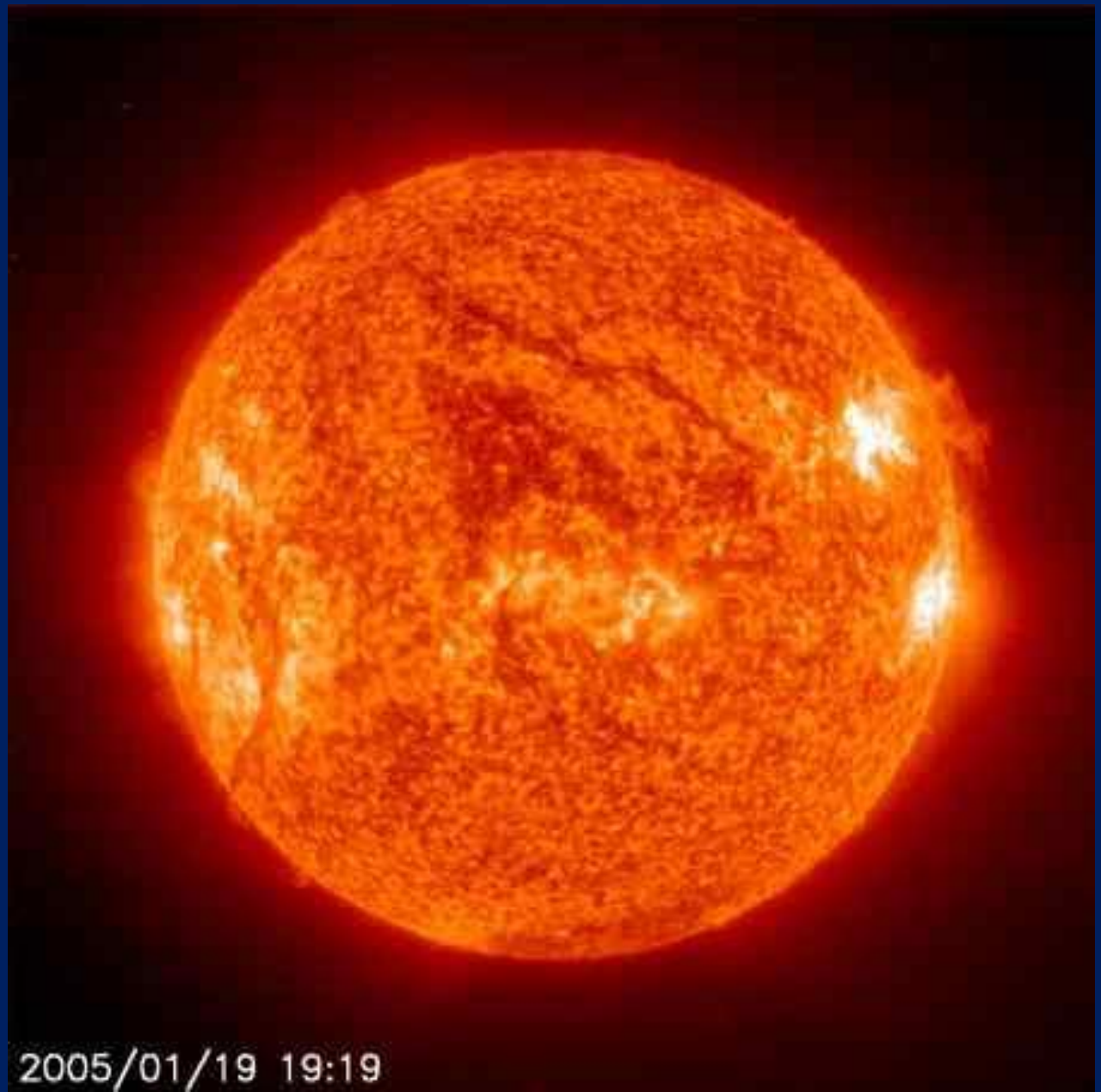
Energy in Earth Processes



What is Energy?

Energy: The ability to do work

Everything that is done in the universe – involves the use or transfer of energy.

Types of Energy

1) Potential Energy:

stored energy

EXAMPLES

AT THE TOP OF A SKI SLOPE
WATER BEHIND A DAM

Types of Energy

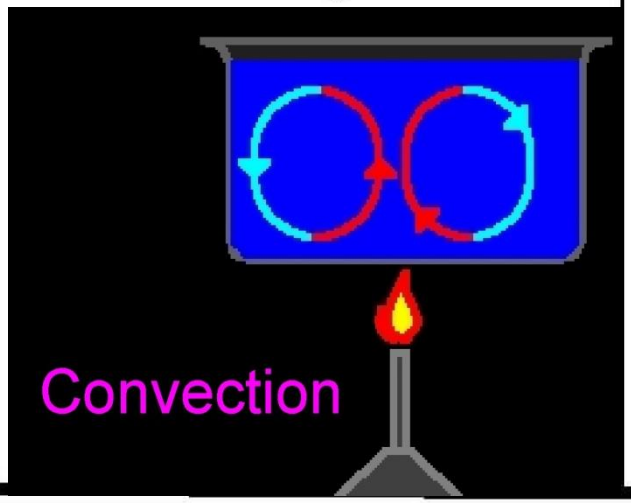
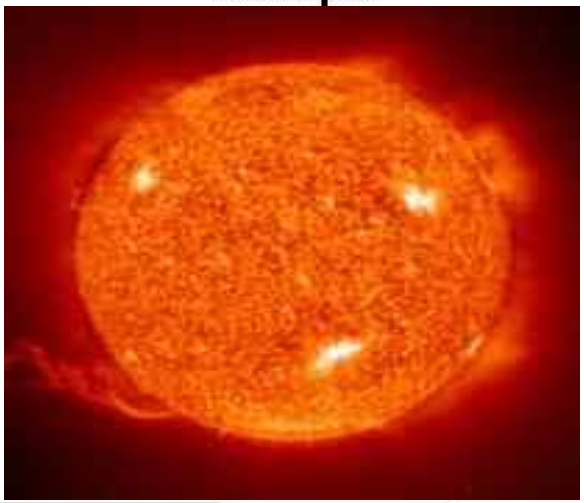
2)Kinetic Energy

energy in motion

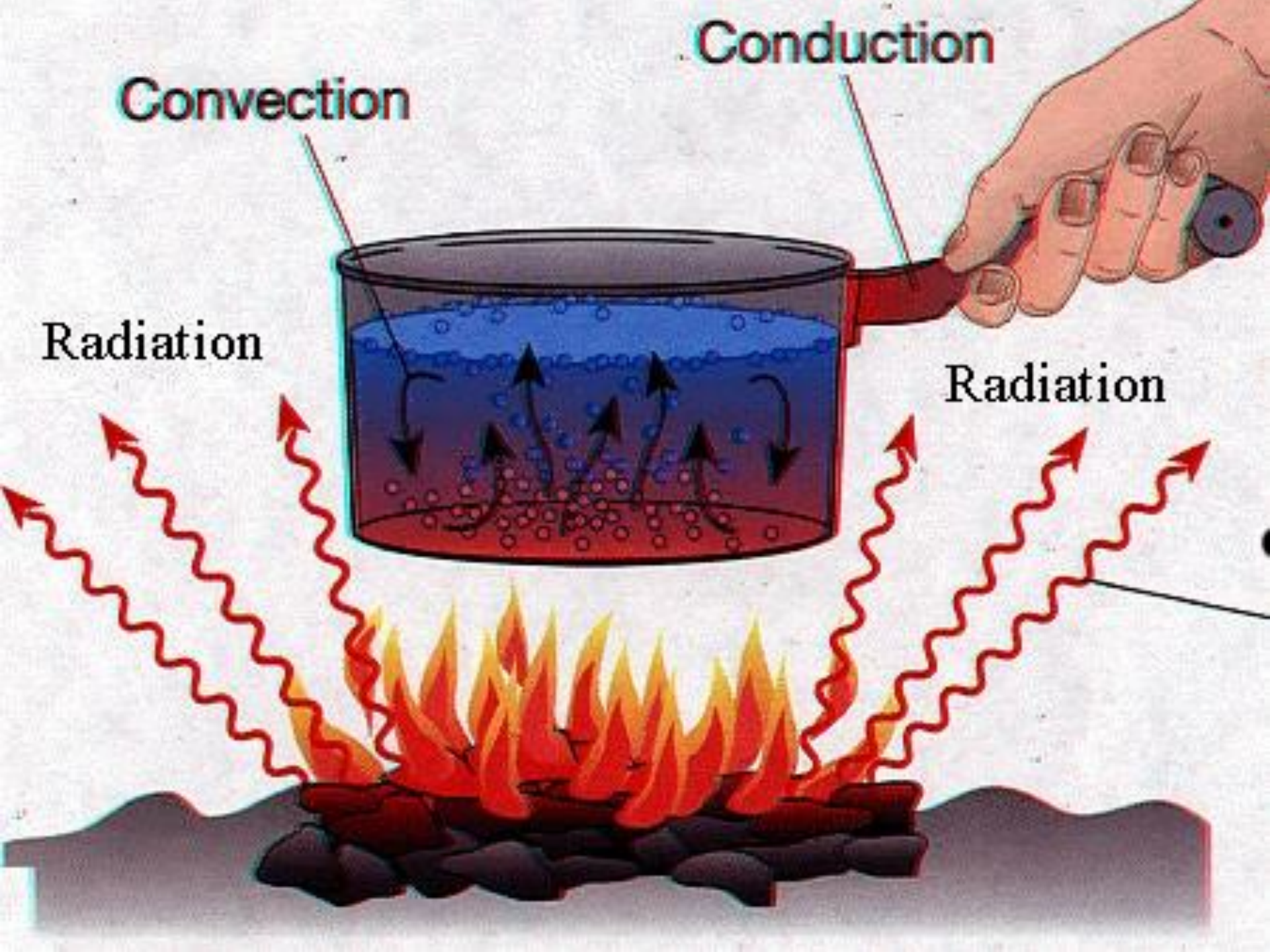
EXAMPLES

SKIING DOWNHILL
THROWING A BOWLING BALL
WATER FLOWING IN A RIVER

What are the three ways that energy can be transferred between objects? Give one real-life example of each.

