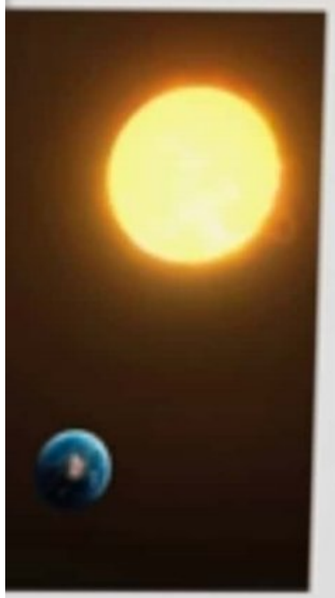

Sun is the major source **of atmospheric temperature.**

Atmosphere receives low amount of heat energy from Sun and receives most of its energy from **long wave Terrestrial radiation**.

The heating and cooling of earth atmosphere is accomplished through the process of **conduction, convection** and **radiation**.

Heat- form of energy

Temperature- intensity of hotness or coldness of any substance

Thus, temperature of any substance may be raised or lowered with addition or subtraction of heat . And the transfer of heat from one body to another - conduction, convection and radiation.

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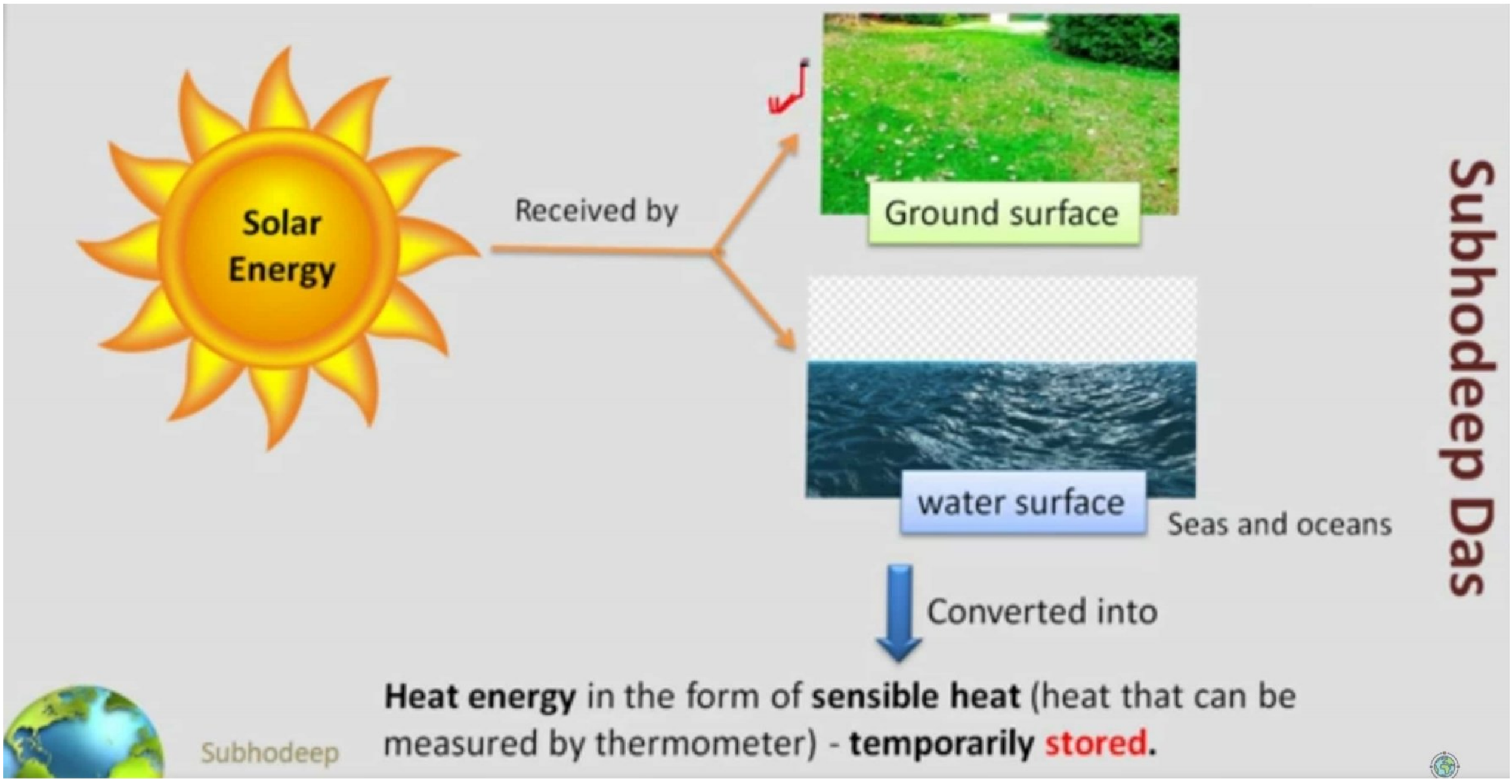

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Stored energy - radiated from ground and water surface - form of **long waves** into **atmosphere**.

(process is called **ground radiation**)

Including radiation from both **ground** and **water** surface

Part of **ground radiation absorbed** by the atmosphere - **radiated back** to earth surface(process- **counter radiation**).

