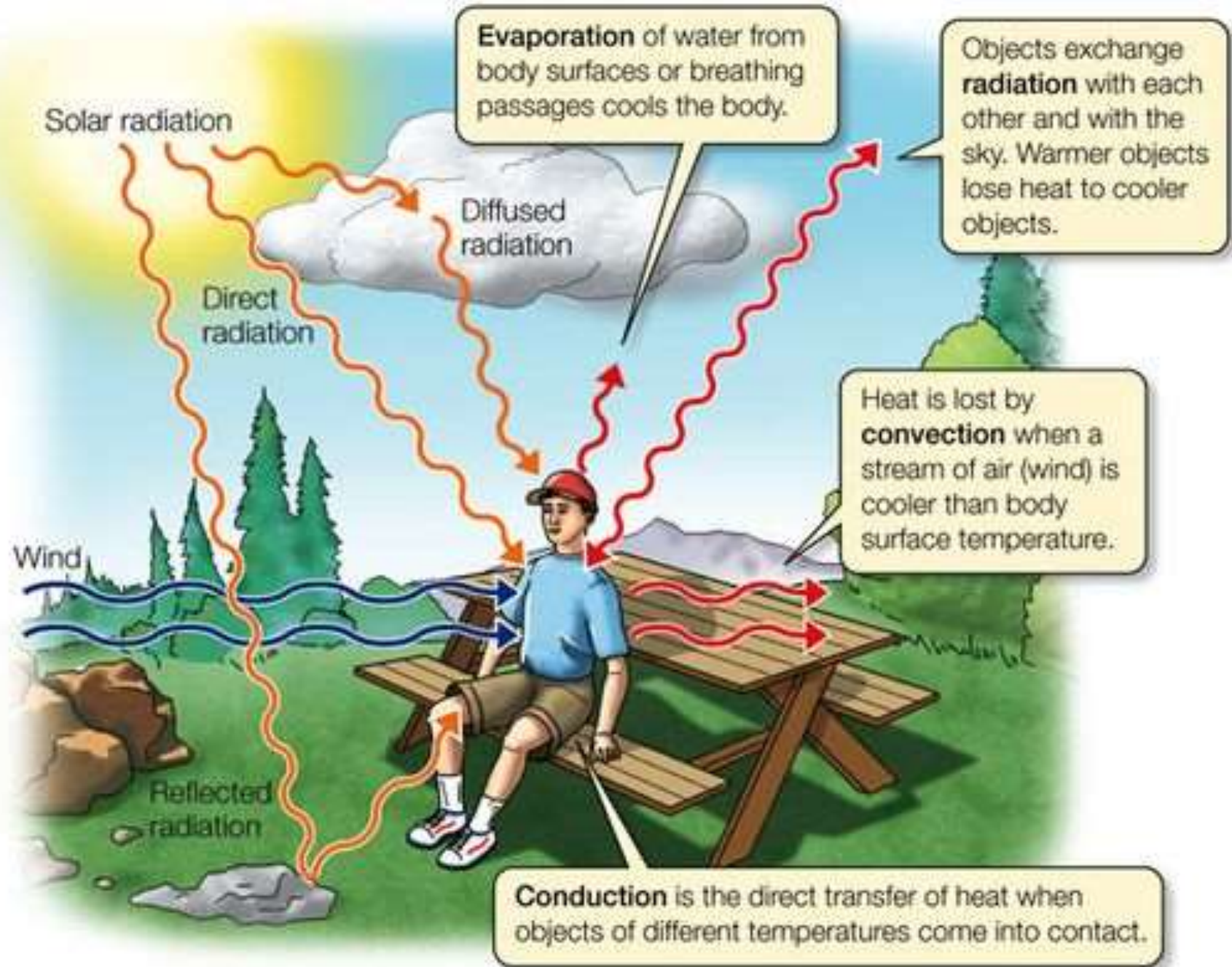
PROCESSES INVOLVED IN HEATING OF ATMOSPHERE

- 1. **Convection:** The transfer of heat through rising of warm air and sinking of cold air is called Convection. These currents of moving air is called as Convection Currents.
- 2. **Conduction:** Conduction is transfer of heat when between two bodies of unequal temperature are contact with one another. The flow of energy is from warmer to cooler body. The transfer continues until both bodies maintain the same temperature. The air gets heated and slowly and it heats the upper layer of atmosphere. This process is called Conduction.



- **Radiation:** Radiation is the form of energy that is transmitted in the form of waves. The energy received from sun is in the form of short wave radiation and the atmosphere emits it in the form of long wave radiation.
- **Advection:** It is the horizontal transfer of energy . In Middle latitudes variation in daily weather is caused by Advection alone. It is opposite to process of Convection in terms of Direction of flow of energy.