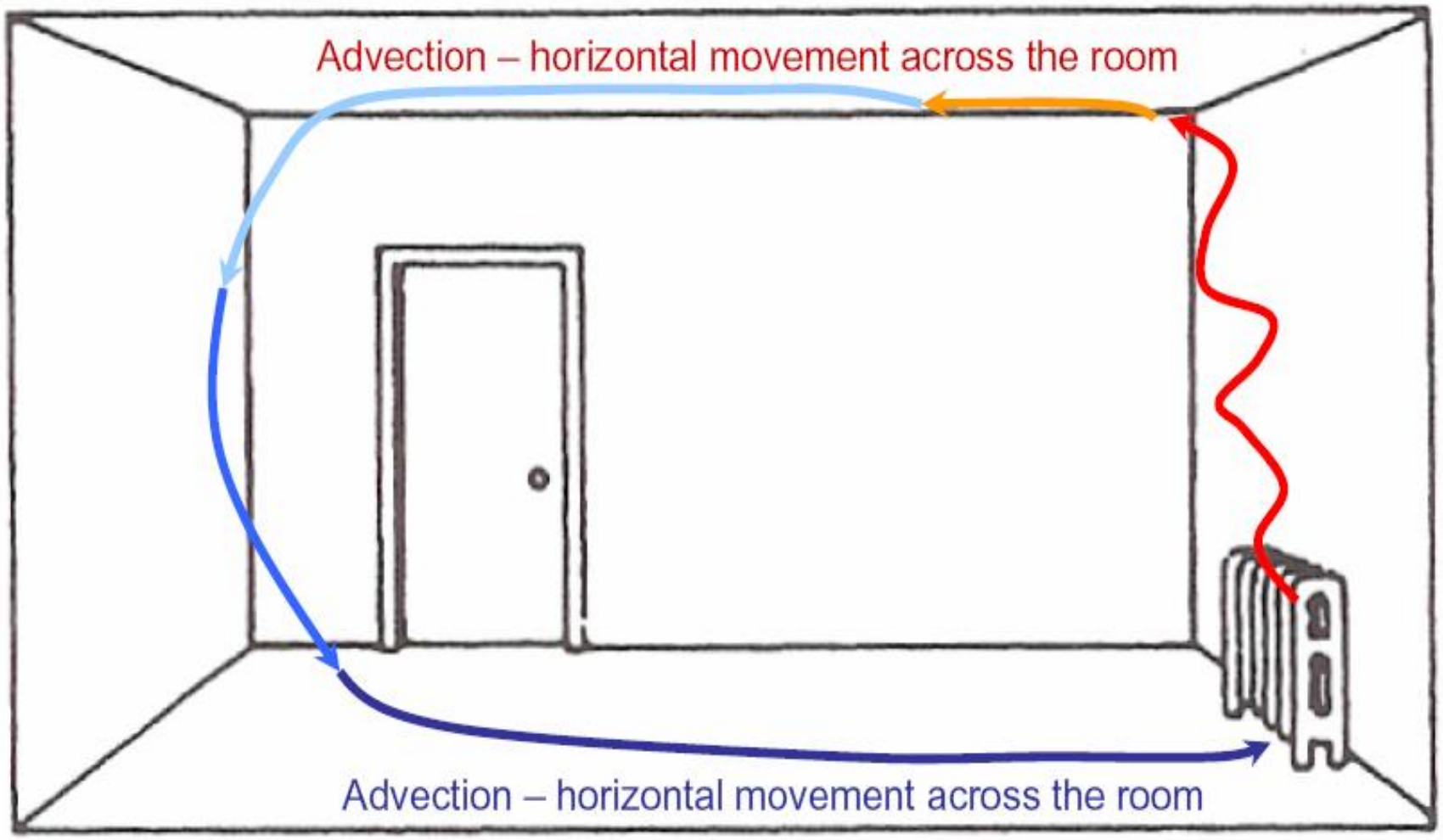
Conduction	Convection	Radiation
Transfer of energy due to collision of molecules. *Mostly in Solids*	Transfer of energy caused by differences in density. *In Liquids and Gasses*	Transfer of energy by electromagnetic waves. *In solids, liquids, gasses and empty space*
Example 	Example 	Example 

http://www.teachersdomain.org/resources/lsps07/sci/phys/energy/heattransfer/assets/lsps07_int_heattransfer/lsps07_int_heattransfer_swf.html

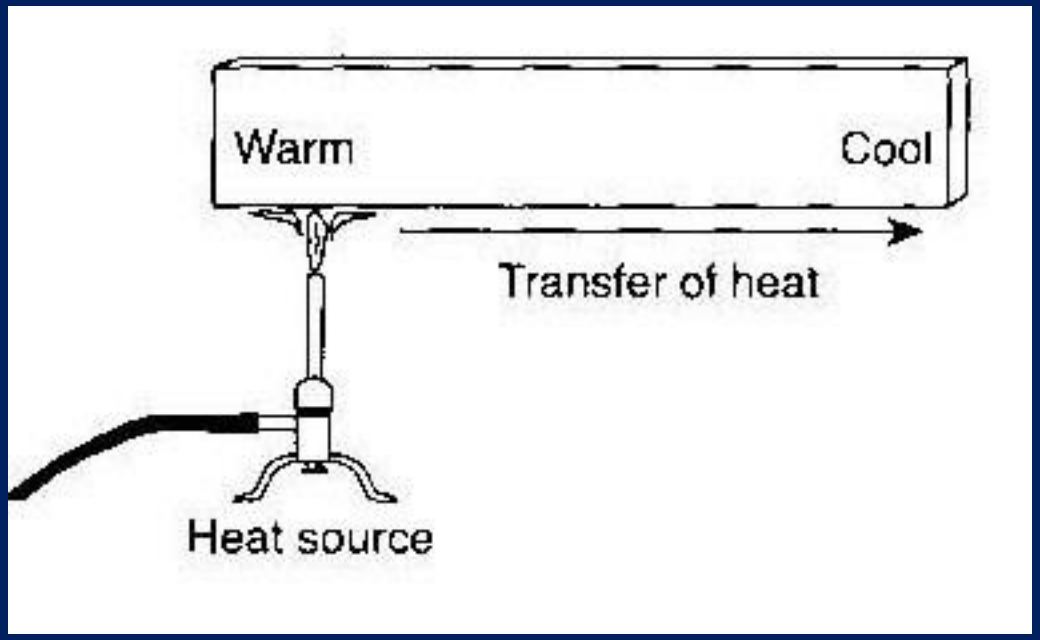

Conduction
Convection
Radiation
Radiation

Convective energy flows in “cells”.

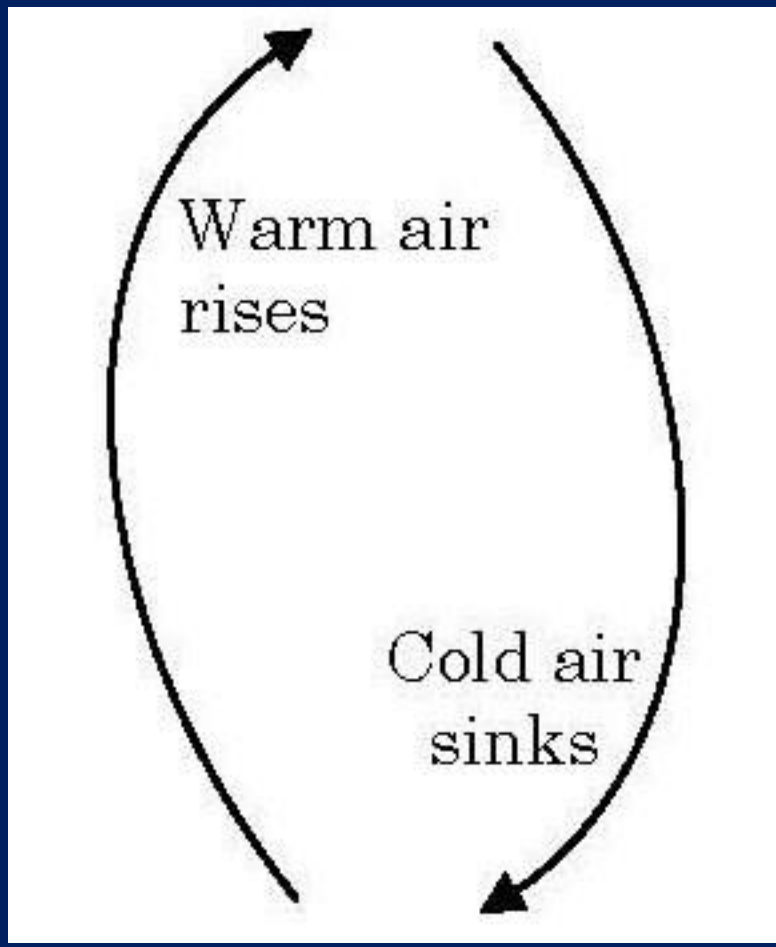
THE CONVECTION CELL



What type of Energy Transfer is going on???



Conduction

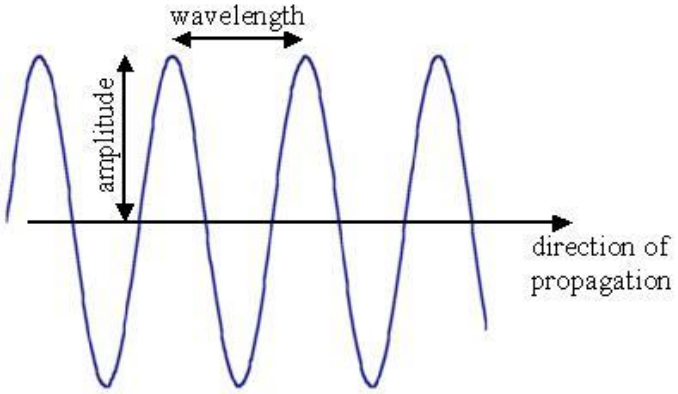


Convection

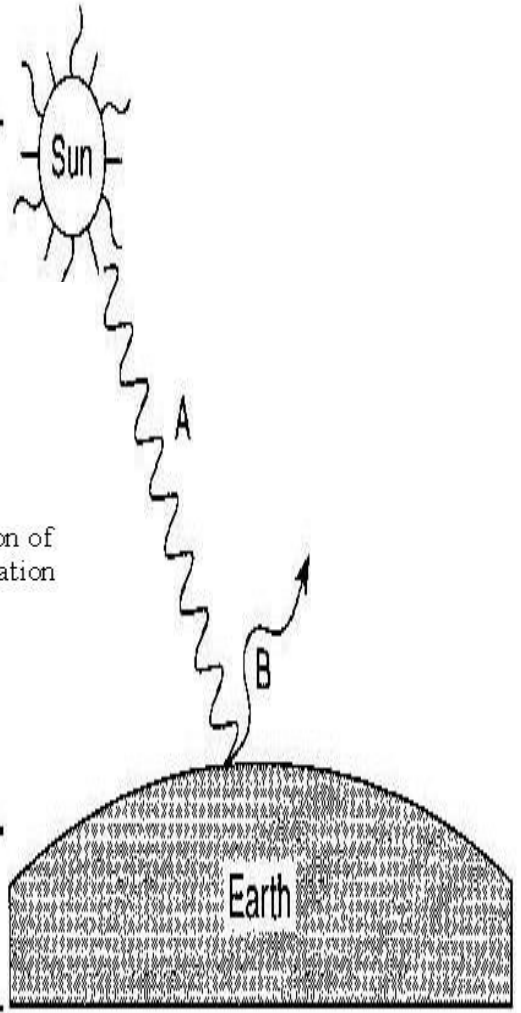
Radiation

Electromagnetic Energy:

- Energy that is radiated in the form of a transverse wave.