Affected by water vapour and atmospheric carbon dioxide

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The Sun emits different types of rays

But our eyes are not able to perceive all types of rays

Light is an ELECTROMAGNETIC wave

A wave has a wavelength and a frequency

Light has a wavelength and a frequency

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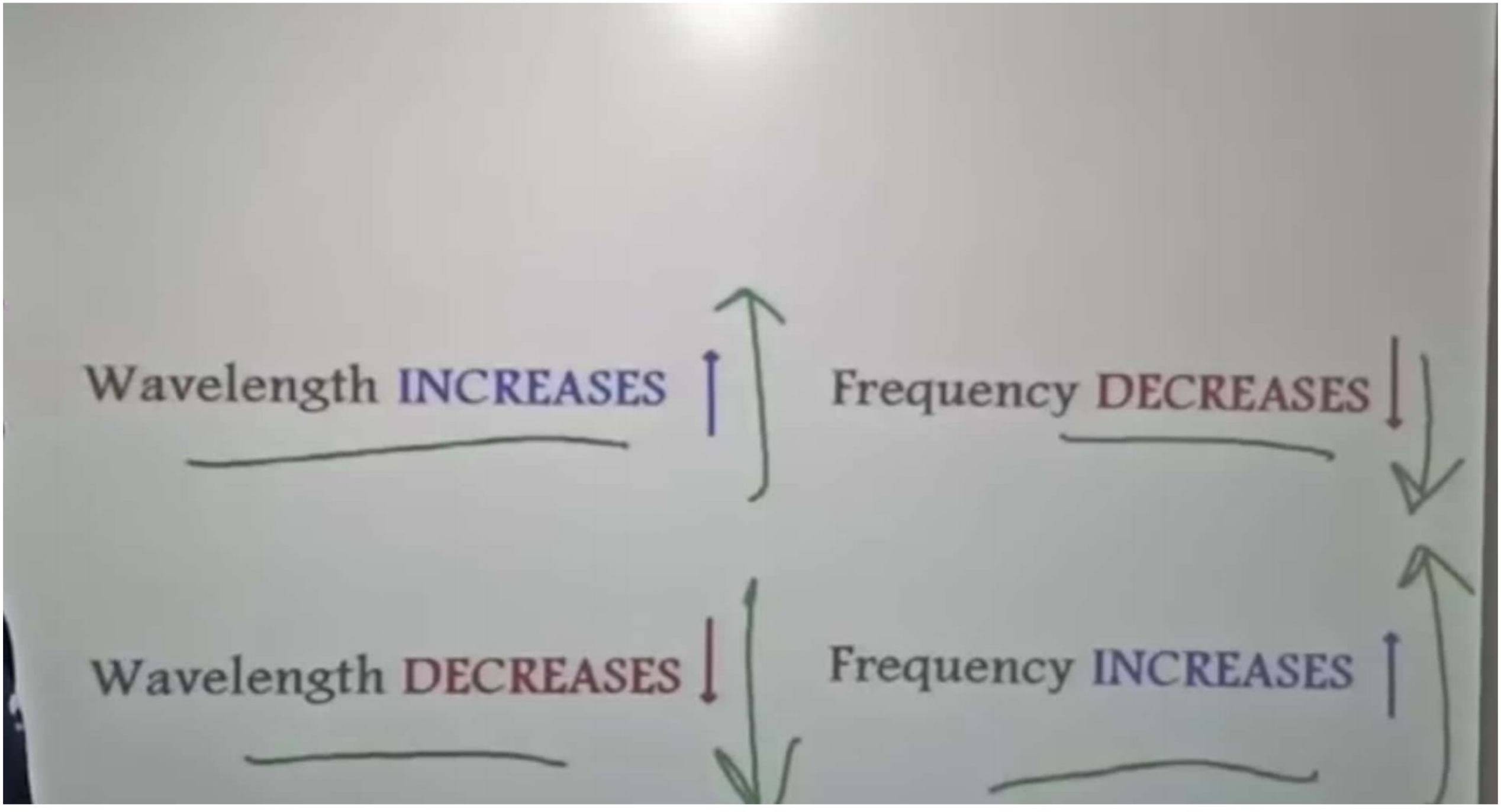

