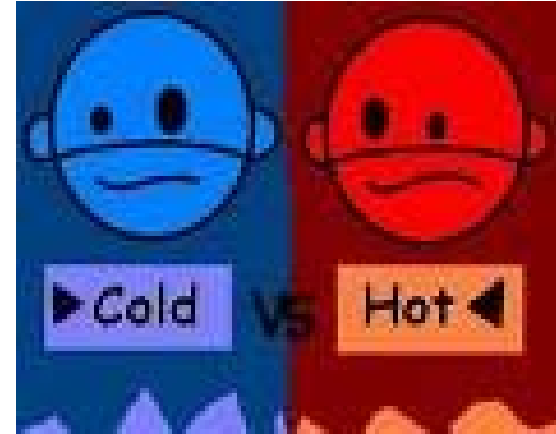


HEAT NOTES

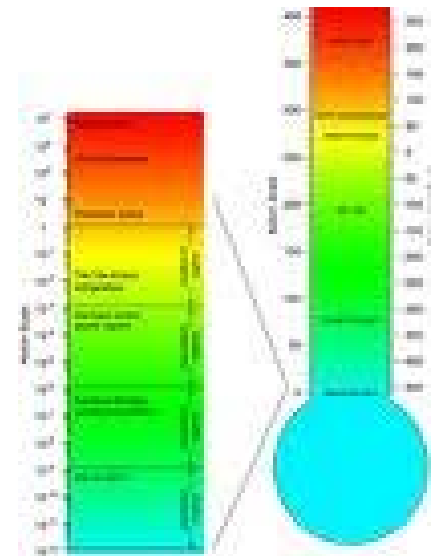
HEAT NOTES



**1. HEAT: the energy of
moving _____ particles**



**2. HOT OBJECTS contain
_____ more _____ heat
than cold ones**



3. All objects above
Absolute zero contain heat

4. Heat always flows from
hotter objects to cooler
objects until the objects reach
same temperature.

**5. The greater the difference
in temperature between
the two objects, the
faster heat is
transferred.**



Specific Heat

1. Quantity of heat needed to raise One gram of any Substance by 1 degree Celsius.
2. The higher the Specific heat... The more energy is needed to raise the temperature.

Specific Heats of Common Materials

MATERIAL	SPECIFIC HEAT (Joules/gram • °C)
Liquid water	4.18
Solid water (ice)	2.11
Water vapor	2.00
Dry air	1.01
Basalt	0.84
Granite	0.79
Iron	0.45
Copper	0.38
Lead	0.13

Measuring Specific Heat

Energy can be measures in many different ways. Typical units include:

Joules

Watts, &

Calories

The term "Joule" is named after English Scientist James Prescott Joule who lived from 1818 to 1889. He discovered that Heat is a type of Energy!

$1,000 \text{ joules} = 1 \text{ kilojoule}$
 $= 1 \text{ Btu}$



James Joule
(1818-1889)

Water has the highest specific heat of all naturally occurring substances. $4.18 \text{ joules/gram/}^{\circ}\text{C}$

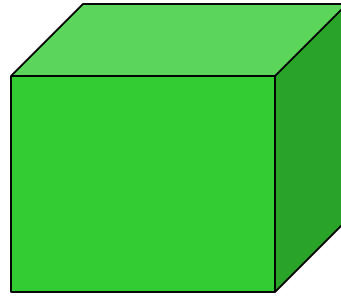
- It takes longer to heat up and cool down.
- This factor effects weather and climate.

PHASES OF Matter:

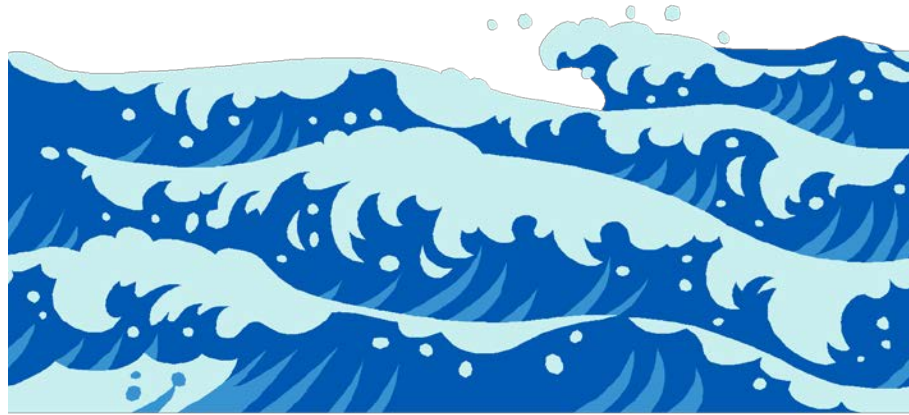
**Matter is
anything made of
atoms and molecules.**

1. There are three states (phases) of matter, solid liquid and gas.
2. When water changes from one state to another it is called a PHASE CHANGE.
3. Energy stored during a phase change is called LATENT HEAT.