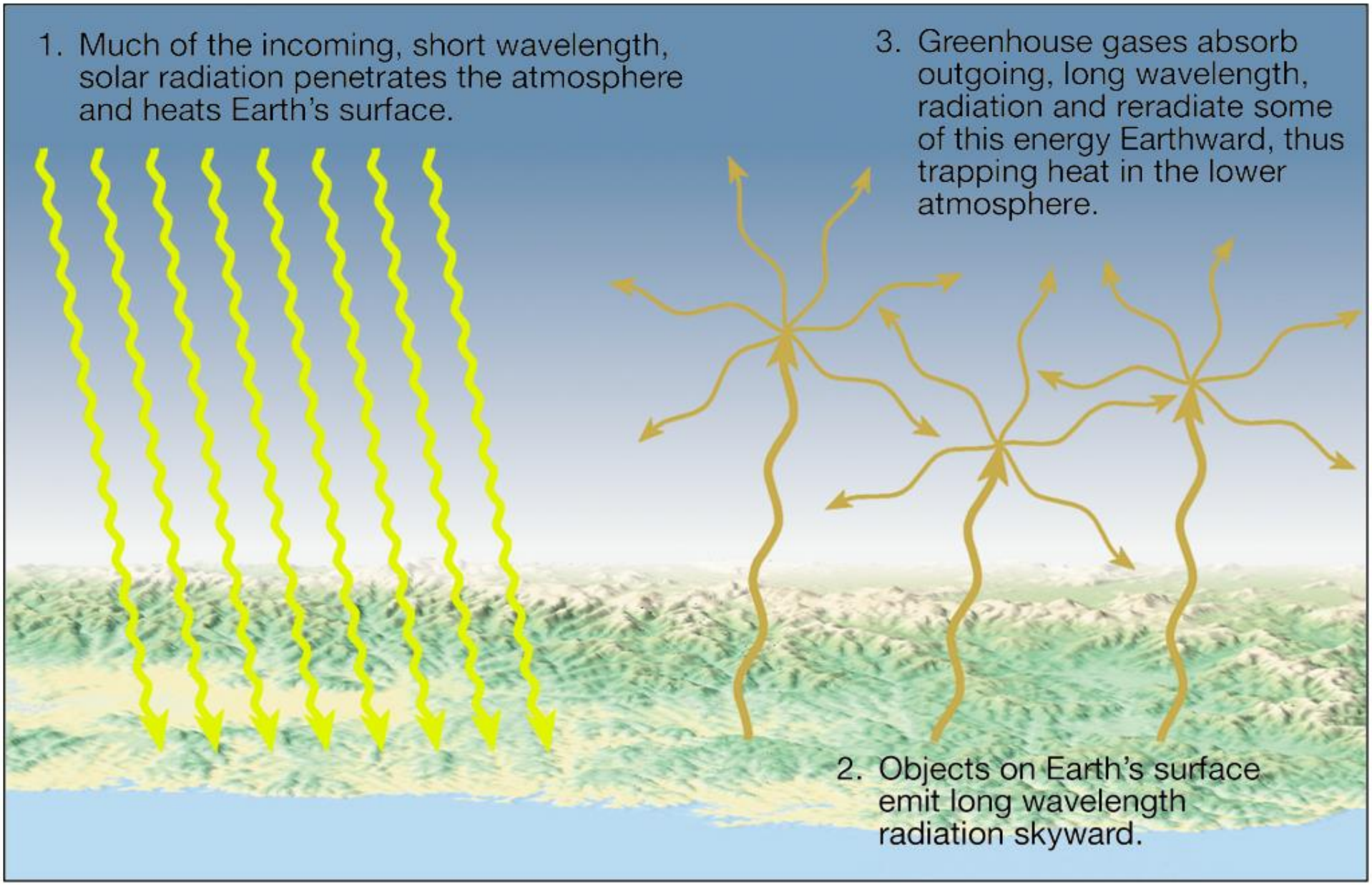


-This is how we get energy from the sun.



- Difference between forms of electromagnetic energy is due to size of wavelength.

- Shorter wavelength= more powerful



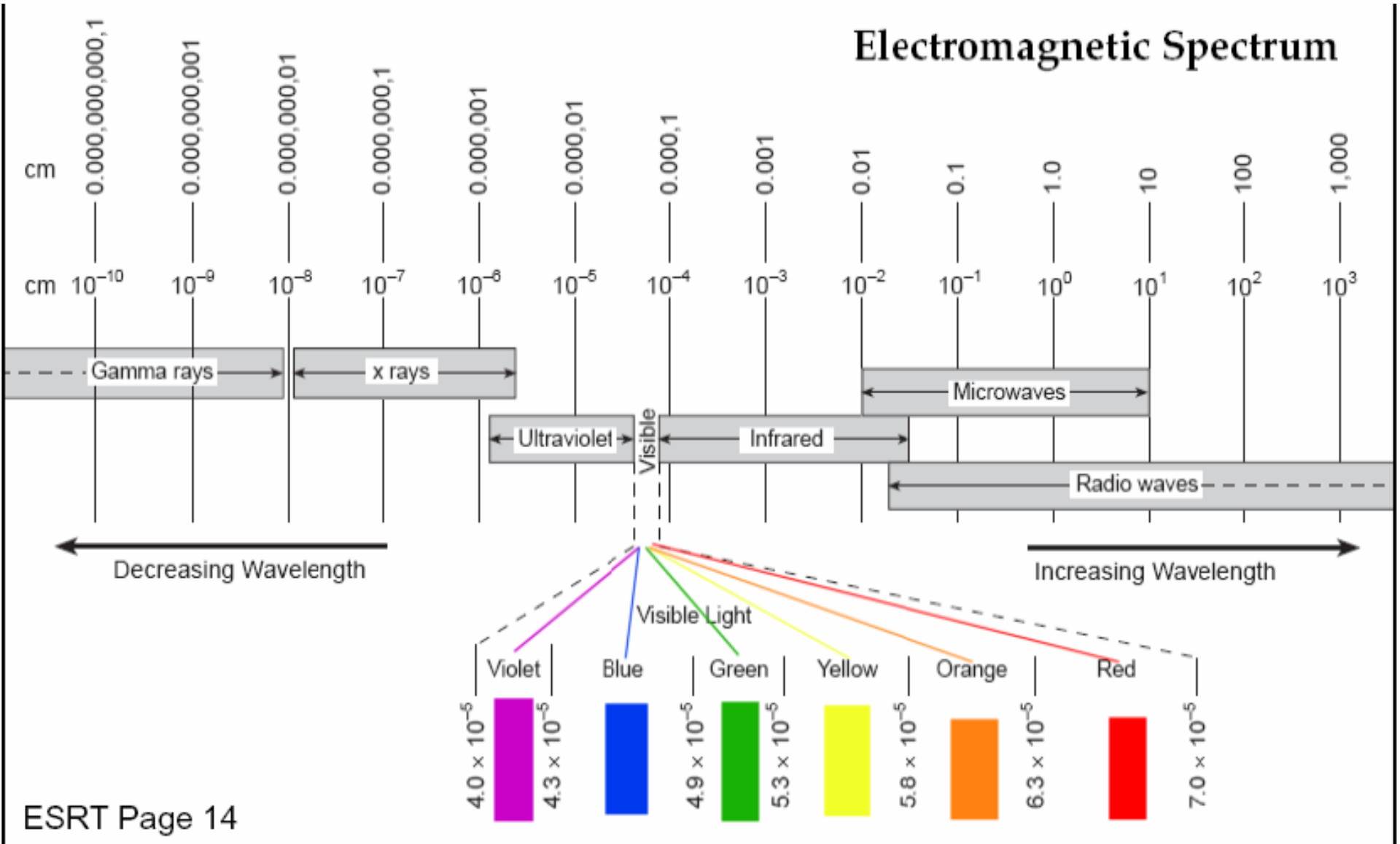
- http://www.teachersdomain.org/asset/ess05_int_irgallery/

- And video

Electromagnetic spectrum

Range of radiation identified by wavelength.

