Unit D
Energy

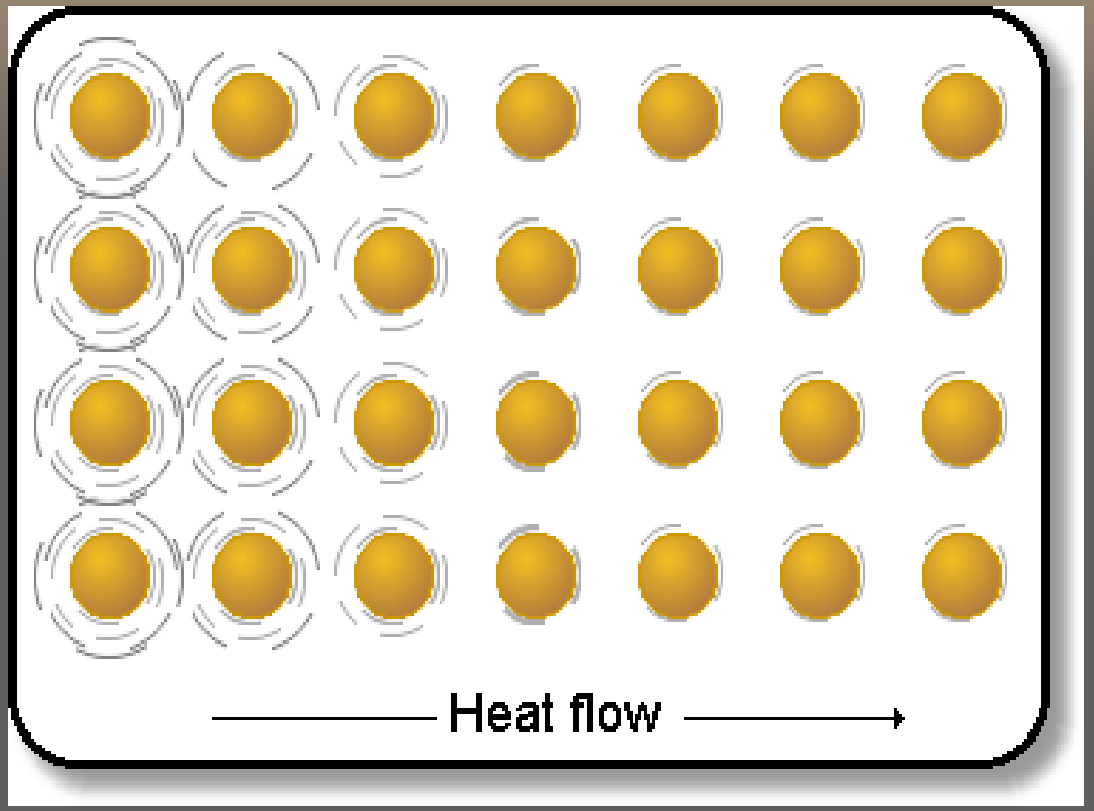
- ENERGY TRANSFER
  - CONDUCTION
  - CONVECTION
  - RADIATION

Temperature vs. Heat

- Temperature
  - The average kinetic energy of the molecules of a substance
- Heat
  - A transfer of energy due to differences in temperature.