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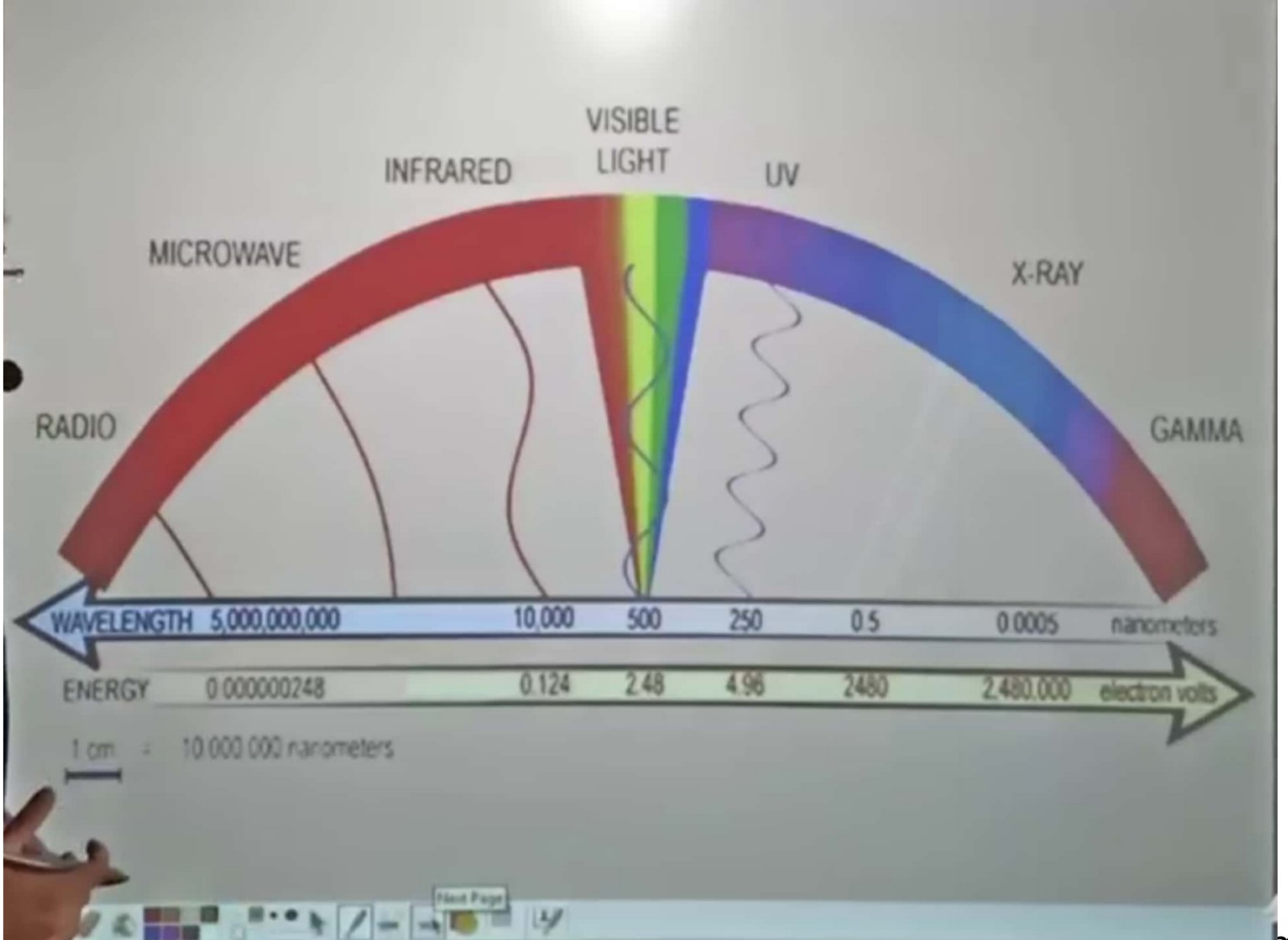

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VISIBLE SPECTRUM – Wavelengths in nanometres

400 450 500 550 600 650 750

Ultraviolet (UV)

Infrared (IR)

VIOLET 400–450 nm

BLUE 450–500 nm

GREEN 500–570 nm

RED 610–750 nm

ORANGE 590–610 nm

YELLOW 570–590 nm

Wavelength of red > Wavelength of violet

Frequency of red < Frequency of violet

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Ultraviolet spectrum

- Wavelength 10 nm to 400 nm
- Undergoes reflection, refraction and scattering like visible light rays
- Travels in a straight line with a speed of 3×10^8 m/s
- They cause health hazards like skin cancer

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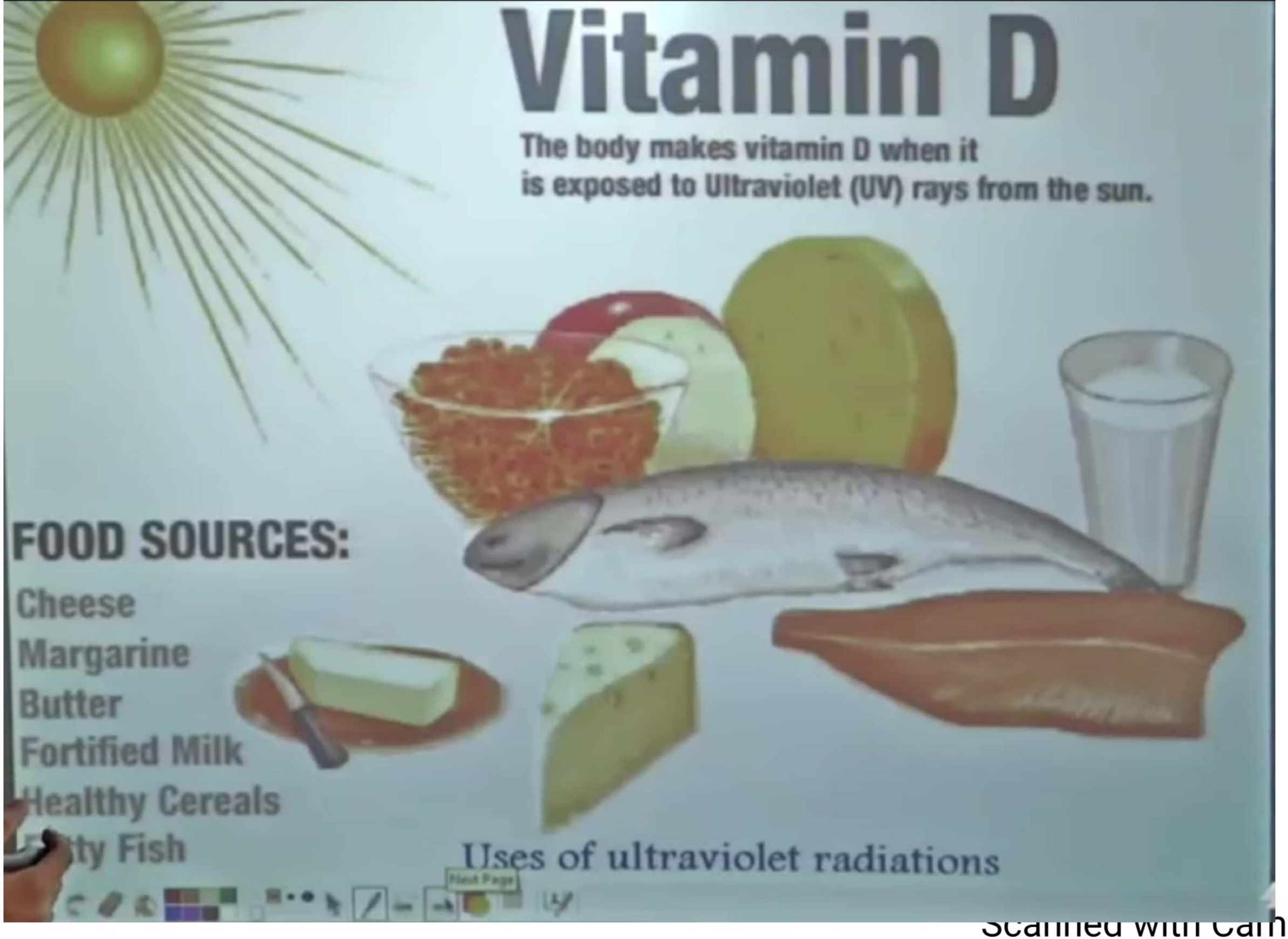
Vitamin D