A) SOLID



B) LIQUID



C) GAS



	Motion (Kinetic energy)	How is it bonded?	Does it have A definite shape?	Volume?
Solid	Little K.E. Molecules vibrate	Strong	yes	yes
Liquid	More K.E. Molecules move freely	Not bonded rigidly	no	yes
Gas	Most K.E. Molecules move fast	Not bonded	no	no

4. PROPERTIES OF WATER

- a. ESRT's Page 1 – gives you the amount of heat gained or lost during a change in phase

Properties of Water

Heat energy gained during melting	334 J/g
Heat energy released during freezing	334 J/g
Heat energy gained during vaporization	2260 J/g
Heat energy released during condensation . . .	2260 J/g
Density at 3.98°C	1.0 g/mL

b. Melting –

b. SOLID to a LIQUID

c. 334 joules absorbed/gained by ice

c. Vaporization –

a. LIQUID to a GAS

b. 2260 joules absorbed/gained by the water

d. Freezing –

a. LIQUID to a SOLID

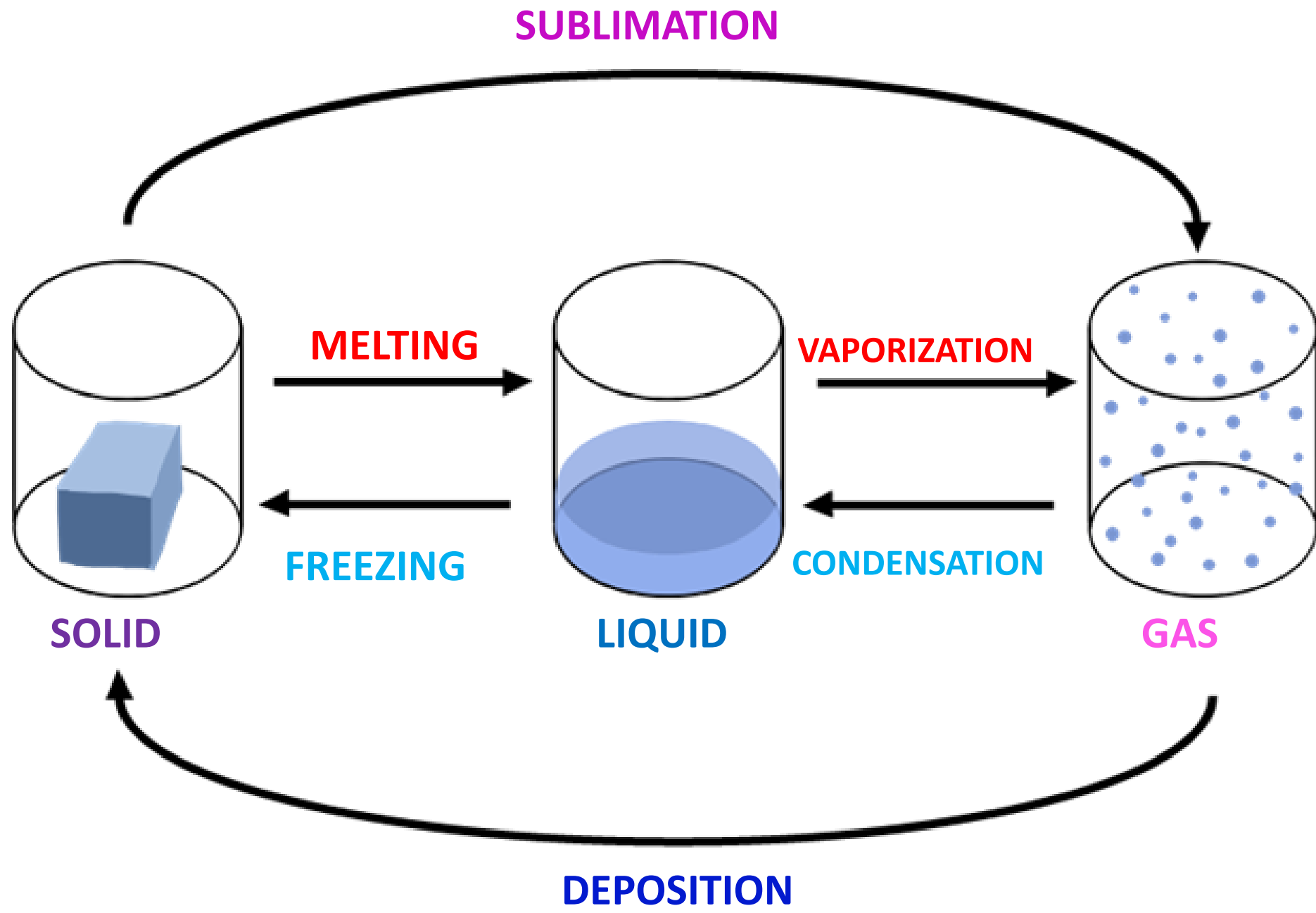
b. 334 joules lost/released by the water