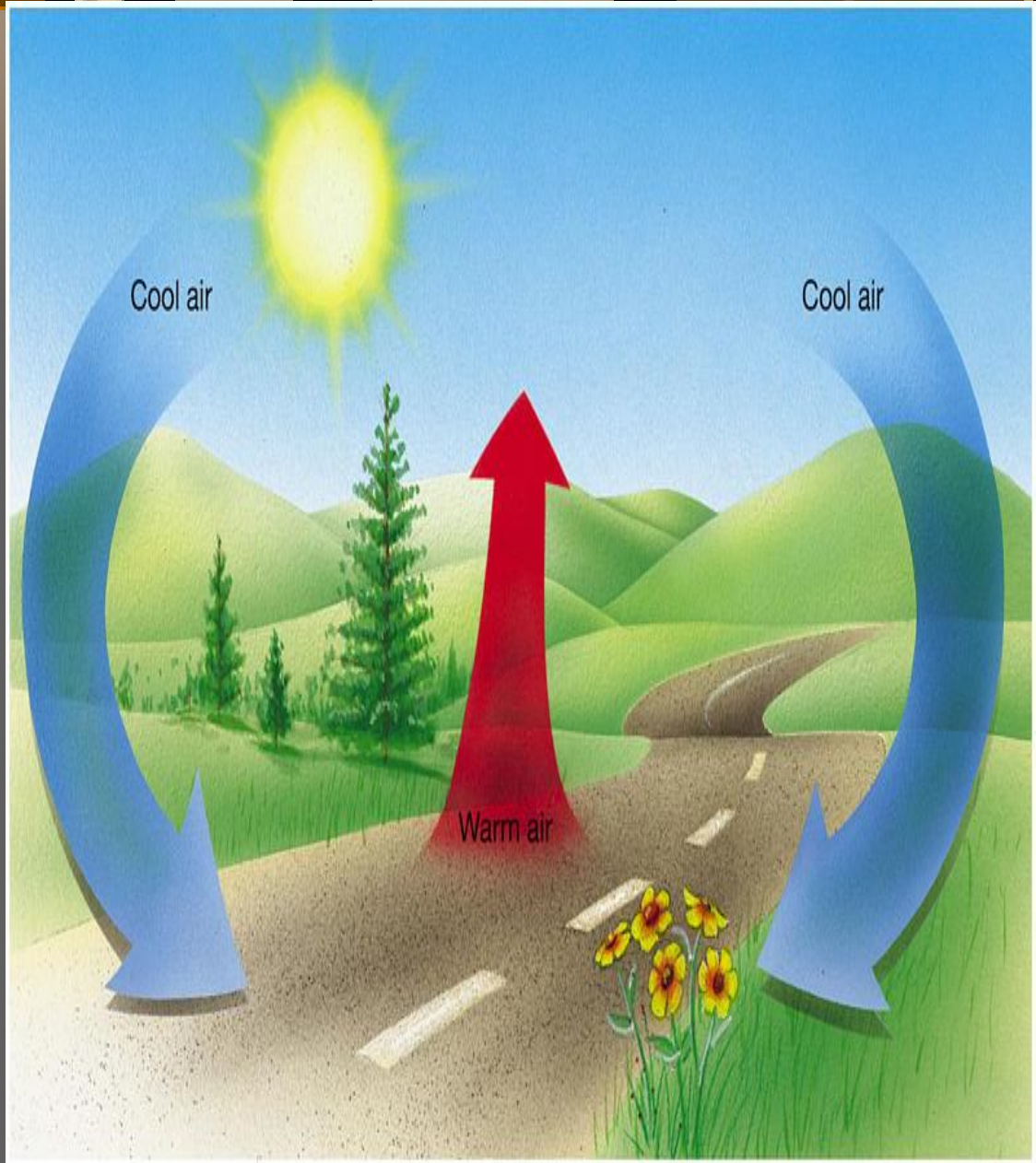
Conduction

- Energy transfer through molecular collisions
- Works well in solids



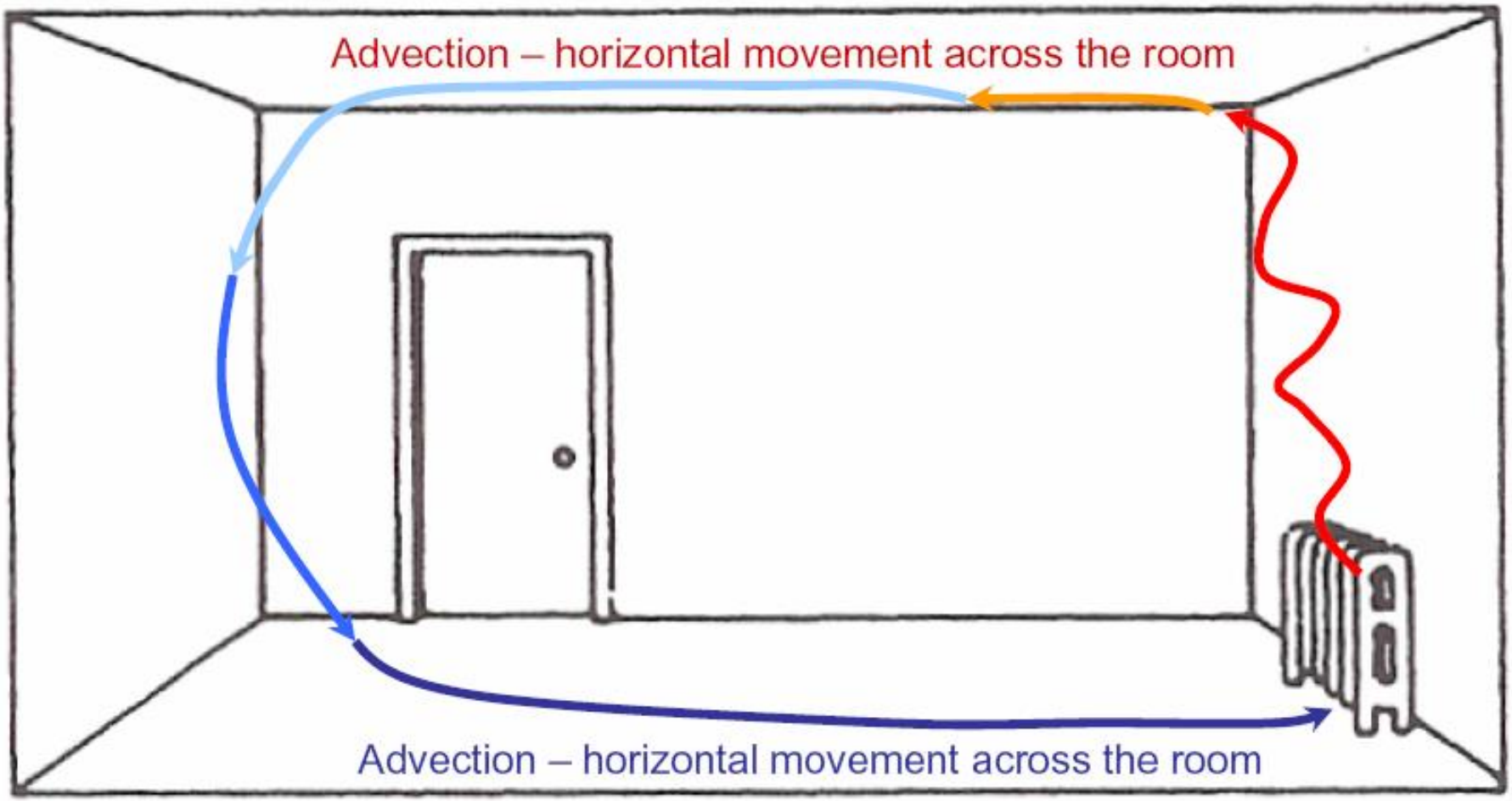
Convection

- Method of energy transfer through density differences
- Works well in gasses and liquids