The body makes vitamin D when it is exposed to Ultraviolet (UV) rays from the sun.



FOOD SOURCES:

- Cheese
- Margarine
- Butter
- Fortified Milk
- Healthy Cereals
- [illegible]ty Fish

Uses of ultraviolet radiations

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Infrared spectrum

- Wavelength 700 nm to 1 mm
- *Undergoes reflection, refraction and scattering like visible light rays*
- *Travels in a straight line with a speed of* 3×10^8 *m/s*
- *Less scattered as they have long wavelengths*

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Uses of infrared radiations

- The infrared radiations are used in therapeutic purposes by doctors

- Used in photography at night and also in mist and fog as they are less scattered

- Used in television remote control and other gadgets

Gamma rays

- Shortest wavelength less than 0.01 nm
- Highest frequency
- Easily penetrate through the human body and can damage our body
- Travel in a straight line with a speed of 3×10^8 m/s
- Used to kill cancer cells

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X rays

- Wavelength of 0.01 nm to 10 nm
- Used for detection of fracture in bones
- Used for studying atomic arrangements in crystals and complex molecules
- Travel in a straight line with a speed of 3×10^8 m/s

Microwaves

- Wavelength 1 mm to 1 m
- Used for satellite communication
- Used for cooking in microwaves
- Travel in a straight line with a speed of 3×10^8 m/s

- They have longest wavelength above 10 m
- These waves are used mainly in radar communication and in radio and television communication
- Travel in a straight line with a speed of 3×10^8 m/s

Heating of atmosphere by :

- Direct insolation
- Conduction
- Terrestrial radiation
- Convection

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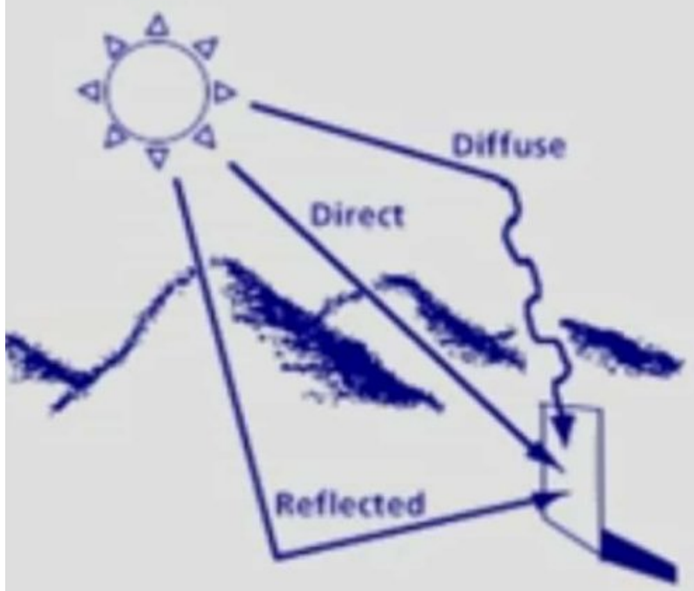
Direct insolation



Earth atmosphere absorbs **14%** of incoming <u>shortwave solar radiation</u>

Through ozone, water vapour etc.

7% of energy is spread in **lower atmosphere** - upto 2 km height

Too low to heat the atmosphere significantly

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Conduction

Transfer of heat - through the **molecules** of matter of anybody.

Transfer of heat-2 ways ;