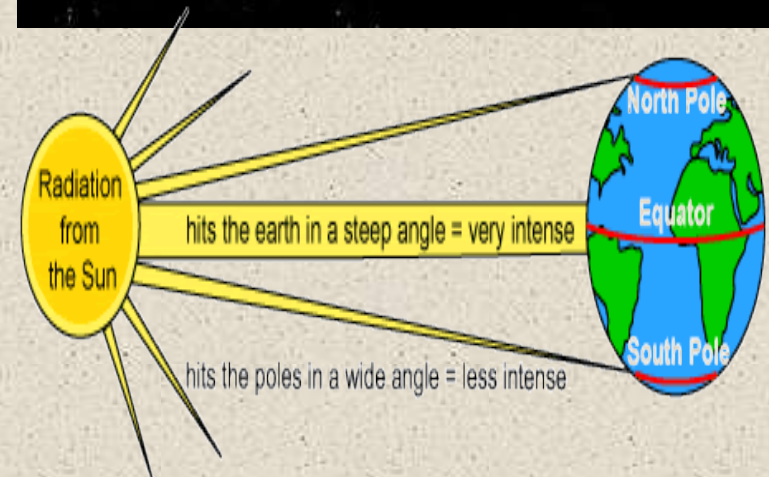
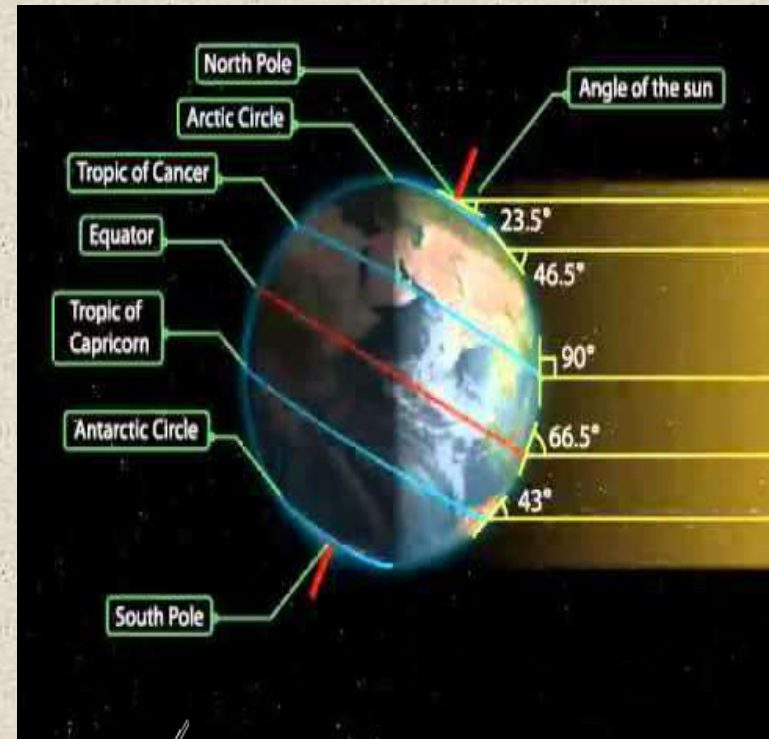