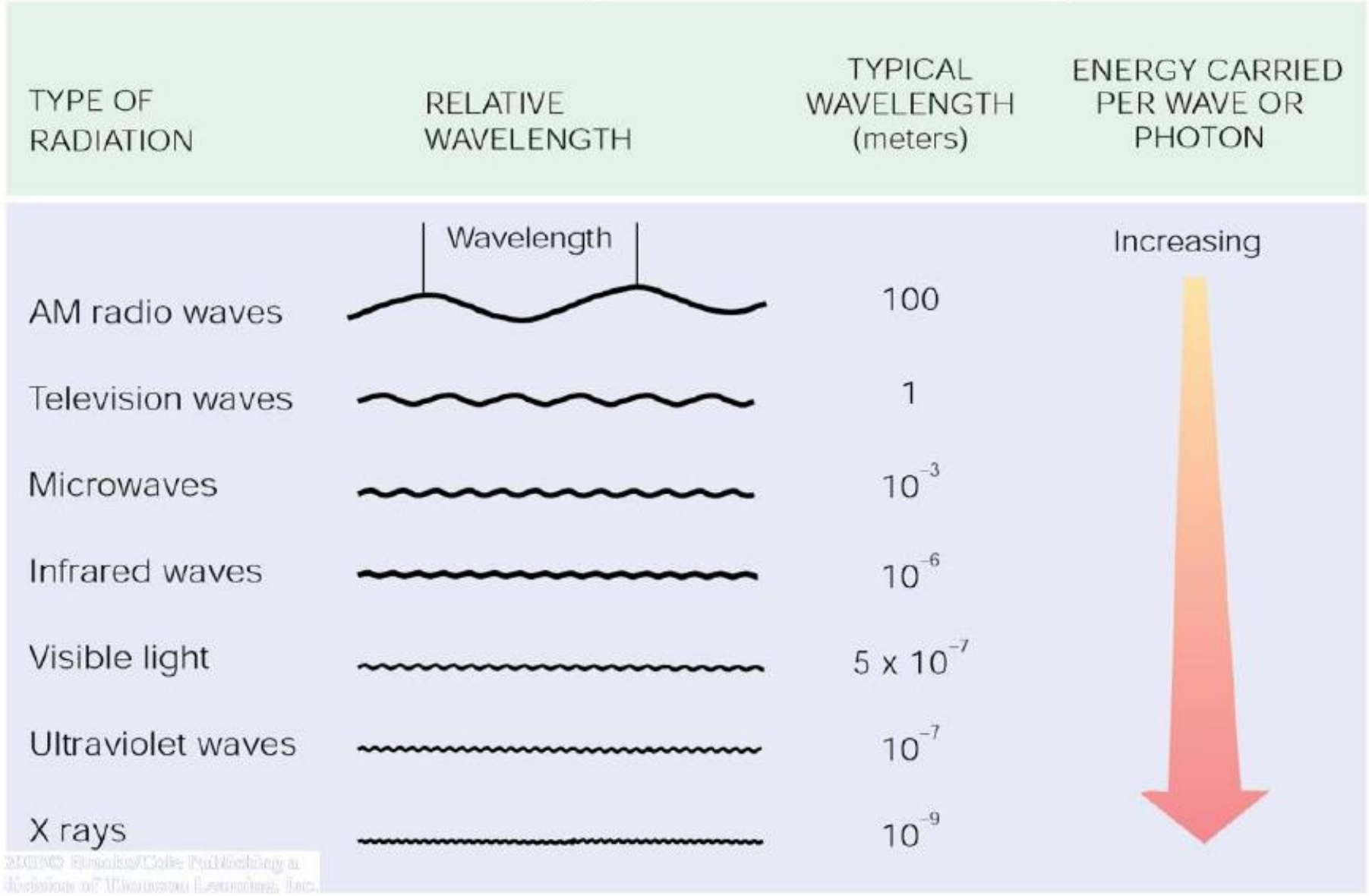
Earth Science Reference Tables, page **14**

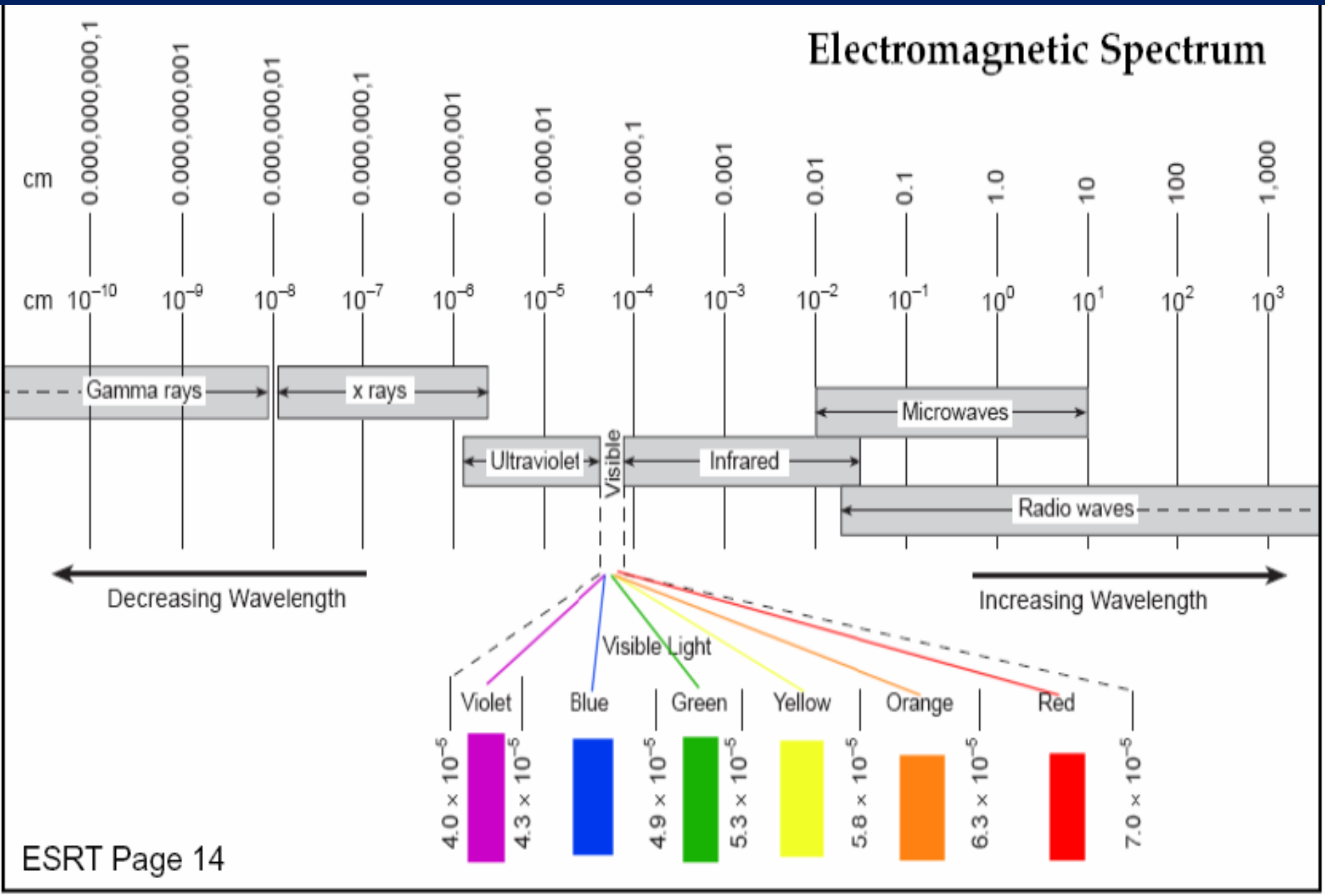


ESRT Page 14

Radiation and Heat Transfer

Radiation travels as waves of photons that release energy if absorbed.




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

When ELECTROMAGNETIC ENERGY (RADIATION) REACHES EARTH it is …

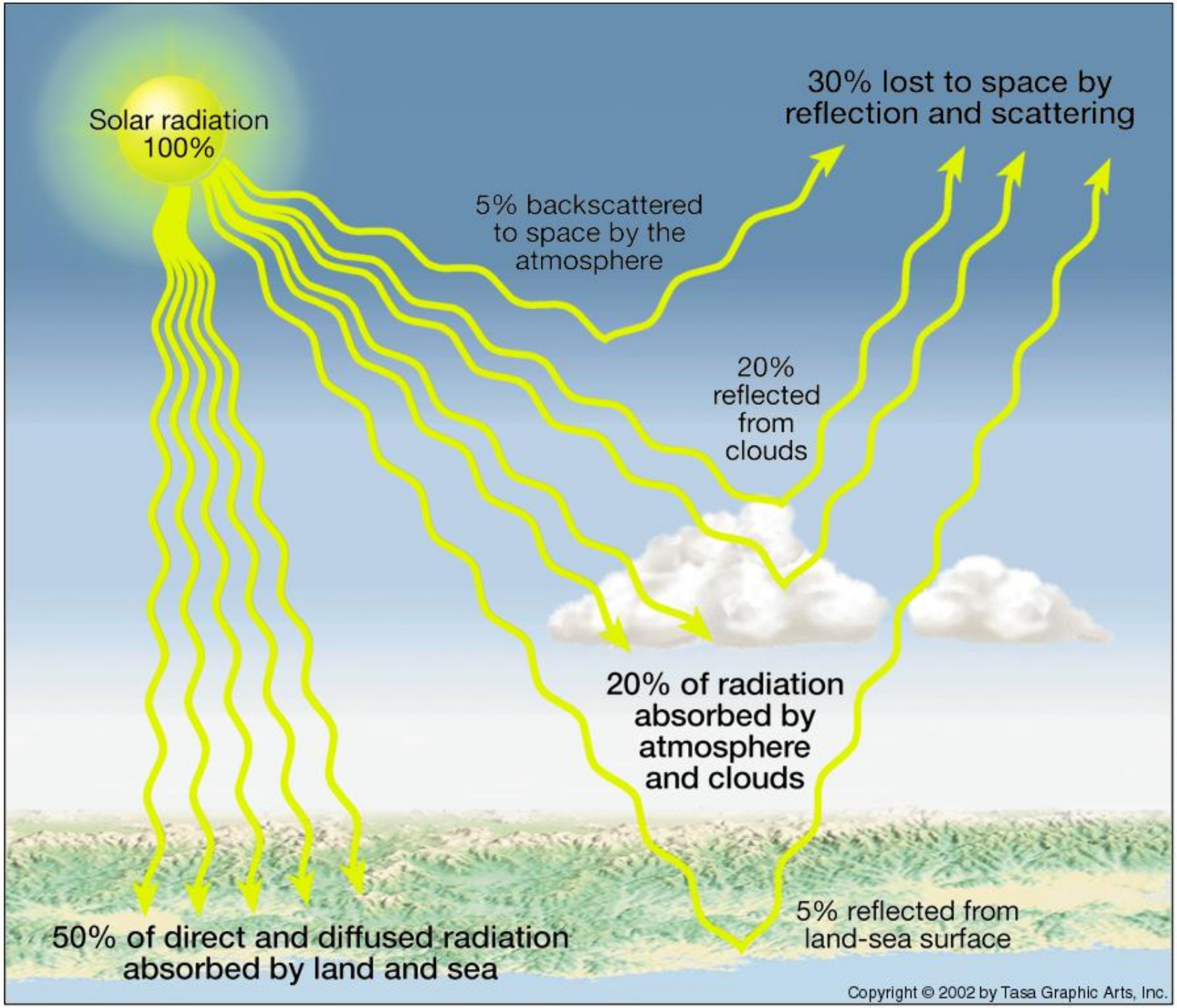
Reflected – bounced back at the same angle they arrived