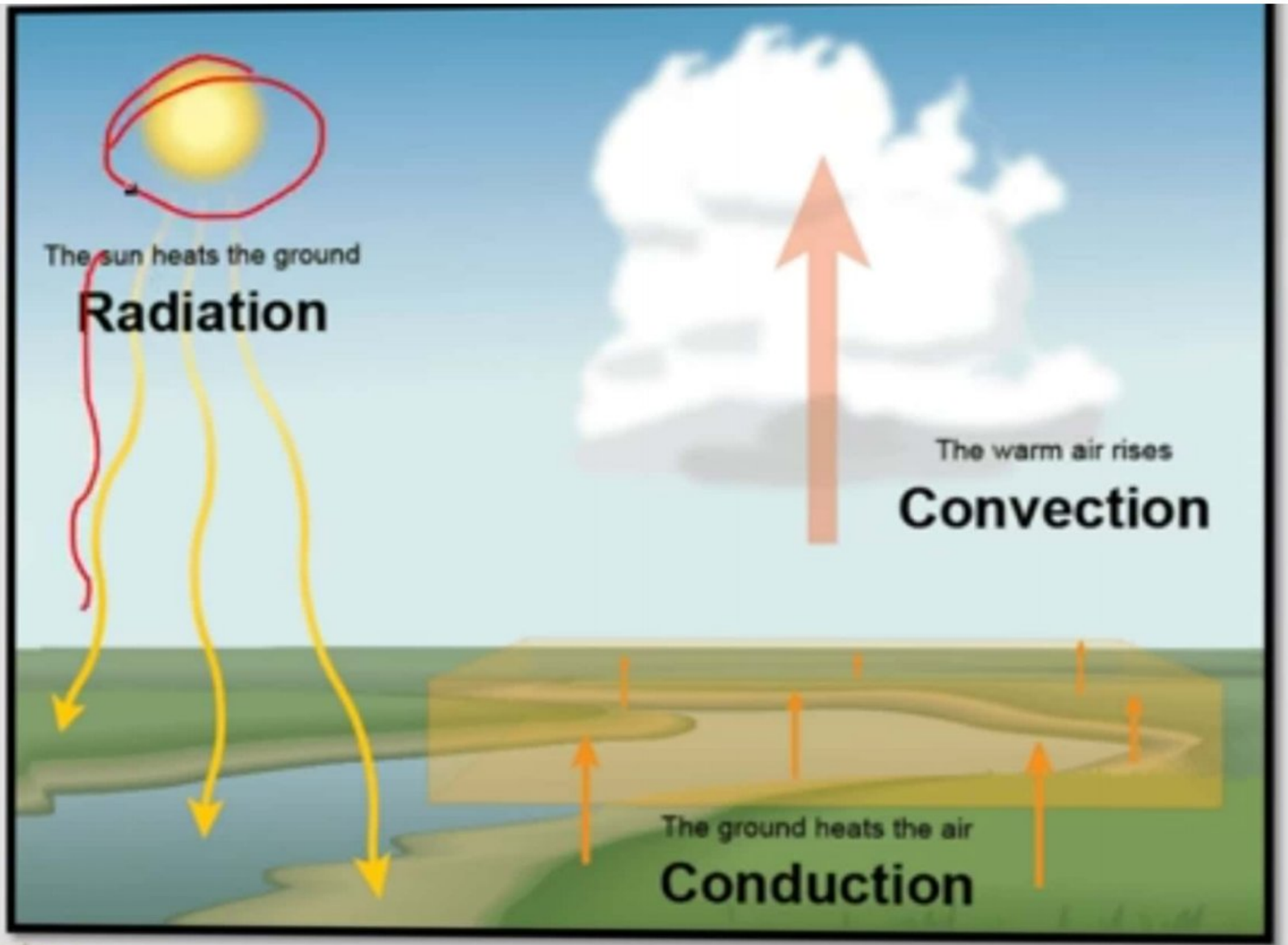
1. Heat transfer from <u>one part of a body to other</u>.
2. Heat transfer from <u>one body to another</u> touching body.

Conduction is effective - when difference in temperature

Movement of heat from **warmer** body **to cooler** body through molecular movement - depend on heat conductivity of the substance.

The **air coming in contact** with **warmer earth surface** - gets heated due to conduction.

But it is **effective** only **upto few metres** in lower atmosphere (air is poor conductor of heat)



Terrestrial radiation

Process of **heat transfer** - one body to another - **without** the aid of **material medium(solid**, liquid, gas) - called radiation.

Earth surface gets heated - insolation from Sun - through **short wave** electromagnetic radiation

Radiate heat to the atmosphere- form of long wave or infrared radiation - throughout 24 hours.

Atmosphere transparent for incoming shortwave solar radiation

But **absorbs more than 90%** of outgoing Terrestrial radiation (through water vapour, carbon dioxide, ozone etc.)

Convection

Transfer of heat energy through movement of **mass of a substance** - from one place to another.

Convection is **effective** - only in **fluid** or **gases**- because their internal **mass motion** activates Convection of heat energy.

Air coming in **contact** with warmer Earth surface - gets heated and expand in volume.

Warmer air - becomes lighter and Rises upward - **vertical circulation of Air** sets in.

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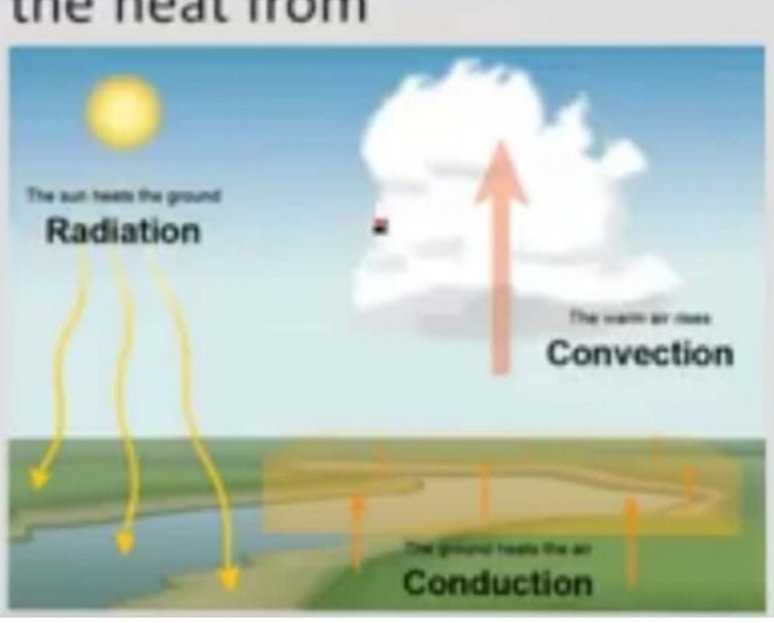
Consequently, **relatively colder air** becomes **heavier**(contraction in volume) - thus it **decends.**

The **descending air** is **warme**d- because of dry adiabatic rate.