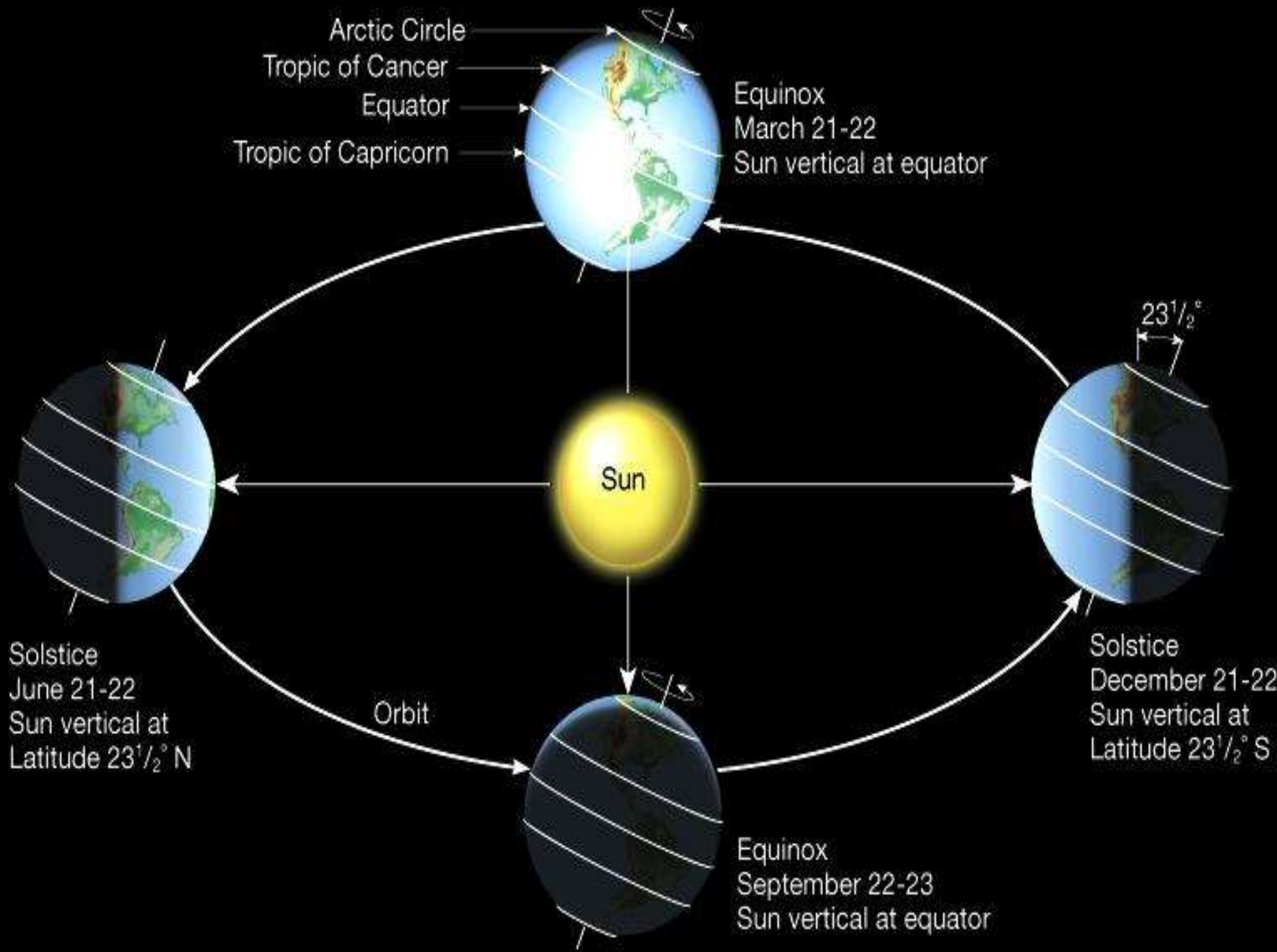


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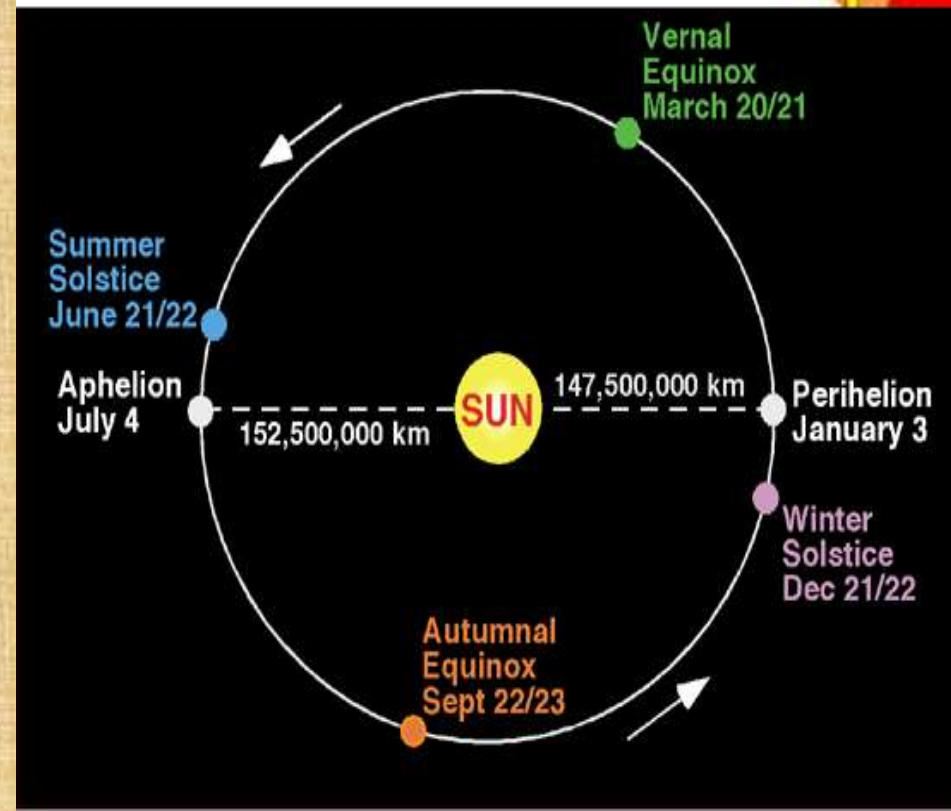
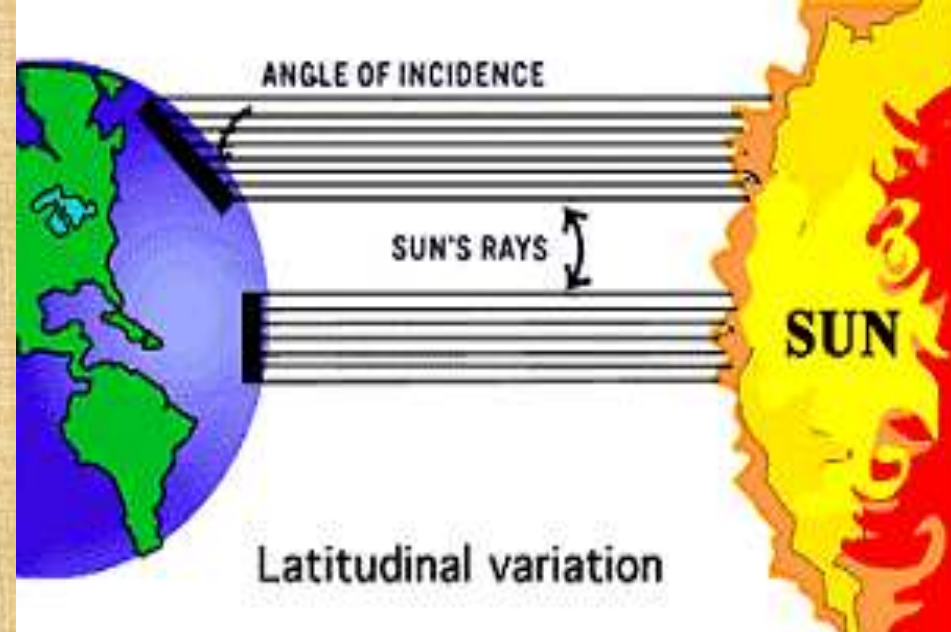
FACTORS RESPONSIBLE FOR DIFFERENCE OF INSOLATION AT SURFACE OF EARTH