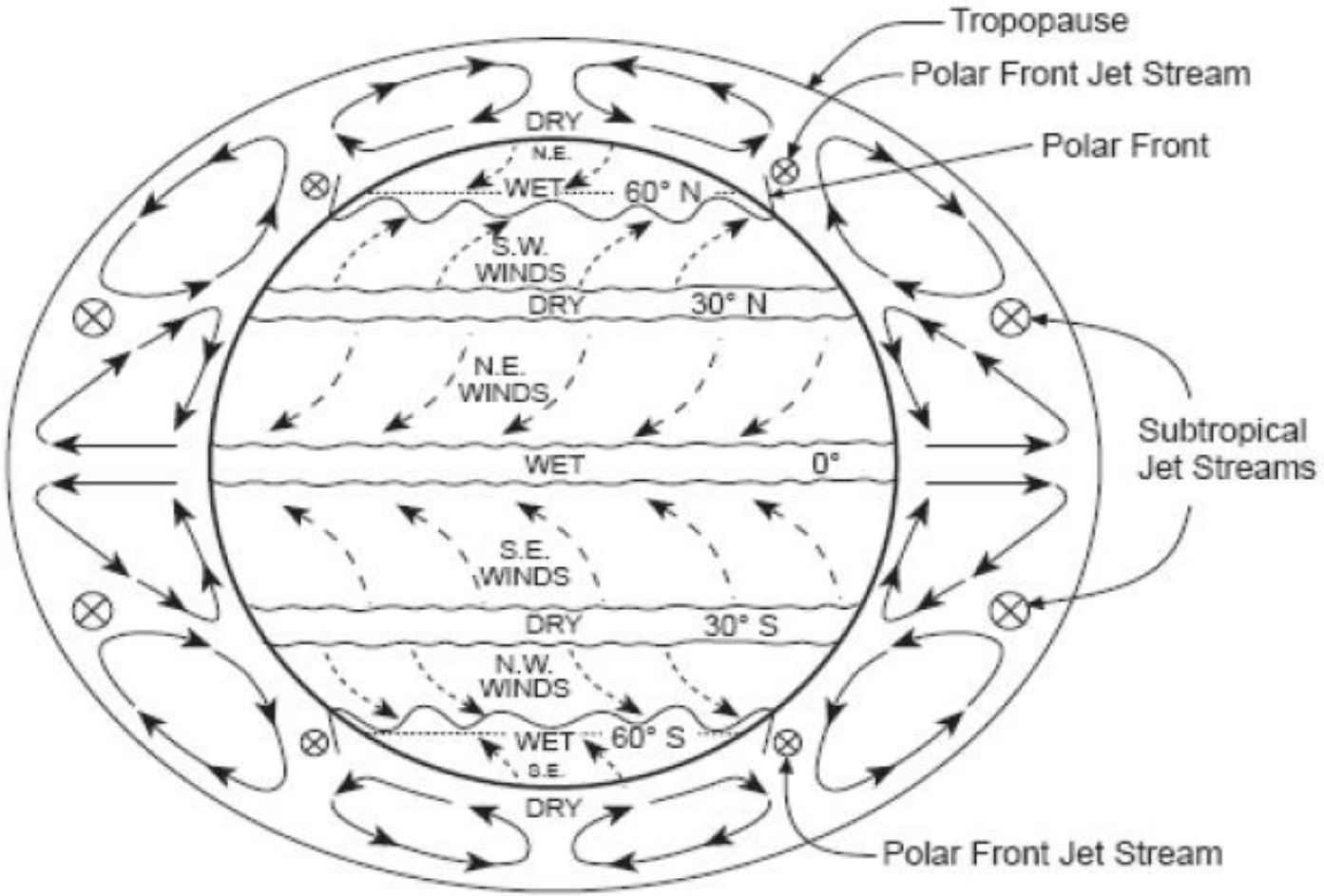
Convective energy flows in “cells”.

THE CONVECTION CELL



Convection in our atmosphere:

Can you find (and explain) the "convection cells"?



Reminder: this is a 2-D representation of a 3-D object!!

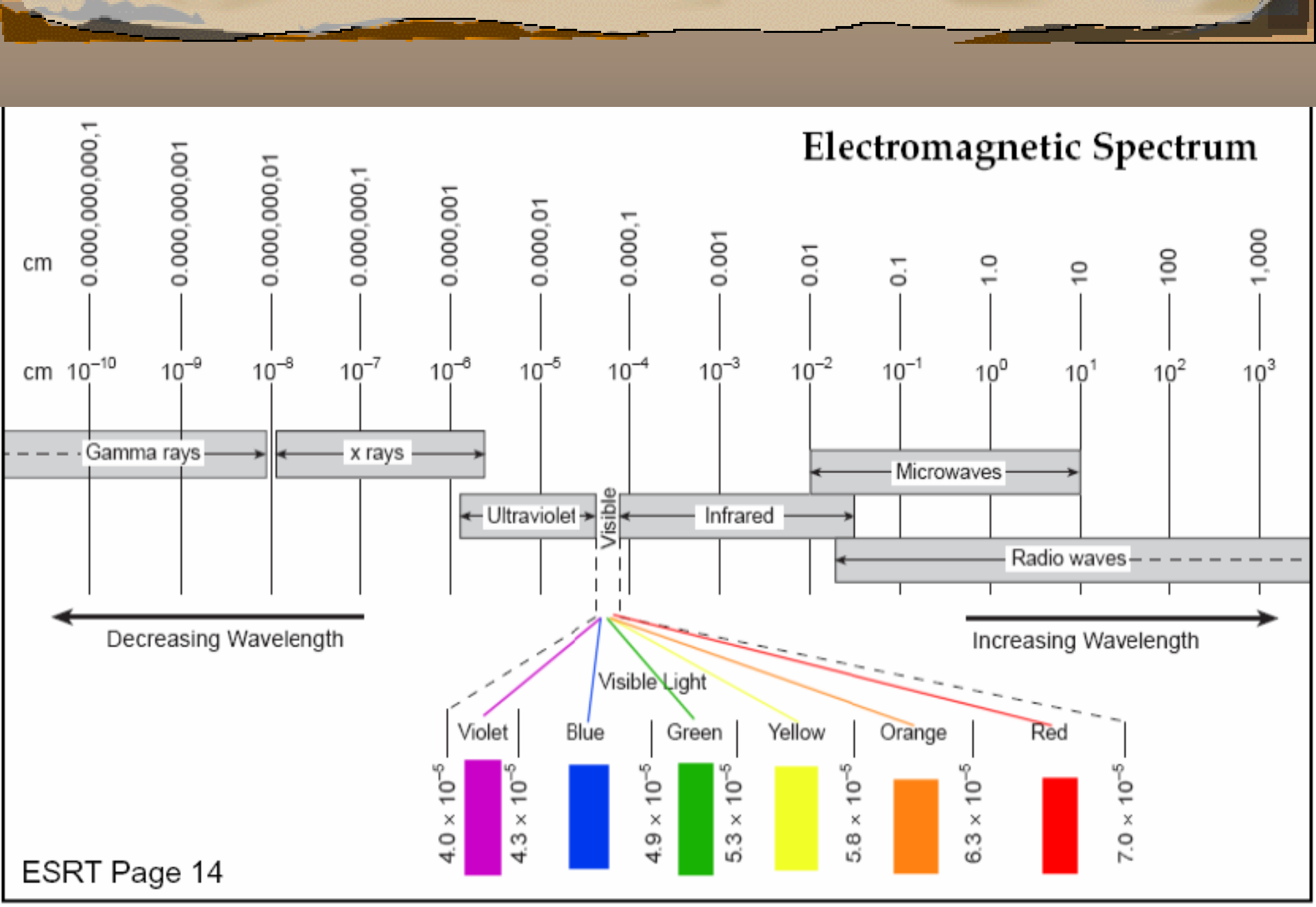
Why is it important to know this?