This whole mechanism - ascent of warmer + Descent of colder air --> **generates convective current** - transporting the heat from ground surface to atmosphere



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Facts ;

1. Earth surface receives m**aximum energy at 12 noon** but the maximum temperature never occurred at 12 noon because the **transformation** of solar energy i**nto heat energy** required time.

2. The energy received exceeds the loss of energy through longwave radiation (from 6AM - 2-4 PM). So, maximum recorded temperature is between 2 p.m. - 4 p.m.(called maximum daily temperature)

3. The loss of energy the amount of energy received from 4 p.m. To 6 a.m. (minimum daily temperature).

4. There is no conincidence between the time of maximum / minimum amount of insolation received from Sun **and** maximum and minimum temperature of air.(called **lag of temperature**).

5. Average of maximum and minimum temperatures within 24 hours(called m**ean daily temperature**).

6. The difference between maximum and minimum temperature of a day(24 hrs) - called daily / d**iurnal range of temperature.**

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Distribution of temperature

The spatial and temporal distribution of temperature - very significant

Because- different types of weather, climate, vegetation zone, animal and human life etc. **depends on temperature distribution.** **(**horizontal / vertical**).**

The spatial distribution of temperature - controlled by variety of factors:

1. Latitude / distance from equator.
2. Altitude / height from sea level.
3. Distance from sea coast.
4. Nature of land and water.
5. Properties of ground surface.
6. Nature of slopes.
7. Prevailing winds.
8. Ocean currents.

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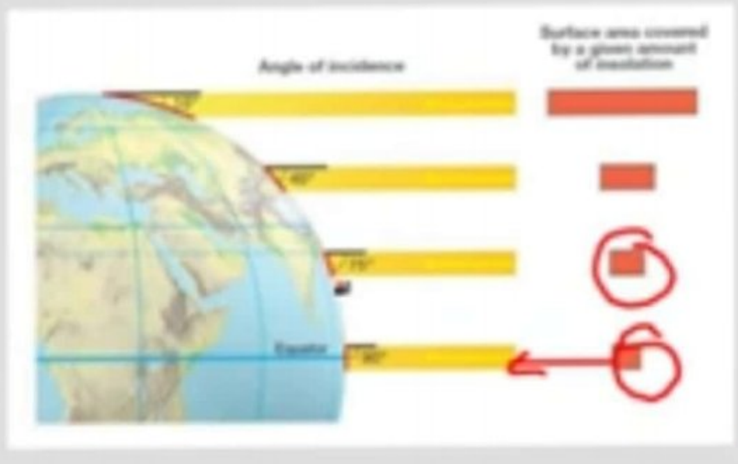
1. Latitude / distance from equator.

Temperature of atmosphere of a particular place - depends on **amount of insolation** received.

Air **temperature - decreases poleward**.

Maximum temperature recorded along **20 degree** latitude- not along equator(major portion of insulation is reflected by clouds + heat is lost in evaporation)



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2. Altitude / height from sea level.

Temperature decreases with increasing altitude - **6.5 'C per KM**.

Reasons ;

1. **Major source** of atmospheric heat is **Earth's surface** (conduction, convection, radiation).

2. **Near Earth surface** - layer of air- denser- becomes lighter upward.

Lower layer - more water vapour and dust particle - absorb larger amount of heat radiated from Earth's surface.

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3. Distance from sea coast.

Moderate weather conditions - **mixing of** temperature - daily rhythm of **land** and **sea breezes.**

Daily range of temperature near coastal environment- minimum (increases with distance from sea coast).

Feature of **marine climate** - minimum daily range of temperature.

Feature of **Continental climate** - extremely high daily range of temperature

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4. Nature of land and water.

Land becomes **warm and cold** more quickly than water bodies

That is why, **even after receiving equal amount of insolation** - temperature of land is **more**.

Reasons behind **differential rate** of **heating** and **cooling** of land and water ;

a) Sun rays penetrate ~3 feet in land(opaque)
- greater depth water (transparent to solar radiation)

thin layer of soil and rocks - **heated quickly** (greater concentration of insulation - respectively smaller mass)
similarly, thin ground layer emits heat quickly and becomes **colder.**

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b) Heat is distributed in **water** surface (**mobile**) unlike **land** surface (**static**).

When heated- light water moves away horizontally to other place - **solar rays** have to **heat fresh layer** of **cold water.**

c) More **evaporation** from sea and oceans. Hence, **heat is spent** in the process - O**cean get less insolation** than land surface.

d) The **specific heat of water** is much greater than land - because the **relative density of water** is much **lower** - means more heat is required to raise the temperature of 1 gram of water by 1'C.

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e) The **albedo** of incoming solar radiation - **ocean water** is far **more than land** surface - so water receive less insolation than land.

f) Oceanic areas - **clouded** - receive **less insolation**.- but clouds **absorbed outgoing Terrestrial radiation** and <u>counter radiate</u> the heat back.

Process **retards - loss of heat** from ocean surface & slows down the mechanism of cooling of air lying over the Ocean.