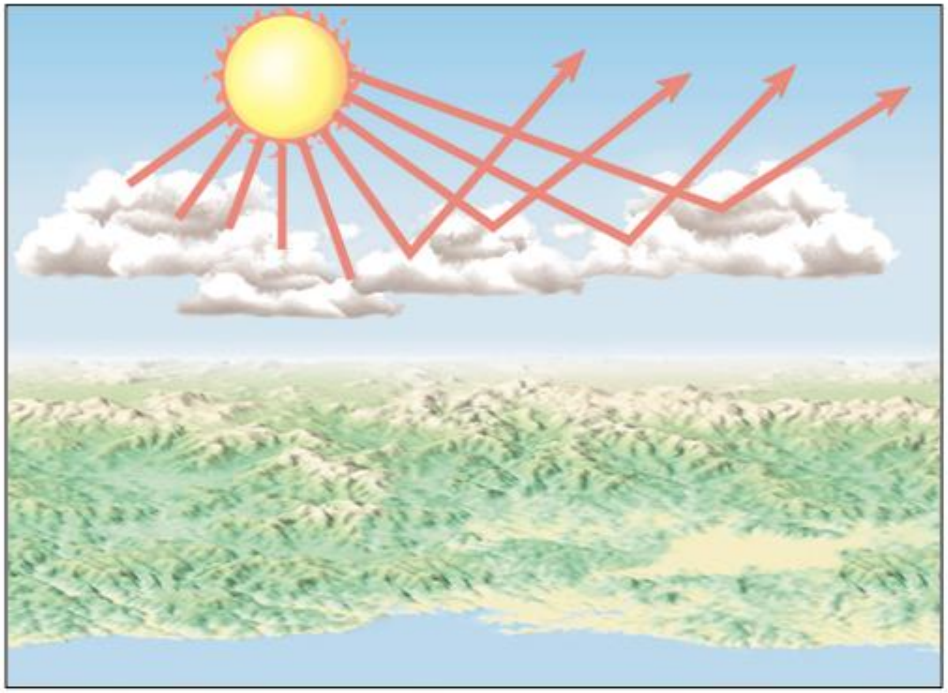
Scattered – reflected in various directions

Refracted – bent

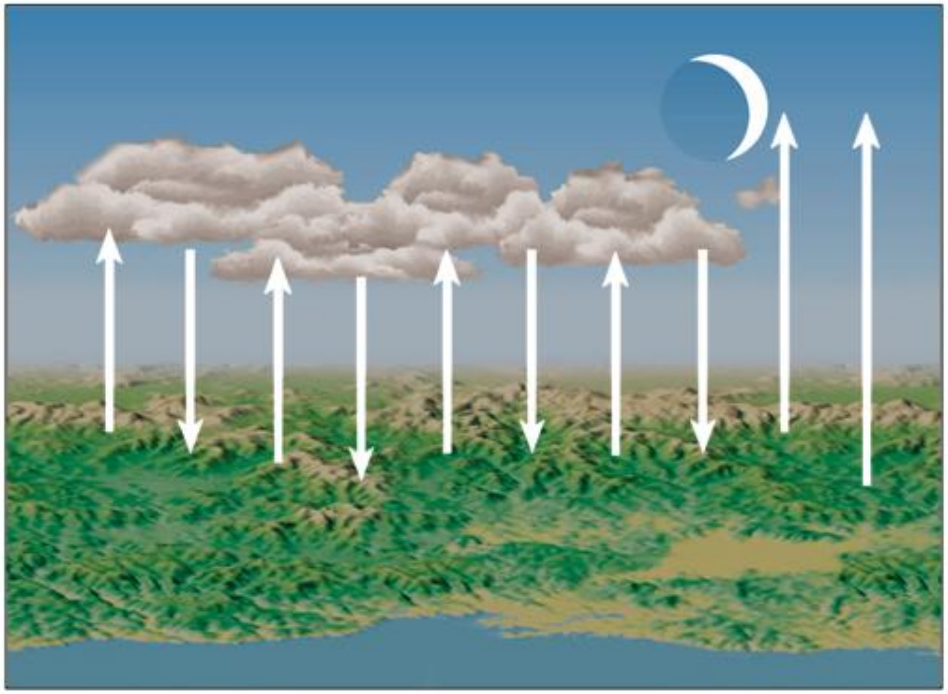
Transmitted – pass through the material

Absorbed (taken in as heat energy)


Solar radiation
100%
30% lost to space by
reflection and scattering
5% backscattered
to space by the
atmosphere
20%
reflected
from
clouds
20% of radiation
absorbed by
atmosphere
and clouds
5% reflected from
land-sea surface
50% of direct and diffused radiation
absorbed by land and sea
Copyright © 2002 by Tasa Graphic Arts, Inc.



A.



B.

Surface Properties and Absorption/Reflection

On a hot summer day, what color clothes do you wear?

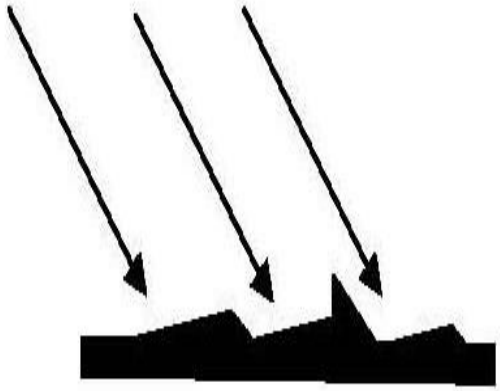
The Best Absorbers are

dark & rough

The Best Reflectors are

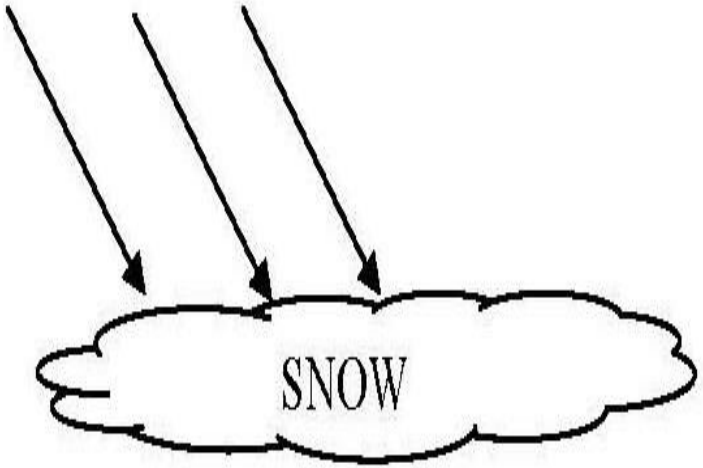
light colored & smooth

Light vs. Dark



Dark surfaces

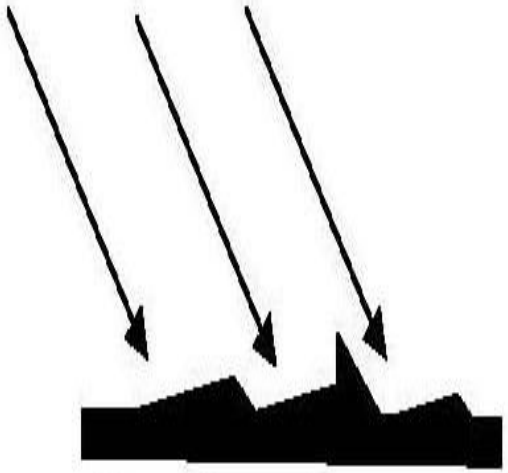
Absorb Radiation from the sun.



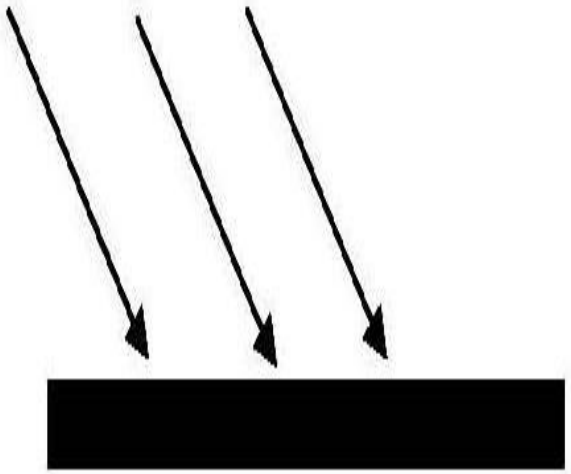
Light surfaces

Reflect Radiation from the sun.

Rough vs. Smooth



Rough surfaces



Smooth surfaces

Absorb Radiation from the sun.

Reflect Radiation from the sun.

What is a better absorber of radiation???

Land vs. Water

-Land is a better absorber and radiator of radiation from the sun.

- Most of the time land is darker and rougher then water.