Radiation

- Electromagnetic Radiation
- Insolation (Incoming Solar Radiation)
- Energy transfer in the form of transverse waves
- No medium needed for transfer

Addison Wesley Astronomy

0 %


Electromagnetic Spectrum
cm
0.000,000,000,1
0.000,000,001
0.000,000,01
0.000,000,1
0.000,001
0.000,01
0.000,1
0.001
0.01
0.1
1.0
10
100
1,000
cm
10^{-10}
10^{-9}
10^{-8}
10^{-7}
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Gamma rays
x rays
Ultraviolet
Visible
Infrared
Microwaves
Radio waves
Decreasing Wavelength
Increasing Wavelength
Visible Light
Violet
Blue
Green
Yellow
Orange
Red
4.0×10^{-5}
4.3×10^{-5}
4.9×10^{-5}
5.3×10^{-5}
5.8×10^{-5}
6.3×10^{-5}
7.0×10^{-5}

ESRT Page 14


0 %
Loading

INSOLATION

- INCOMING SOLAR RADIATION
- FACTORS THAT AFFECT THE *INTENSITY*
  - ANGLE
  - TIME OF DAY
  - LATITUDE

ANGLE OF INSOLATION

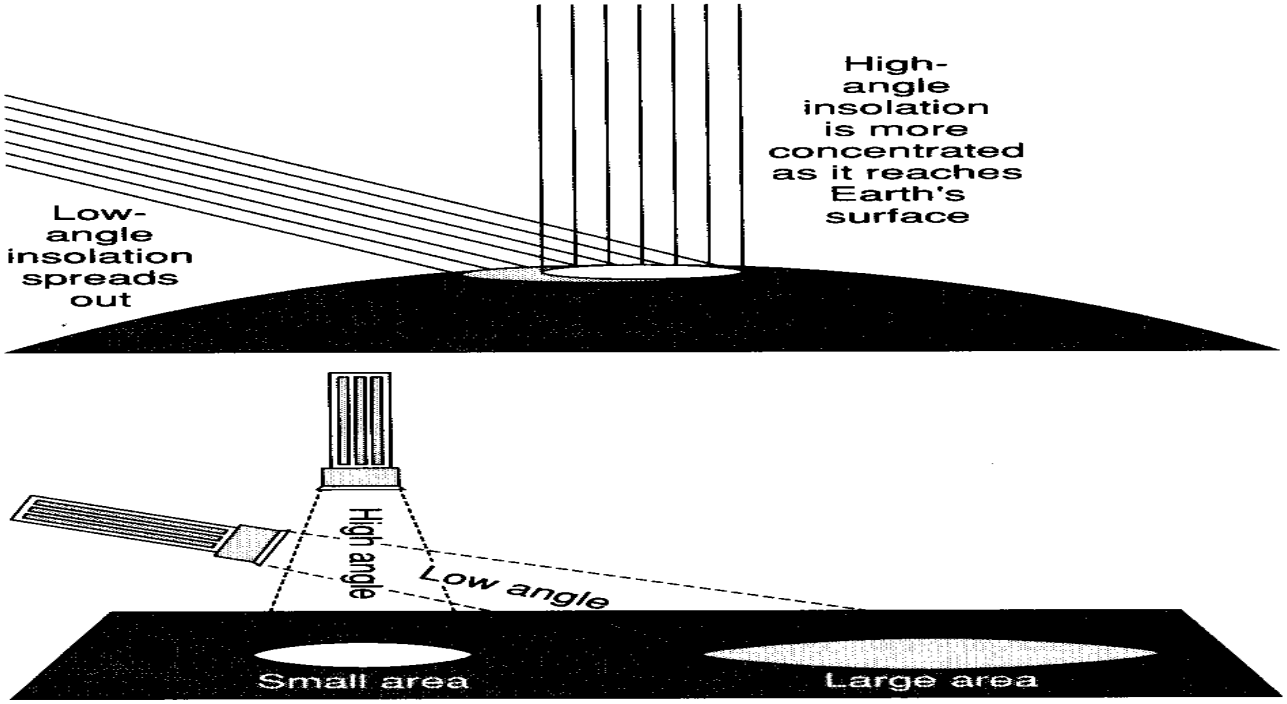
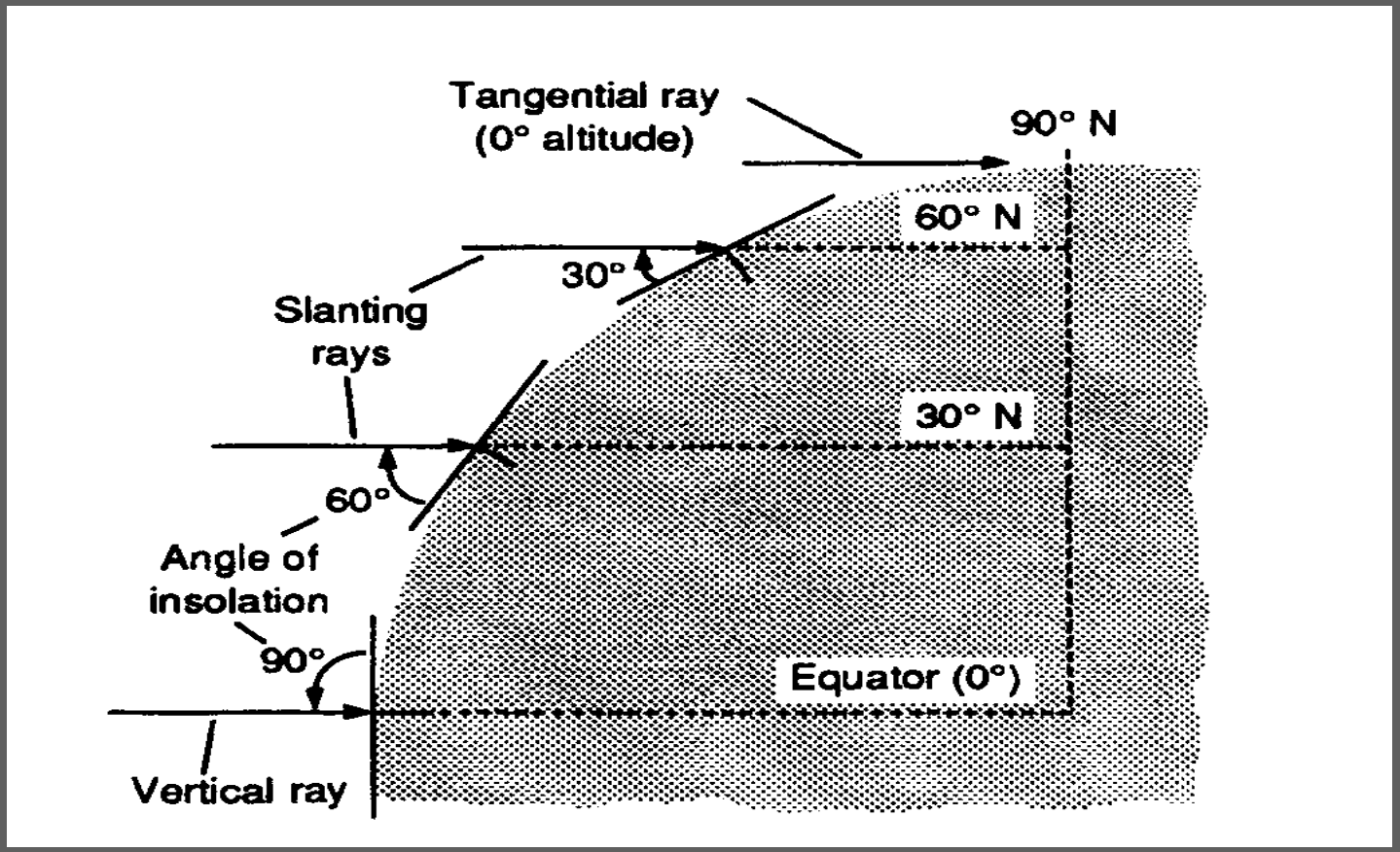
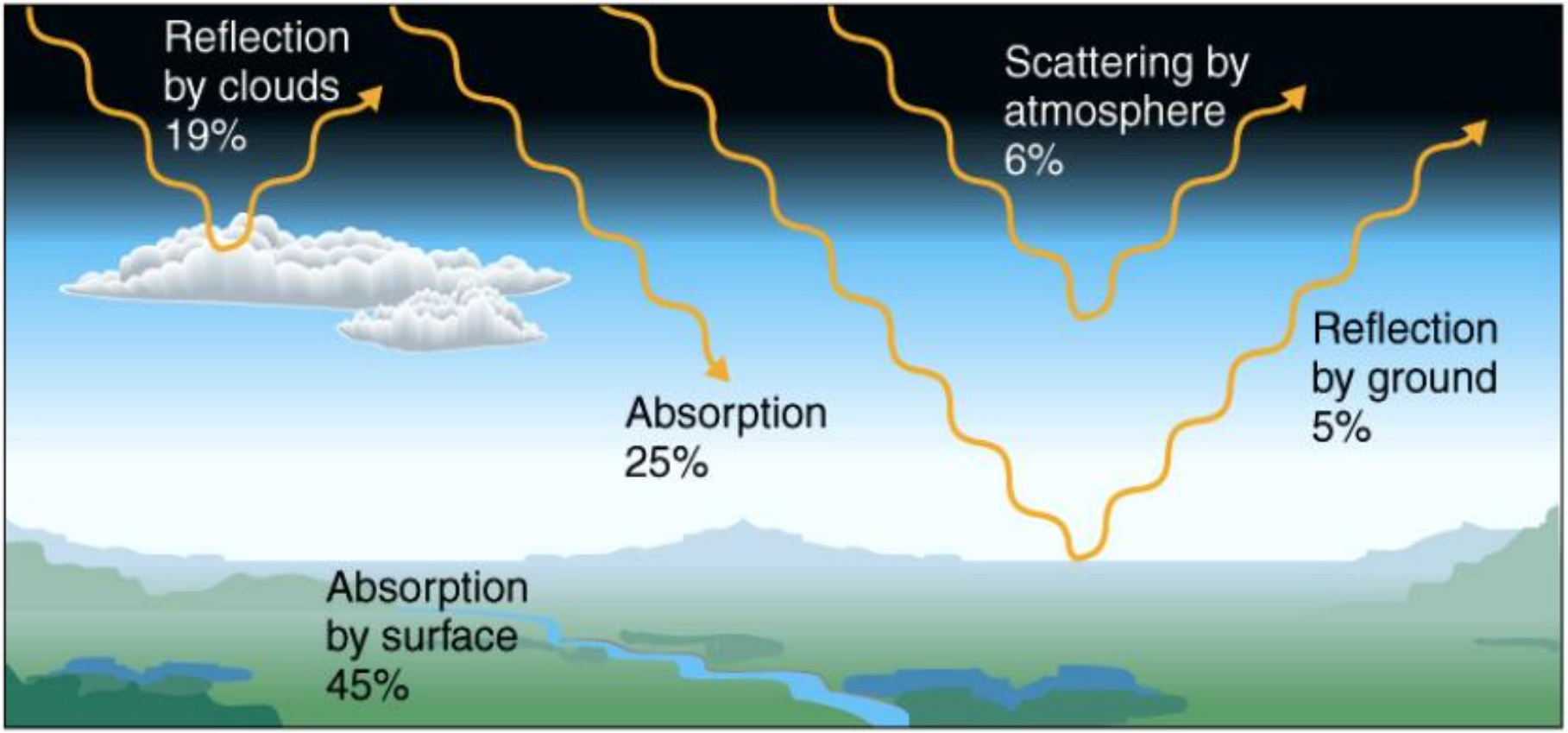


Figure 8-14. Angle of insolation. When the sun is directly overhead, the sun's rays are concentrated in a small area. When the sun is low in the sky, the same energy covers more area so the sunlight is not as strong.