On the other hand - **land surface** receive **more insolation** at faster rate(less cloudiness) - also lose more heat quickly.

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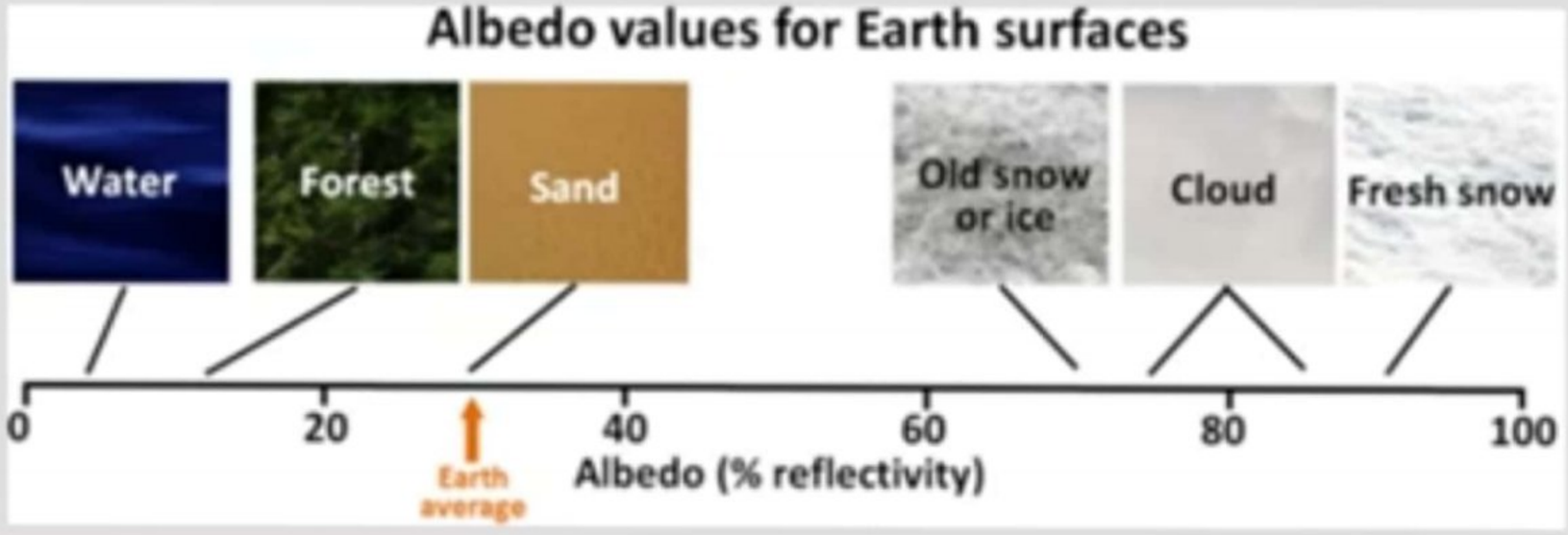
5. Properties of ground surface.

Colour, vegetation and land use practices of land area - affects **temperature distribution.**

Dark coloured ground surface receives **more solar radiation** than **light coloured** surface.



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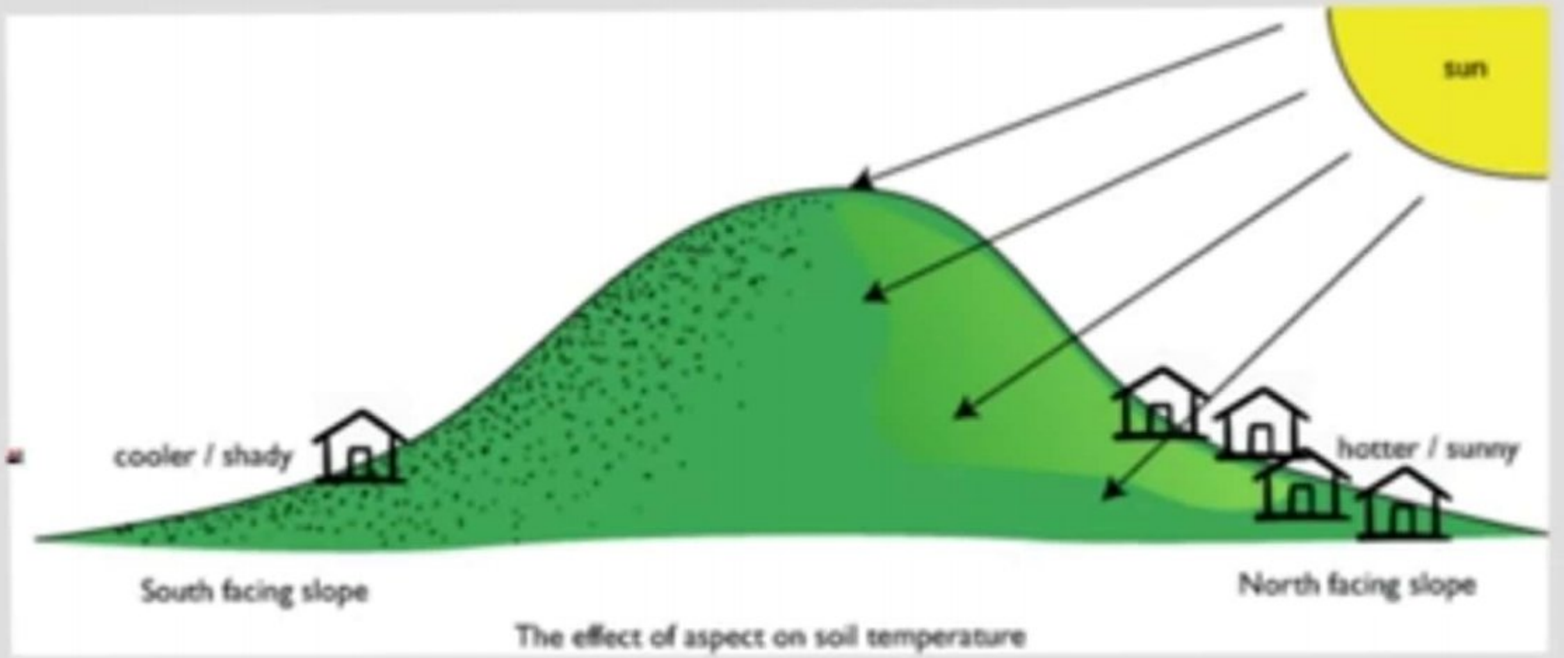
6. Nature of slopes.