- The factors which cause variations in insolation are:
- **1. Rotation of Earth: Rotation refers to movement of Earth around its own axis.** The part of the Earth facing the sun will receive the maximum insolation as compared to the other side of Earth.
- **2. Revolution of Earth:** Revolution refers to movement of Earth around Sun. 4 positions of Earth is determined when it revolves:
- A) June 22 is called the summer solstice when the sun rays are vertical on tropic of Cancer as a result of which there is summer in the northern hemisphere and winters in the southern hemisphere.
- B) December 22 is called the winter solstice when the sun rays are vertical in tropic of Capricorn in the southern hemisphere as a result of which there is winter season in northern hemisphere and summers in southern hemisphere.
- C) On March 21 and September 23 the sun rays are falling vertical on Equator and days and nights seems to be equal these two days . These two are also called as Equinox.
-
- **3. Inclination of Sun rays.:**
- if rays are vertical, it will cover less area but net energy received and distributed is more heat whereas area which receives oblique rays covers more area but net energy received and distributed is less.





- **3.Length of day**(Longer the day, greater is the insolation. Example days are longer and nights are shorter during summer therefore more insolation is received during summer season.
- in winters days are shorter and nights are longer and therefore less insolation is received in this season.
- 4. Latitude of Place: Places at high latitudes like polar areas receive less insolation. Middle latitudes receive high insolation.
- **5. Distance of Earth from Sun**
- Earth moves around sun in a elliptical orbit.
- Earth is nearest to sun on 3rd January at distance of 147 million kms. It is called as Perihelion.
- Earth is farthest away from Sun on 4th July at a distance of 152 million kms and this concept is called as Apehelion.



- **6. Impact of Land and Water:** Specific capacity of water is 5 times more than land. It means that if same energy is provided to water as well as land, land will get heated as well as cool easily as compared to water. Water in turn takes five times more energy to heat as well as cool down.
- Therefore areas on the earth surface where portion of land is more will get heated more and will generate more insolation.
- Areas with less portion of land will have less insolation.

HEAT BUDGET OF EARTH.