ANGLE OF INSOLATION ON EARTH



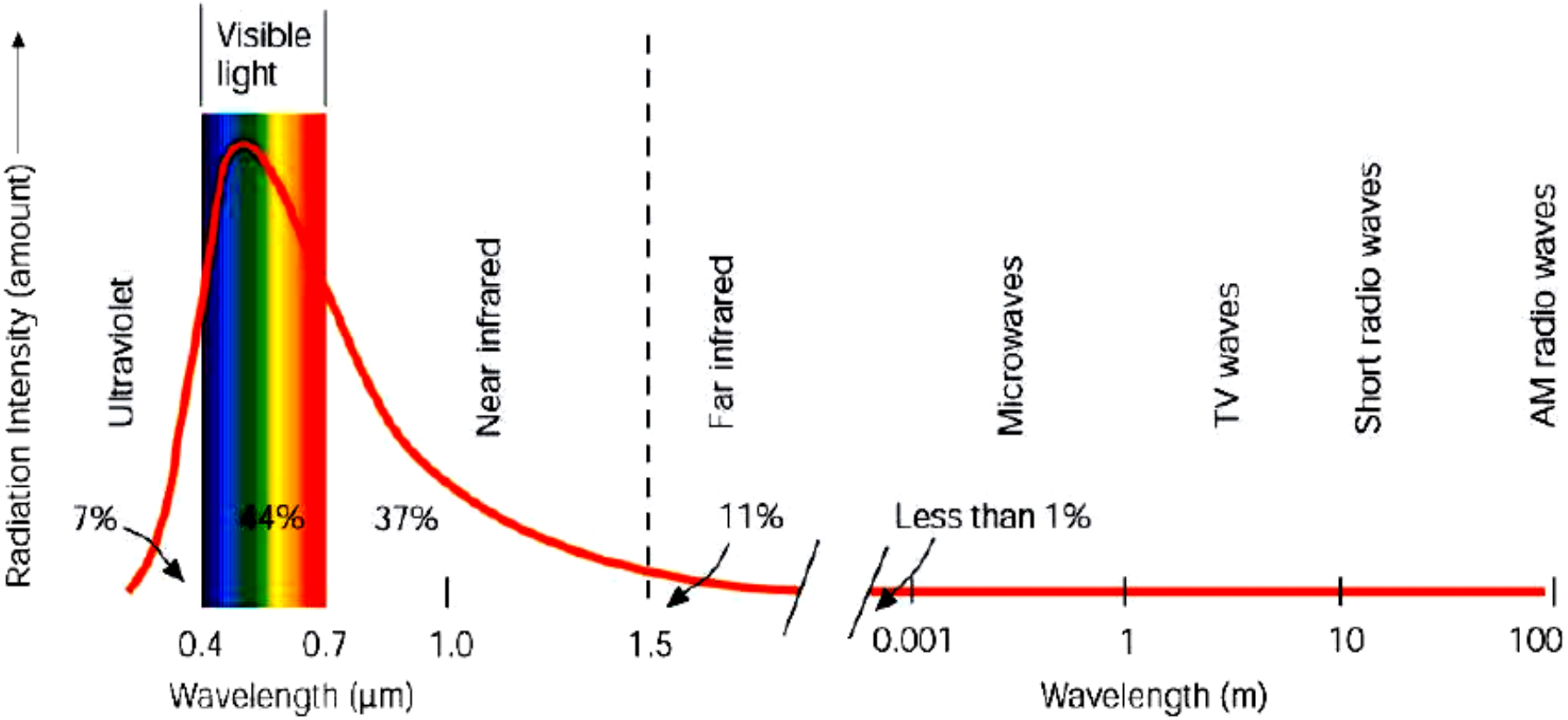
What happens to the Sun's energy that reaches the Earth?



- X-RAYS, GAMMA RAYS AND OTHER SHORT WAVELENGTHS ARE *ABSORBED* BY THE ATMOSPHERE
- INFRARED RAYS (HEAT) ARE ABSORBED BY *WATER VAPOR* AND *CARBON DIOXIDE* (GREENHOUSE GASSES)
- THESE 2 GASSES ARE VERY IMPORTANT AND MUST BE MEMORIZED

- *VISIBLE LIGHT* IS THE MOST *INTENSE* PART OF THE SPECTRUM AND EASILY PENETRATES THE ATMOSPHERE

Radiative Energy Output by the Sun



Solar radiation has peak intensities in the shorter wavelengths.