The ground s**lope facing the sun** receives **more insolation** (than the leeward slope, rays reaches obliquely) - thereby recording higher temperature.



The effect of aspect on soil temperature

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7. Prevailing winds.

Wind - **redistribution of temperature** - moderating effect of ocean to adjacent coastal land areas.

Wind blowing - low latitude to high - raising the temperature of region
- high latitude to low - lowers the temperature of region
- Ocean to coastal land - lower the daily range of tempn.
- higher part of mountain - lower the temperature of Valley

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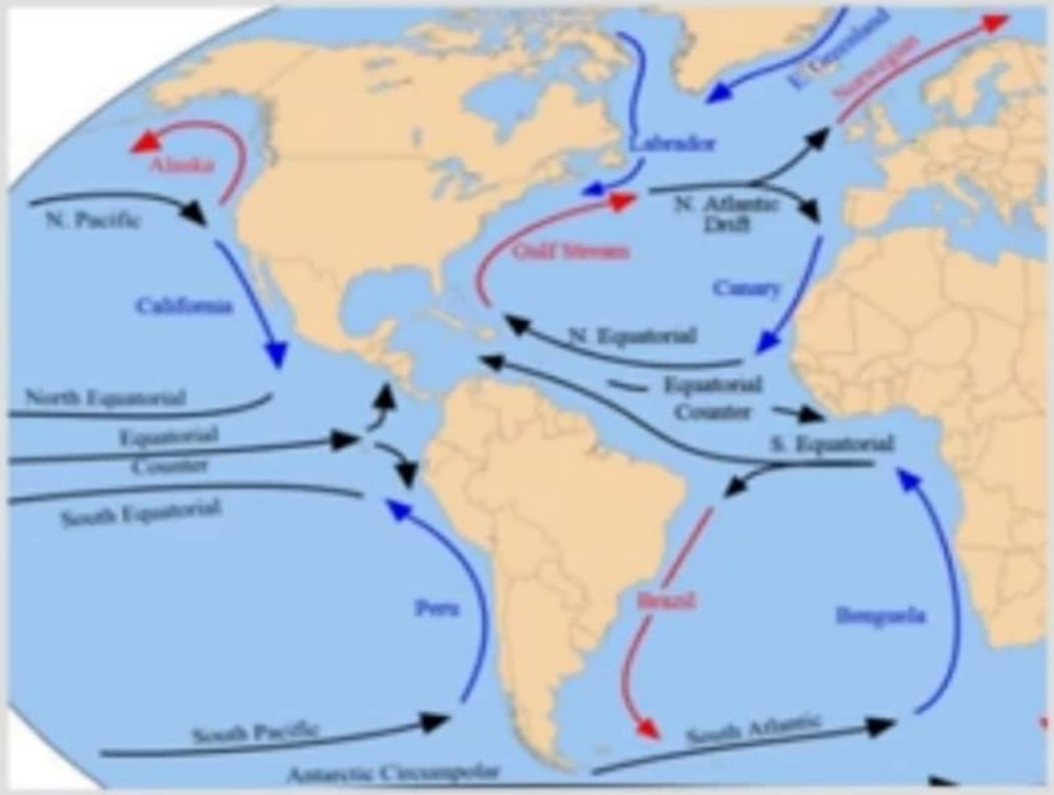
8. Ocean currents.

The **warm ocean current** - - from <u>tropical areas to temperate</u> **raises** the average temperature of affected area. Eg. Gulfstream



Vertical distribution of temperature

Temperature decreases with increasing **height** in troposphere.

The **rate varies** according to season, duration of sunshine, location.

On avg. Rate of decrease of temperature with increasing altitude - stationary column of air(absence of vertical motion) -6.5'C per km.(**normal lapse rate** - 1000 times greater than horizontal lapse rate)

Decrease of temperature upward in atmosphere - proves the fact that **atmosphere gets heat from earth surface** (conduction, convection, radiation)

Reasons - decrease of temperature of upward ;

1. **Heat transfer** to atmosphere - **earth** surface(conduction, convection, radiation). Thus, as altitude increases - the amount of heat transported upward decreases.

2. **Air pressure higher** in **lower portion** of atmosphere - **air density** maximum at lower atmosphere.

3. Quantity of **water vapour, dust particles** etc., which absorbs outgoing long wave Terrestrial radiation - **more concentrated in lower portion** of atmosphere - more absorption of Terrestrial radiation in lower portion

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Temperature at tropopause **increases** - from over the equator towards pole - because <u>height of tropopause decreases</u> from equator - poles.

Sometimes temperature increases with increasing height, warm air rise over cold air - **inversion of temperature.**

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