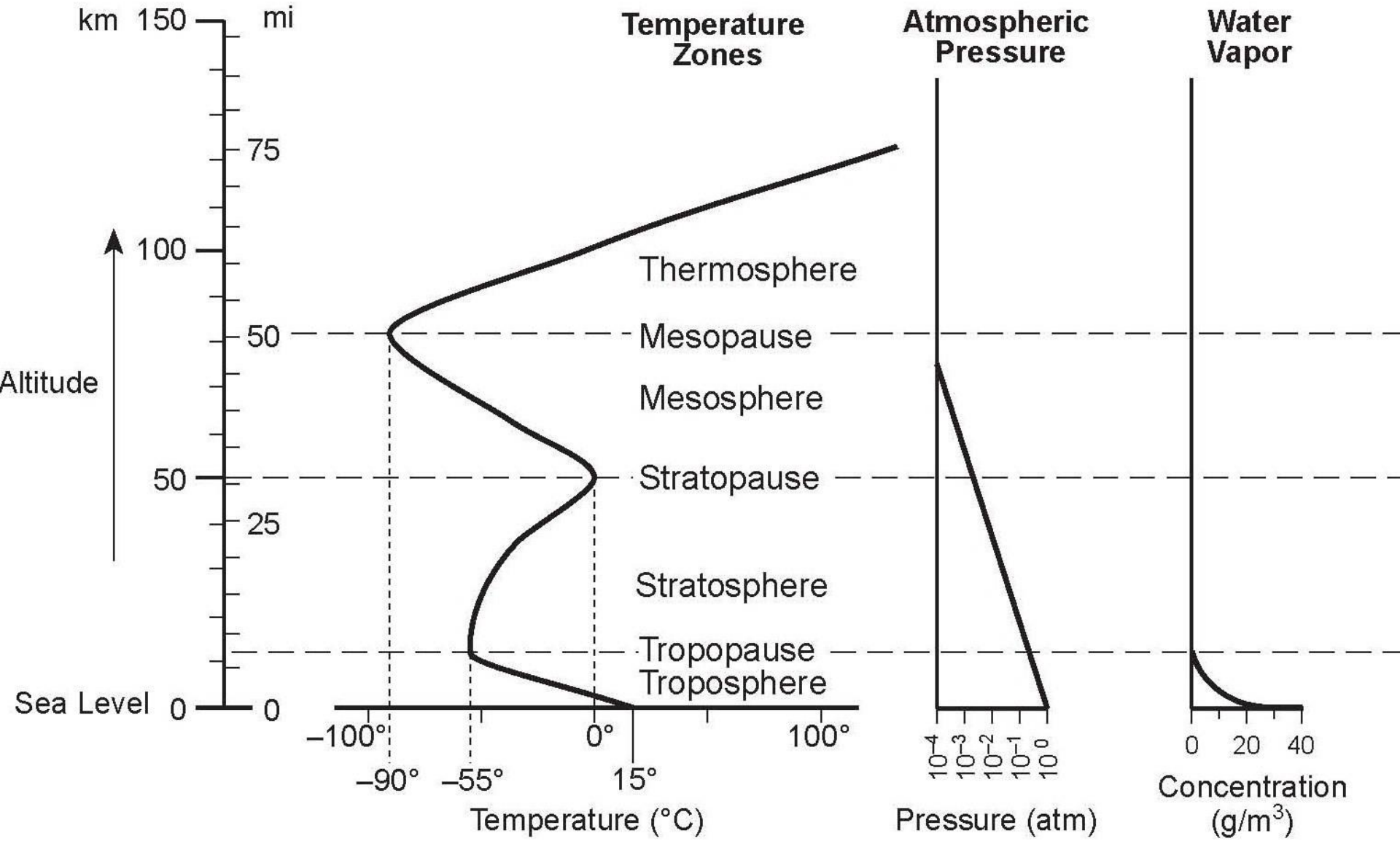
Ex: Dark forest canopy, blacktop.

** A good absorber of energy is also a good Radiator of energy. (Dark and Rough)

Specific Heat: The resistance of a material to heating up or cooling off.

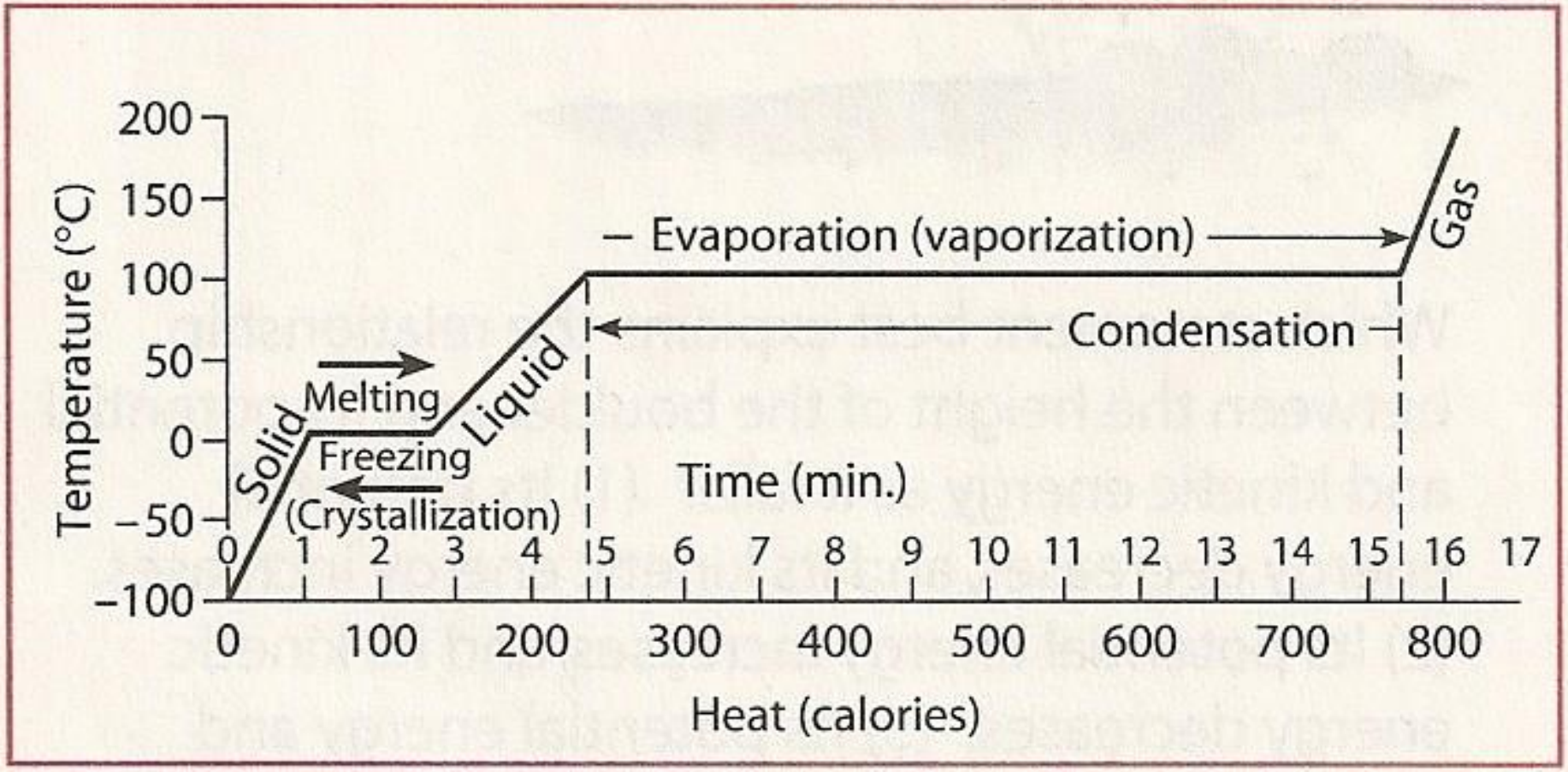
ESRT page 1

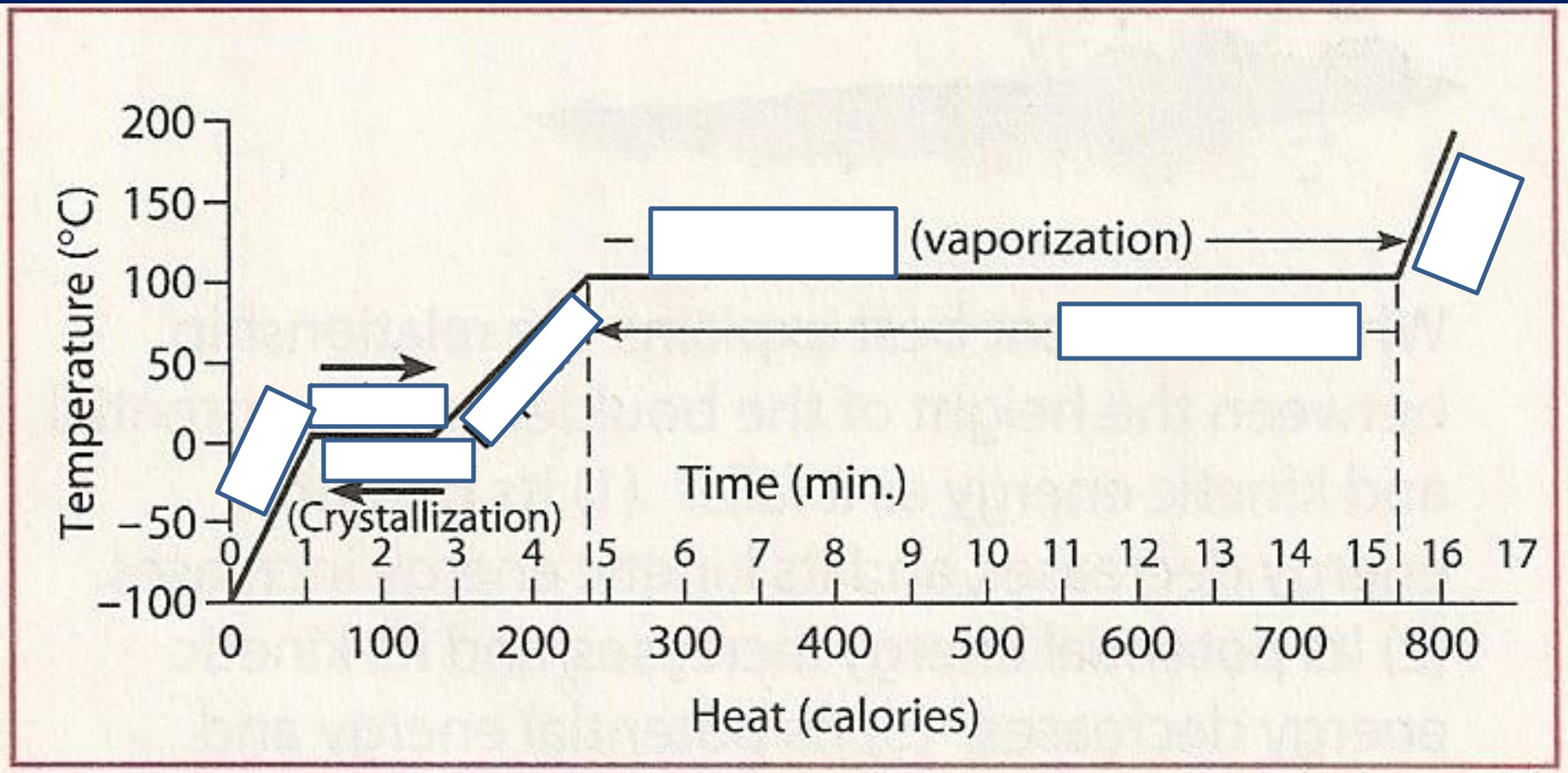
Water has a high specific heat. It heats up SLOWLY and cools off SLOWLY.


km 150
mi
75
100
50
Altitude
50
25
Sea Level 0
0
Temperature Zones
Thermosphere
Mesopause
Mesosphere
Stratopause
Stratosphere
Tropopause
Troposphere
–100°
0°
100°
–90°
–55°
15°
Temperature (°C)
Atmospheric Pressure
10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^{0}
Pressure (atm)
Water Vapor
0 20 40
Concentration (g/m^3)

Heating of Water

Label the following terms in their correct places: condensation, vaporization, solidification, melting.