Surface properties and Absorption

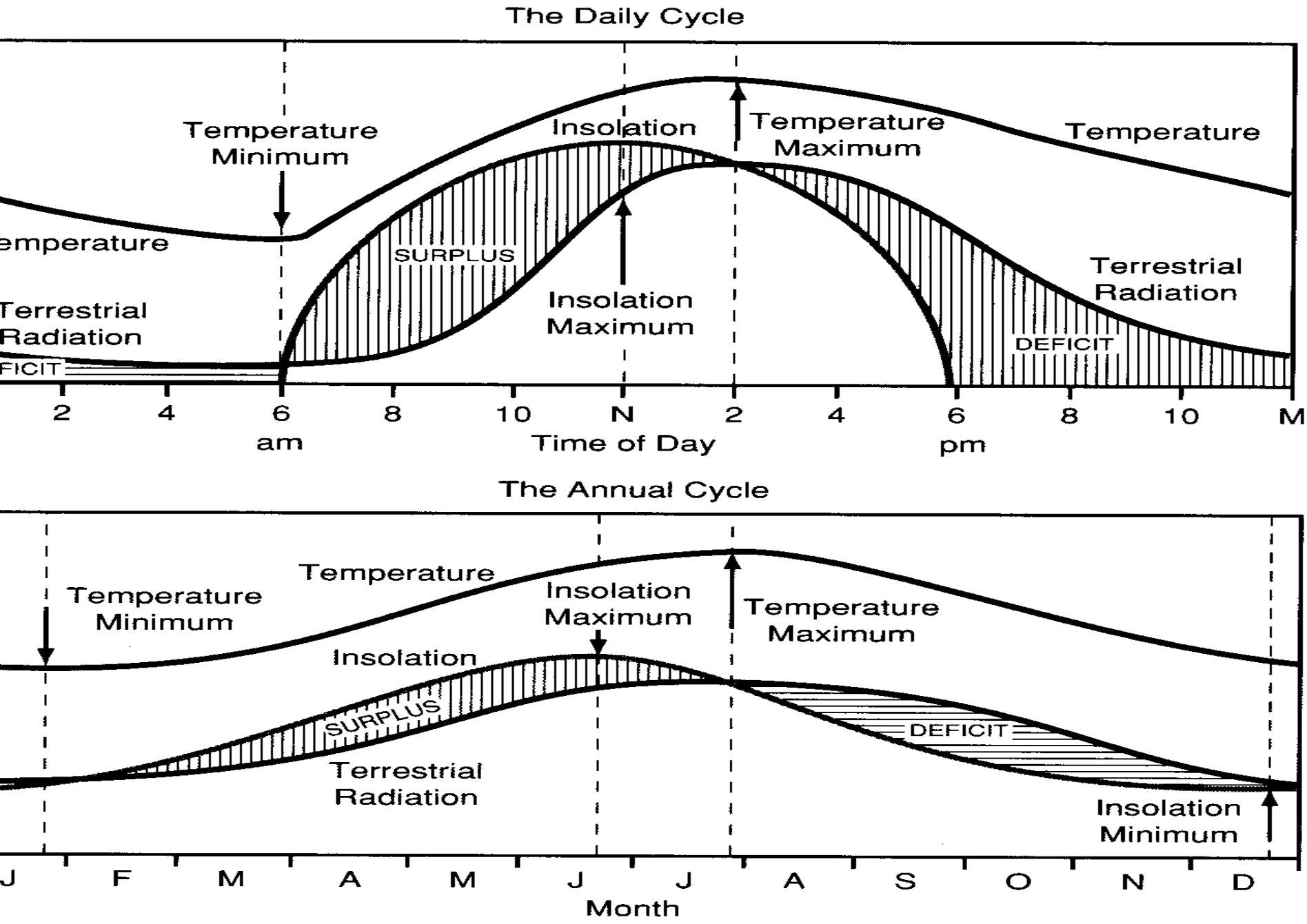
- Characteristics of a surface determine the amount of electromagnetic energy that can be absorbed
  - Color
    - Dark colors are good absorbers while light colors are good reflectors
  - Texture
    - A rough texture is a good absorber while a smooth surface is a good reflector

DAILY TEMPERATURE LAG

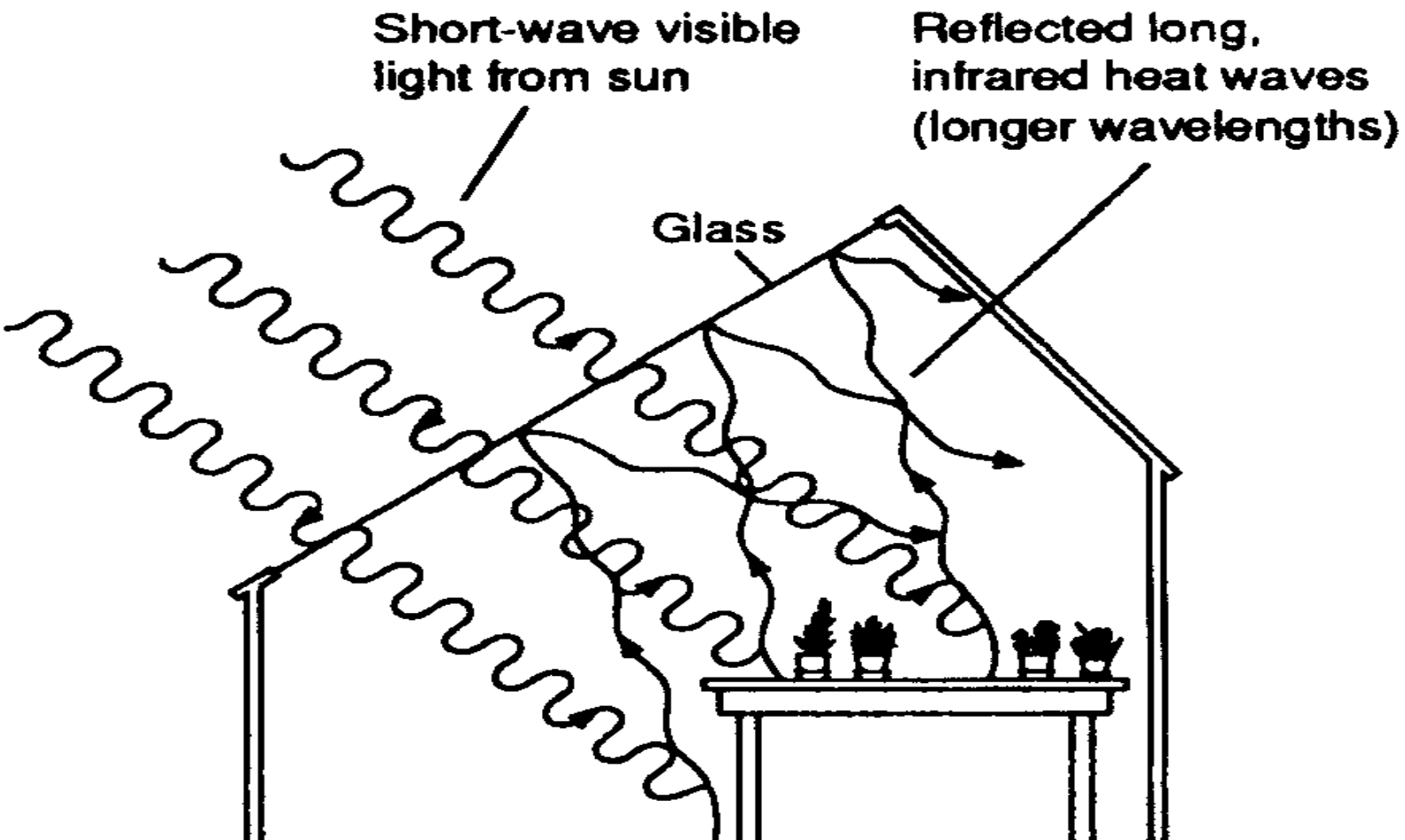
- ALTHOUGH THE INTENSITY OF INSOLATION IS GREATEST AROUND NOON, THE HIGHEST TEMPERATURE OF THE DAY USUALLY OCCURS AROUND 3 P.M.
- WHAT TIME OF DAY IS USUALLY COLDEST?