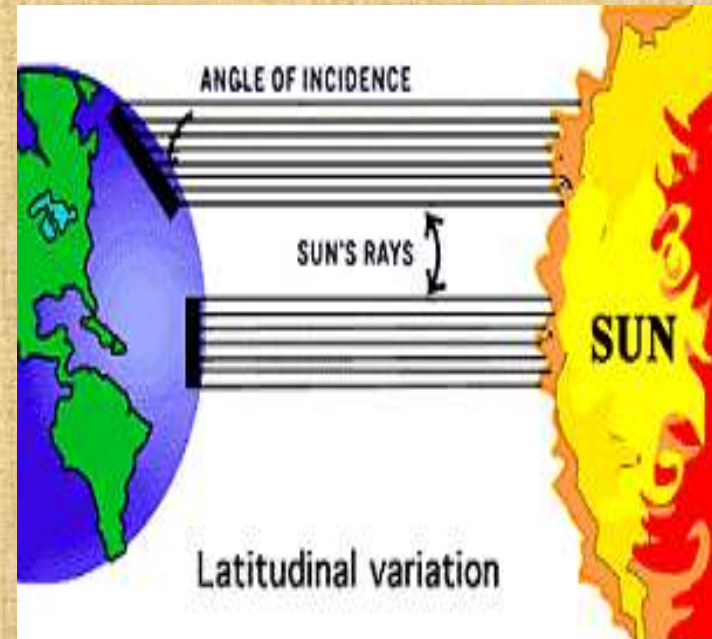
- The Earth as a whole does not accumulate or lose heat. It only maintains its temperature. This can only happen if amount of heat received in the form of insolation equals to amount of heat lost by the Earth.
- Considering that 100 units are received as insolation from sun.
- While passing through atmosphere some energy is absorbed, some is reflected and some is scattered.
- **INCOMING RADIATION/SHORT WAVE RADIATION**
- out of 100 units,
- 35 units are reflected back(27 units by clouds, 2 snow ice covered areas of earth and 6 units are scattered into space)
- 2.Remaining 65 units are absorbed by earth surface (51 units by earth and 14 units by atmosphere).
- Therefore around 65 units are received by earth as incoming insolation..

- **TERRESTRIAL RADIATION/LONG WAVE RADIATION**

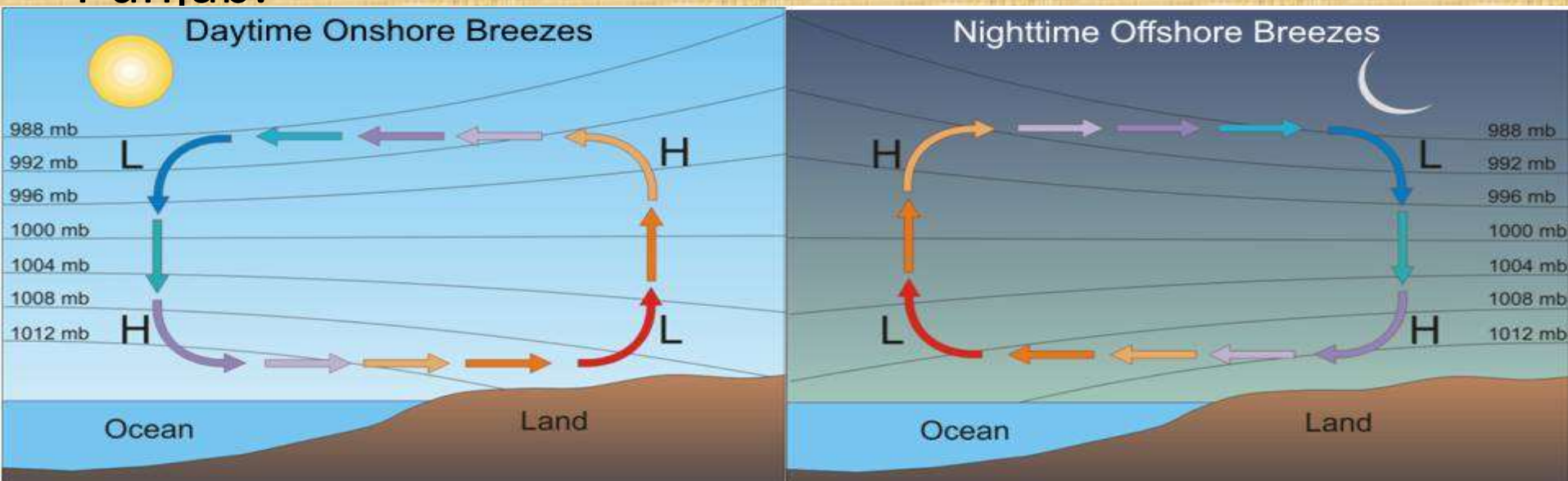
1. 17 units are reflected back to space by earth surface.
 2. 48 units are again reflected to space by atmosphere.
 3. 4. total units reflected are 17 units +48 units =65 units.
- Thus the amount of heat received by earth in form of incoming insolation i.e. 65 units is equal to the amount of units reflected by earth surface as well as atmosphere..
 - This is called as heat budget or heat balance of earth.
 - The reflected amount of radiation is called albedo of Earth.

TEMPERATURE

- The amount of insolation received as well as absorbed by earth(land surface and atmosphere) creates heat which is measure in terms of Temperature.
- Temperature is degree of hotness or coldness of a place. It is measured in degree celsius or Fahrenheit.
- **FACTORS CONTROLLING TEMPERATURE DISTRIBUTION:**
- **1. Latitude:** Areas near to equator will have high temperature as compared to polar areas.
- **2. Altitude:** places at higher altitude have less temperature distribution as temperature decreases by 1 degree celsius with increase in height of 6.25 m. It is because of this reason mountains or hill stations are cooler than the plain areas.
- **3. Nature of Land Surface:** Areas which are covered with snow will reflect the solar radiation and there temperature will be less. Areas which are covered soil and sand absorb the radiation and there temperature will be more.