200
150
100
50
0
−50
−100
Temperature (°C)
(vaporization)
(Crystallization)
Time (min.)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
0 100 200 300 400 500 600 700 800
Heat (calories)

He e

1) Melti

Properties of Water

Energy gained during melting	80 calories/gram
Energy released during freezing	80 calories/gram
Energy gained during vaporization	540 calories/gram
Energy released during condensation	540 calories/gram
Density at 3.98°C	1.00 gram/milliliter

Reference Table page 1


ICE

Heat Energy and Changes of State

2) Solidification: (Freezing)

The changing of a liquid to a solid.

Properties of Water

Energy gained during melting	80 calories/gram
Energy released during freezing	80 calories/gram
Energy gained during vaporization	540 calories/gram
Energy released during condensation	540 calories/gram
Density at 3.98°C	1.00 gram/milliliter

Reference Table page 1

FOG, STEAM

Heat Energy and Changes of State

3) Evaporation, or Vaporization:

The changing of a liquid to a gas, or water vapor.

Properties of Water

Energy gained during melting	80 calories/gram
Energy released during freezing	80 calories/gram
Energy gained during vaporization	540 calories/gram
Energy released during condensation	540 calories/gram
Density at 3.98°C	1.00 gram/milliliter

Reference Table page 1

Heat Energy and Changes of State

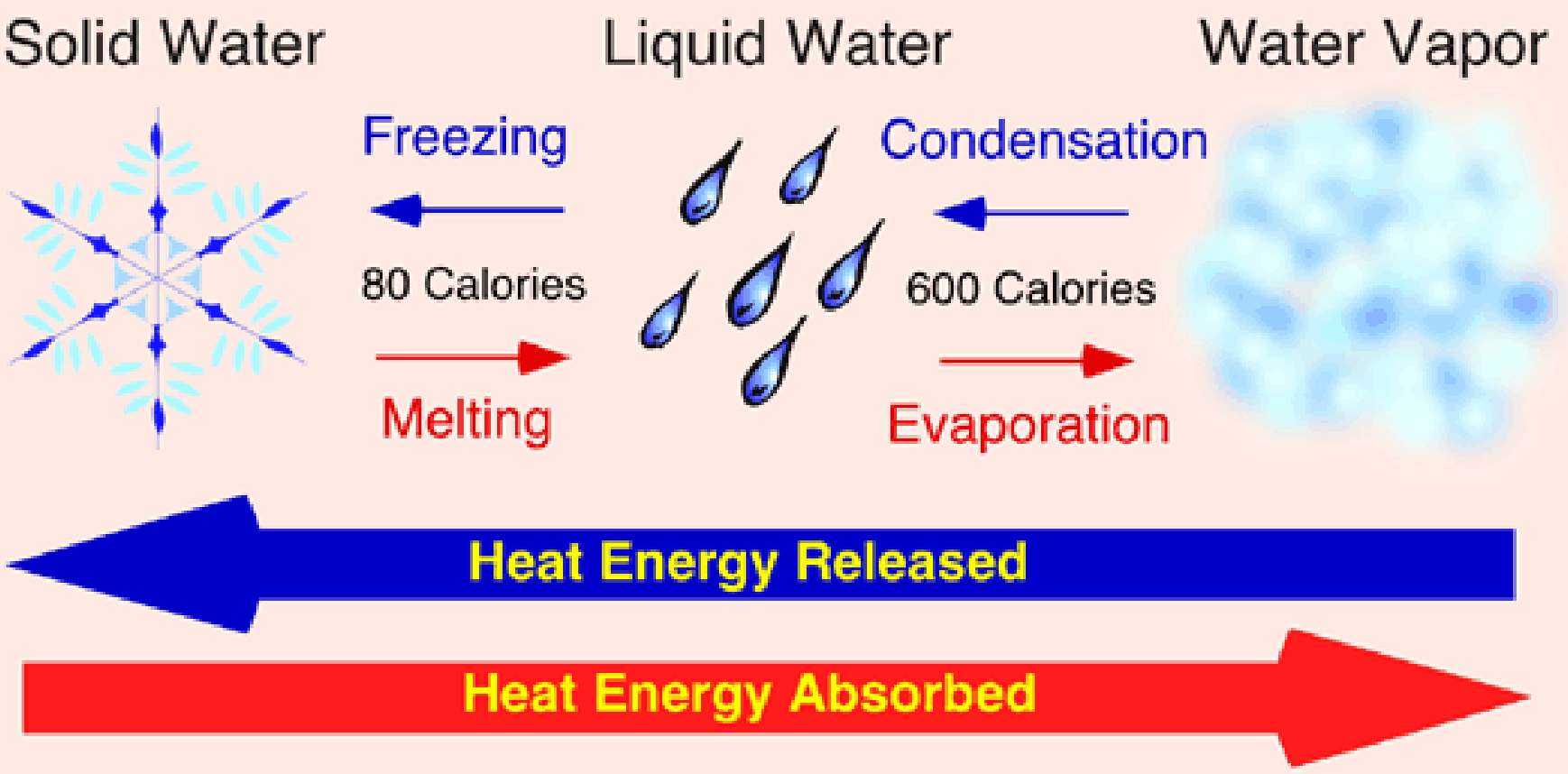
4) Condensation:

The changing of a gas, or vapor to a liquid.

Properties of Water

Energy gained during melting	80 calories/gram
Energy released during freezing	80 calories/gram
Energy gained during vaporization	540 calories/gram
Energy released during condensation	540 calories/gram
Density at 3.98°C	1.00 gram/milliliter

Reference Table page 1


Solid Water
Liquid Water
Water Vapor
Freezing
80 Calories
Melting
Condensation
600 Calories
Evaporation
Heat Energy Released
Heat Energy Absorbed

Heat Energy and Changes of State

Sublimation:

- The changing of a gas directly to a solid, or from a solid directly to a gas.

- Without going through a liquid state

Properties of Water ESRT pg 1

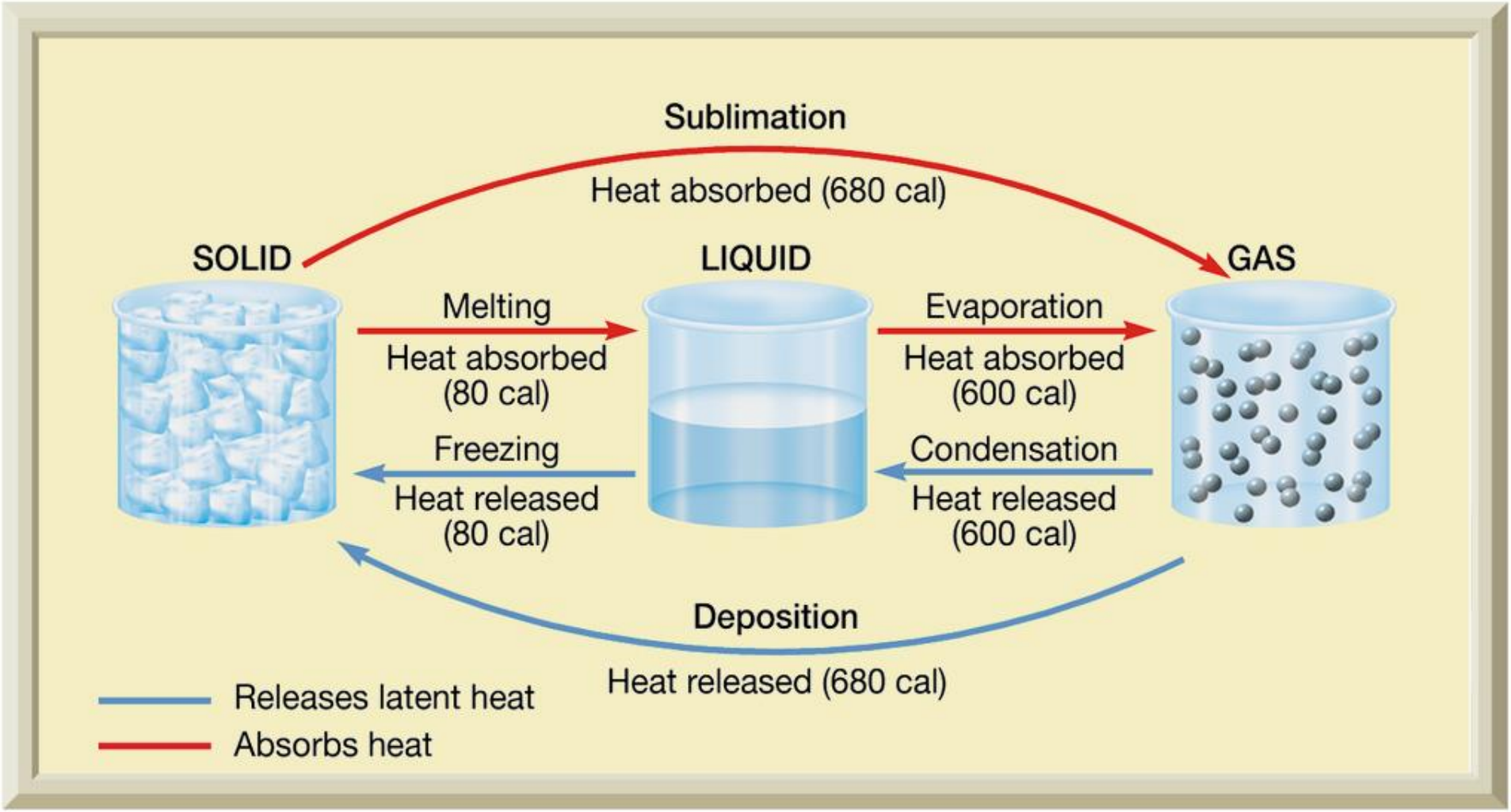
Check the box which describes whether energy is gained or lost for each process.