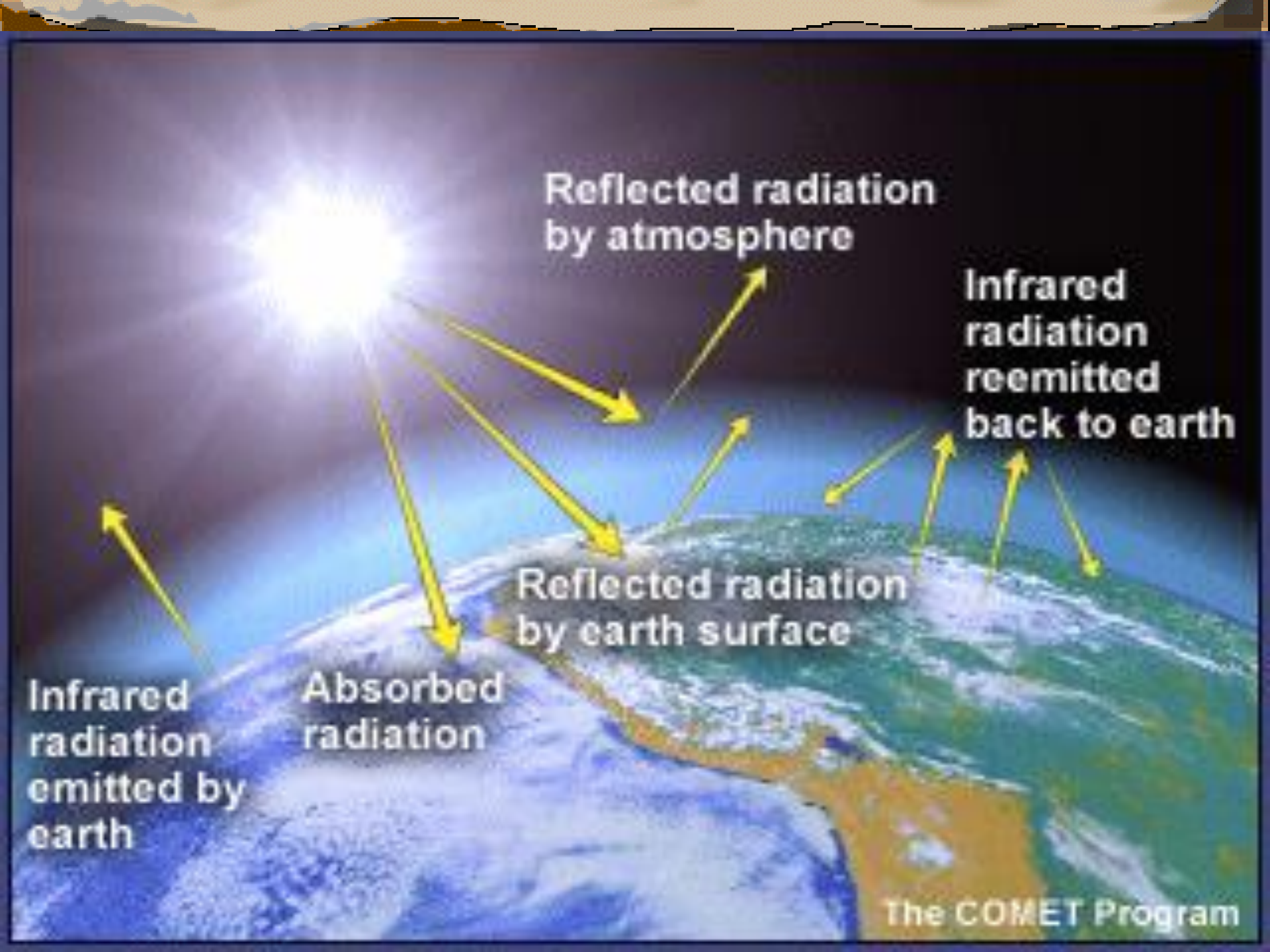
SEASONAL TEMPERATURE LAG

- THE 1ST DAY OF SUMMER IS JUNE 21, BUT THE HIGHEST TEMP OF THE YEAR IS USUALLY ABOUT 6 WEEKS LATER.(AUGUST 1ST.)
- WHAT DAY IS USUALLY THE COLDEST?


The Daily Cycle
Temperature Minimum
Insolation
Temperature Maximum
Temperature
emperature
SURPLUS
Terrestrial Radiation
Insolation Maximum
Terrestrial Radiation
FICIT
DEFICIT
2
4
6
8
10
N
2
4
6
8
10
M
am
Time of Day
pm
The Annual Cycle
Temperature Minimum
Temperature
Insolation Maximum
Temperature Maximum
Insolation
SURPLUS
DEFICIT
Terrestrial Radiation
Insolation Minimum
J
F
M
A
M
J
J
A
S
O
N
D
Month

GREENHOUSE EFFECT




Reflected radiation
by atmosphere
Infrared
radiation
reemitted
back to earth
Reflected radiation
by earth surface
Absorbed
radiation
Infrared
radiation
emitted by
earth
The COMET Program


0 %
Loading

TERRESTRIAL RADIATION

TERRESTRIAL (EARTH) RADIATION OCCURS WHEN INSOLATION IS ABSORBED BY THE EARTH AND RERADIATED BACK INTO THE ATMOSPHERE AS LONG WAVELENGTH RADIATION CALLED INFRARED RADIATION

- THERFORE, THE EARTH ABSORBS SHORT WAVE RADIATION AND RERADIATES THE LONG WAVE RADIATION (INFRARED) DURING THE DAY CAUSING THE TEMP TO INCREASE.
- AT NIGHT, THE EARTH LOSES ENERGY THROUGH RADIATION

- CLEAR, CALM NIGHTS TEND TO BE COLD BECAUSE OF THE GROUND RADIATION
- CLOUDY NIGHTS ARE KEPT WARMER BECAUSE OF THE WATER VAPOR IN THE AIR AND CLOUDS