- **4.Distance from Sea:** Places which are near to sea have moderate temperature because of the sea breeze(movement of wind from sea to land). Lands get heated during day as a result of which area of low pressure is created over it which results in moving of wind from sea.
- Therefore places like Mumbai, Bengaluru have moderate temperature as compared to Delhi and Punjab.

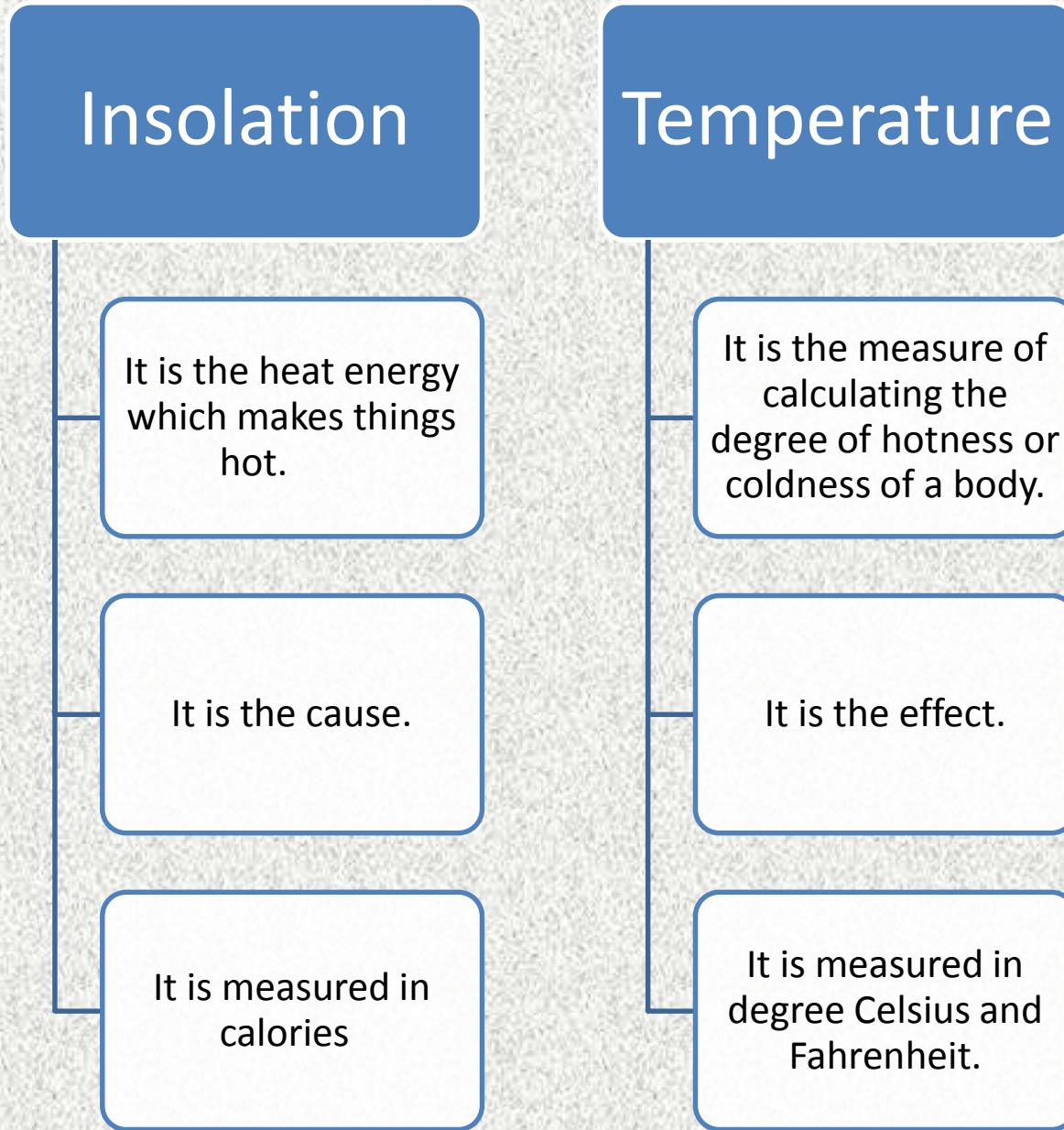


- **5. Ocean currents:** Areas which come under the influence of warm air masses experience higher temperature distribution. Example Gulf Stream is a warm current which passes from coast of USA.
- Places which have influence of cold ocean currents have less temperature. Example Labrador Current rising from Greenland passes through Canada and decreases the temperature of the areas it passes.