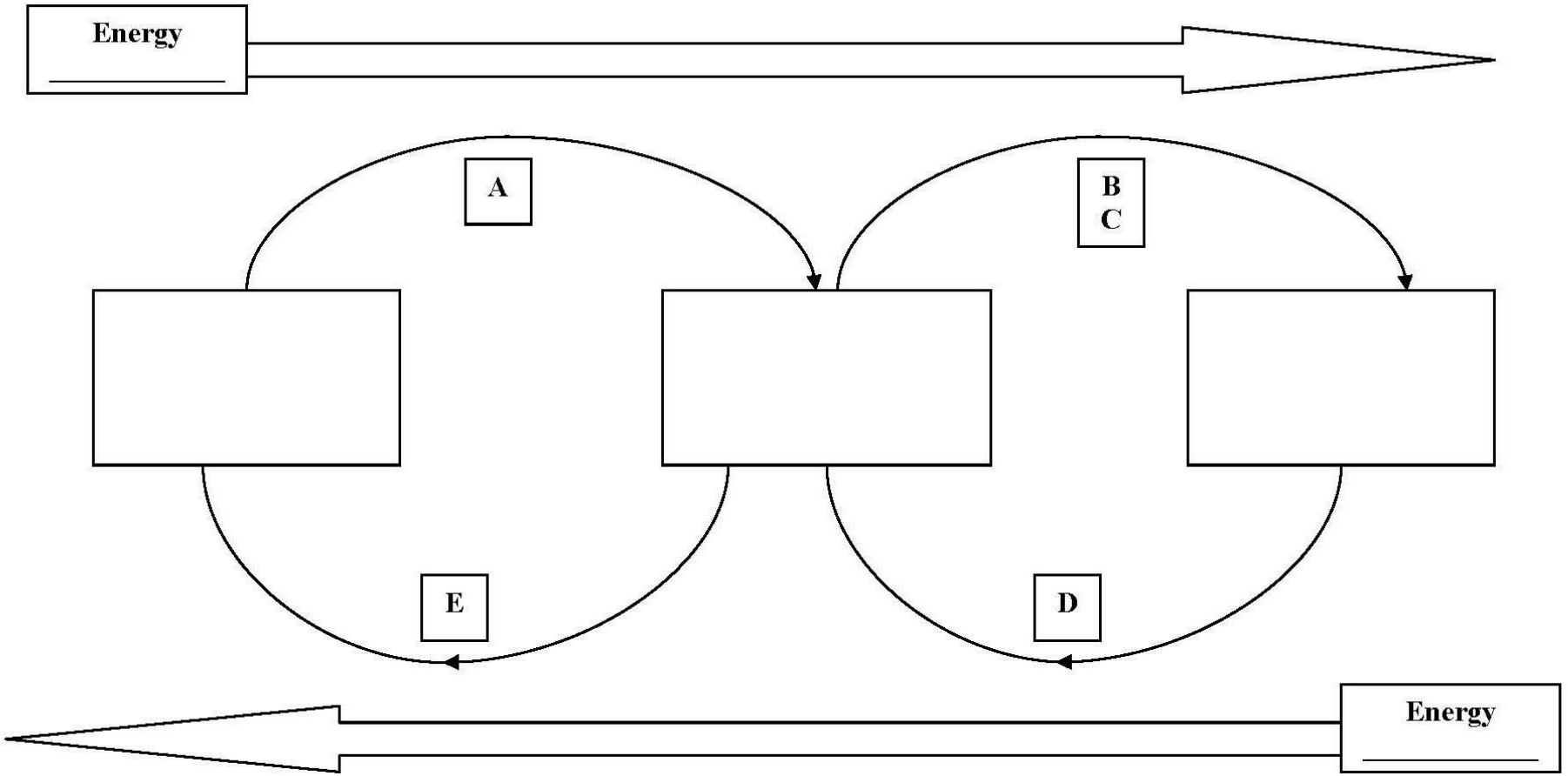
Process	Energy Gained	Energy Lost
Condensation		
Evaporation		
Melting		
Solidification		

How many calories are gained or lost by water for each of the following processes?

Process	Calories Gained	Calories Lost
Condensation		
Evaporation		
Melting		
Solidification		

Changes in state of water.





A. _____ _____

_____

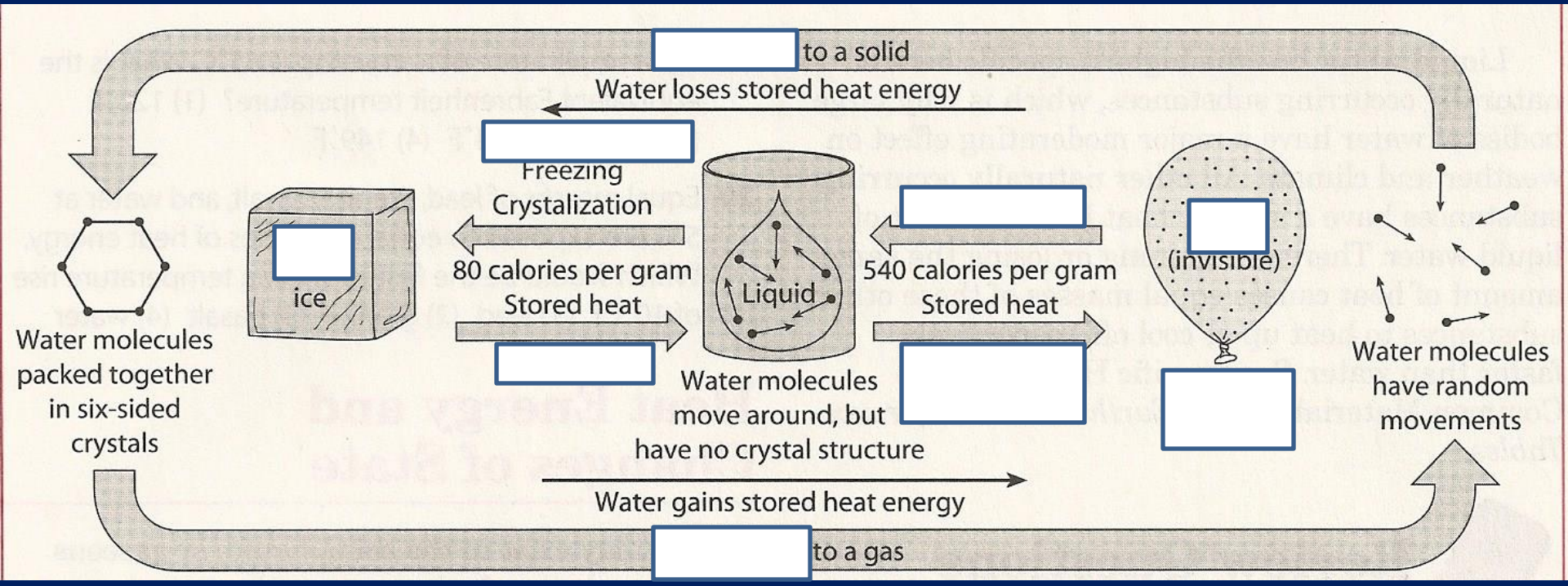
B. _____ _____

C. _____ _____

D. _____ _____

E. _____ _____

F. _____ _____


to a solid
Water loses stored heat energy
Freezing
Crystalization
80 calories per gram
Stored heat
540 calories per gram
Stored heat
ice
Liquid
(invisible)
Water molecules
packed together
in six-sided
crystals
Water molecules
move around, but
have no crystal structure
Water molecules
have random
movements
Water gains stored heat energy
to a gas

Transfer of Energy

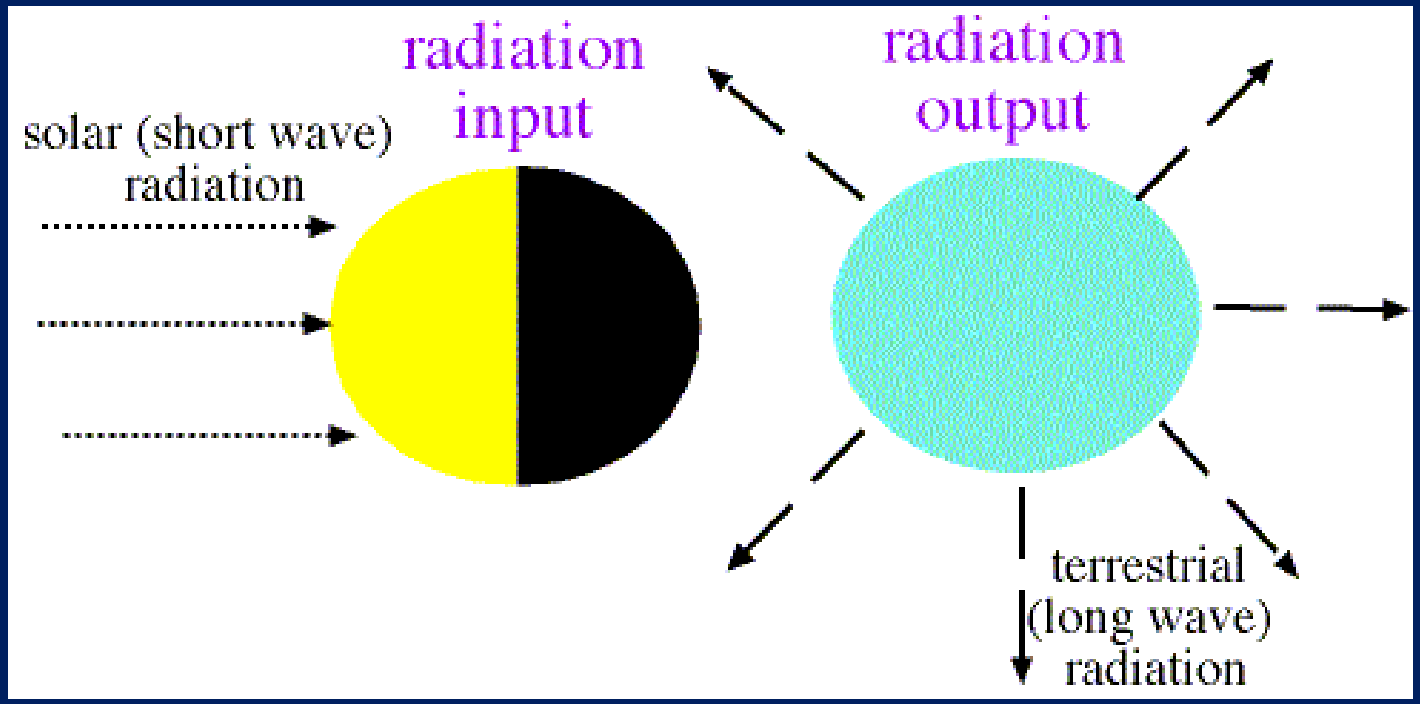
Dynamic Equilibrium: At dynamic equilibrium a region loses and gains equal amounts of energy.

Example : Temp. remains constant

RADIATION BALANCE

DYNAMIC EQUILIBRIUM

INPUT = OUTPUT



Is global warming changing the balance???????

END