- **6. Prevailing Winds:** Some times prevailing winds increase or decrease the temperature of the region from which it passes. Example:
 - a) Sirocco is a warm wind blowing from Sahara Desert and raises the temperature there.
 - b) Chinook is warm wind moving down from Rockies mountain of North America and increases the temperature of the area it passes.
 - c) Loo is warm wind blowing in the areas of Punjab and Haryana and increases its temperature.

Difference Between Insolation and Temperature.



DISTRIBUTION OF TEMPERATURE

- Temperature distribution is shown with help of Isotherms.
- **Isotherms** are line joining places with equal temperature. Close spacing between isotherms indicate rapid change whereas wide spacing means slow change.
- In month of **January**, as the temperature is low over landmasses with high pressure conditions and pressure seems to be low in oceans. In northern hemisphere, isotherms bend equatorward while crossing landmass and poleward crossing oceans. In southern hemisphere, the conditions turn to be reverse.
- In month of **July**, as the temperature is high over landmasses with low pressure conditions and high pressure conditions prevail over ocean body.. In northern hemisphere, isotherms bend equatorward while crossing oceans and poleward crossing landmass. In southern hemisphere, the conditions turn to be reverse.

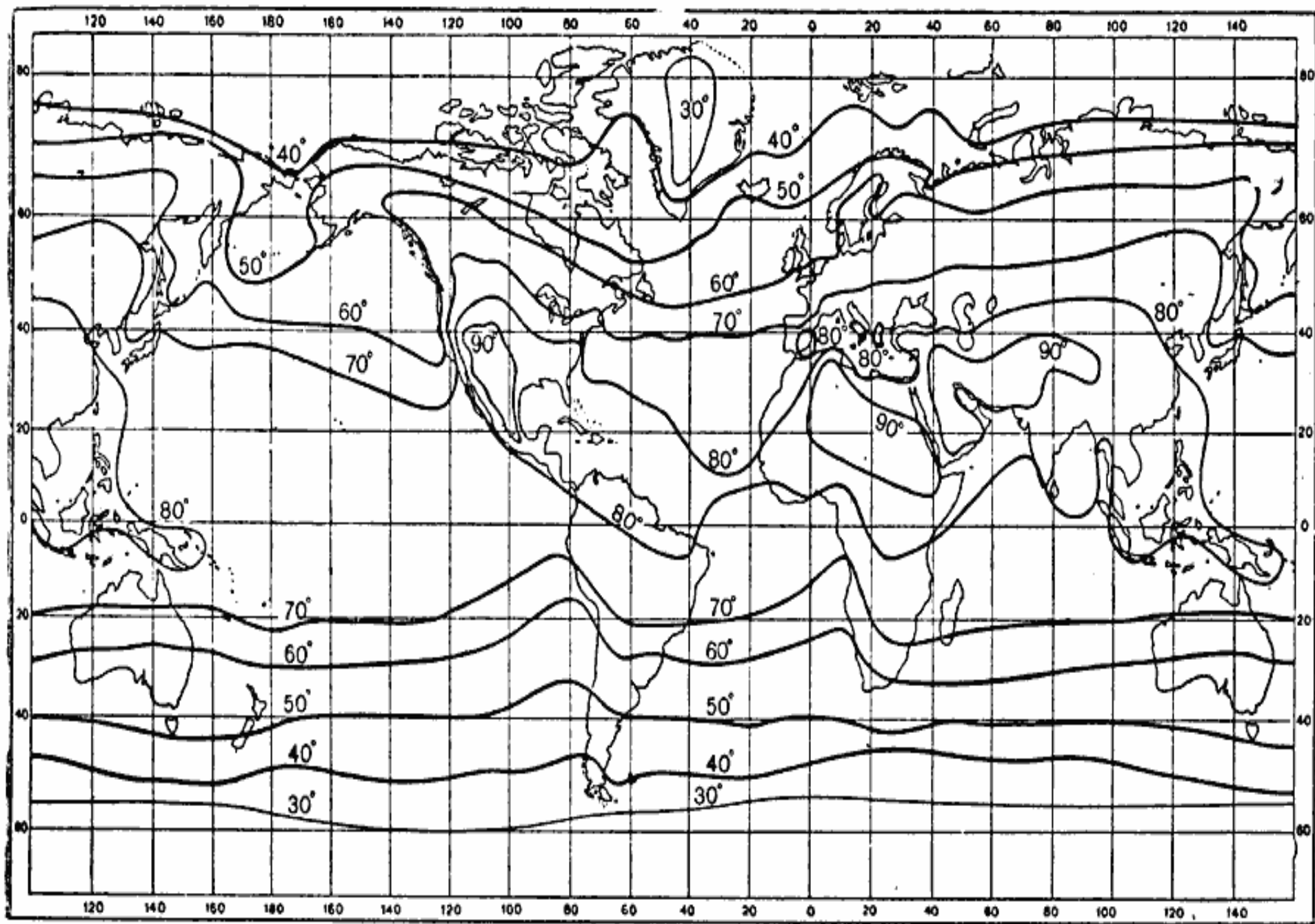
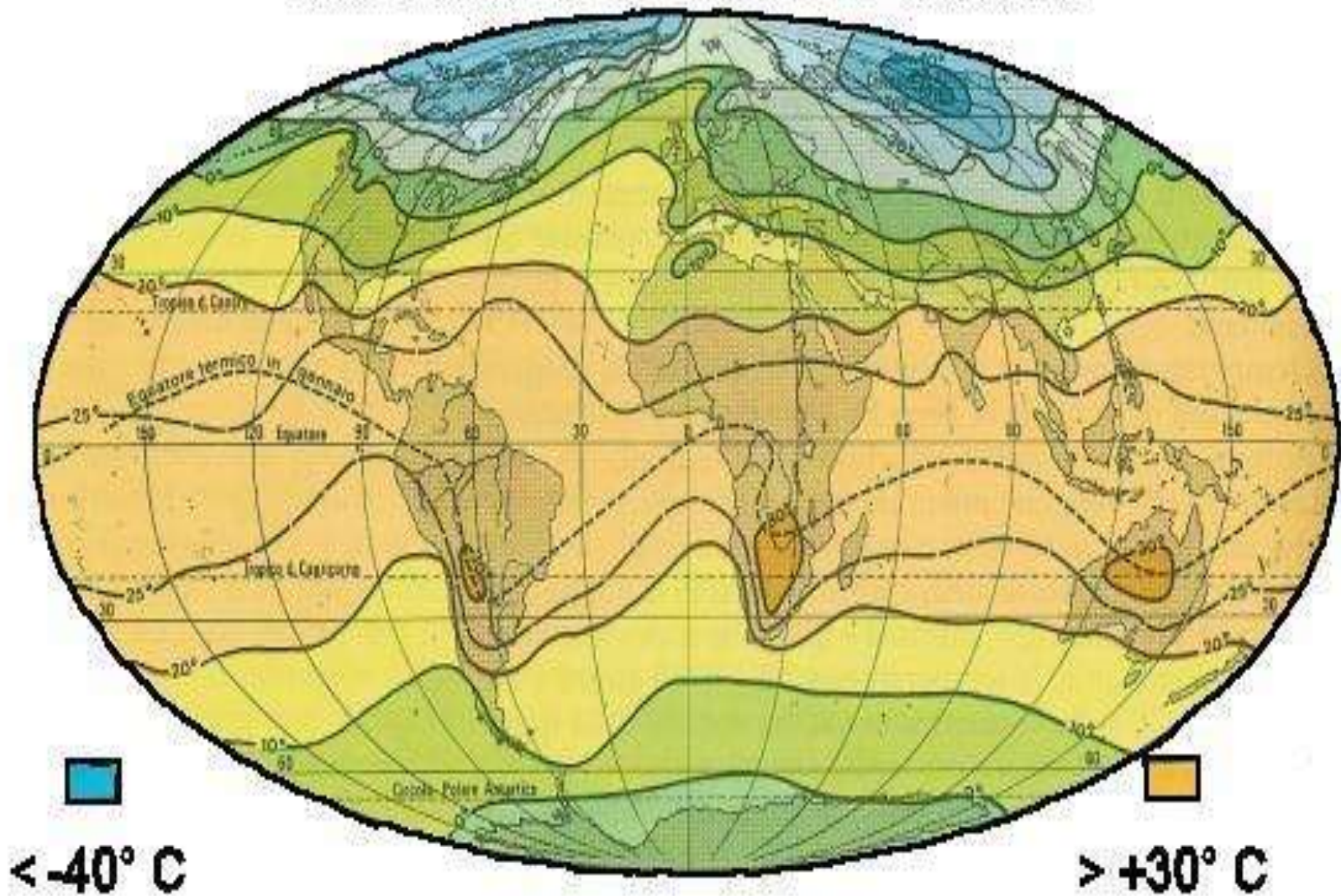


Fig. 4.—JULY ISOTHERMS

ISOTHERMS IN THE MONTH OF JANUARY



Inversion of temperature

- With increase in height, the temperature decreases with height which is called NORMAL LASE RATE.
- In some situations, temperature increases with increases in height. **This change in temperature which increases with height is called Inversion of Temperature.**
- Conditions in which temperature inversion occurs:
- **1.Long nights:** air touching surface cold, but upper layers of atmosphere are still warm. Long nights help in inversion of temperature.
- **2.Clear Sky:** Clouds help in reflecting the radiations. If sky is clear during night, it will create conditions of inversion of temperature.
- **3.Dry air:** Moist air has capacity to absorb radiation and obstructs temperature inversion whereas dry air does not absorb radiation and promotes temperature inversion.