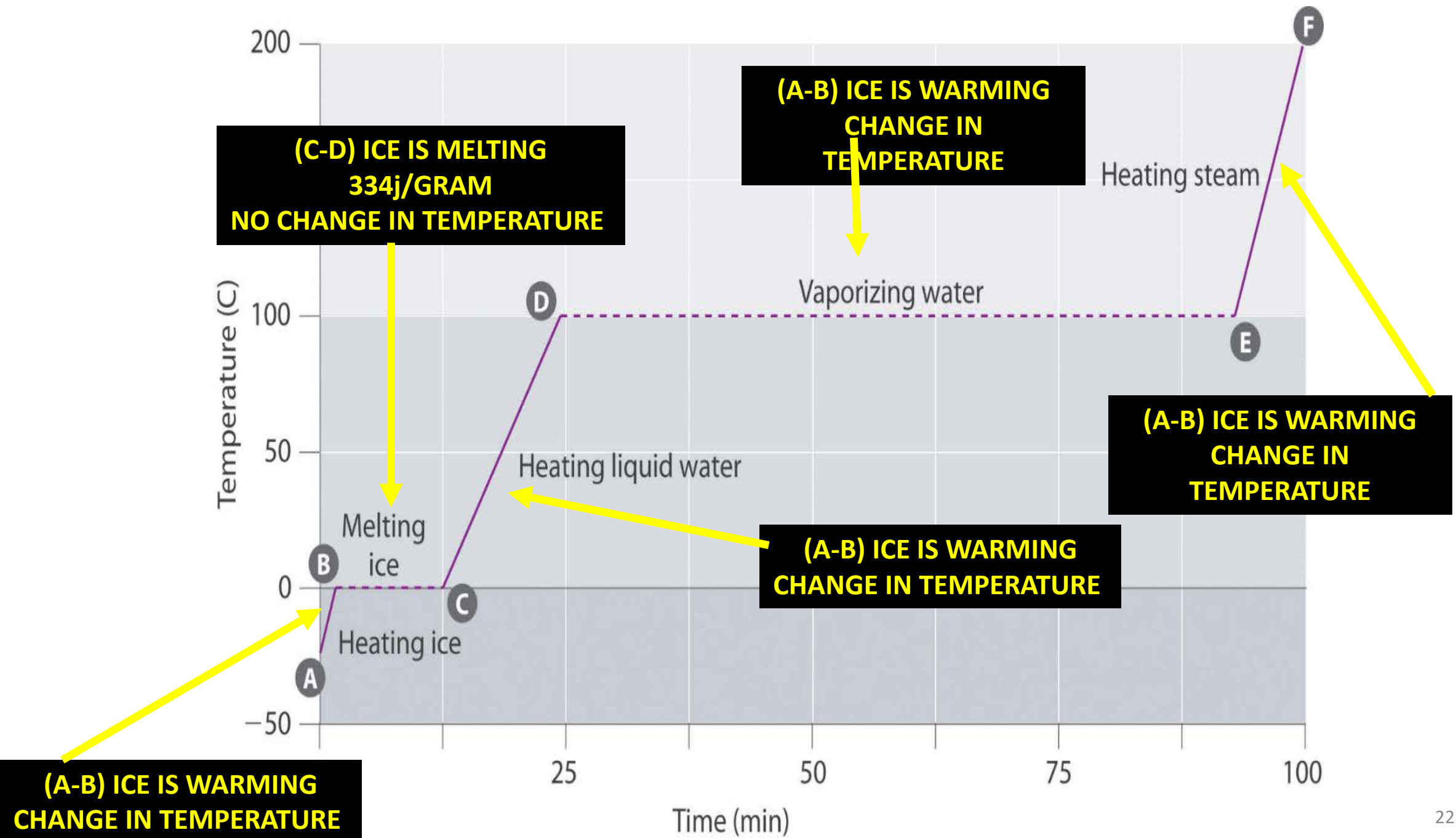
e. Condensation –

a. GAS to a LIQUID

b. 2260 joules lost/released by the water vapor

Latent Heat: When water is undergoing a phase change there is NO CHANGE in temperature because the heat added its being used to change either melt the ice or evaporate the water.





3. ENERGY IS ABSORBED (gained) DURING:

MELTING
SOLID  LIQUID

VAPORIZATION
LIQUID  GAS

from lower K.E. To higher K.E.

VAPORIZATION
LIQUID  **GAS**

from lower K.E. To higher K.E.

2. ENERGY IS RELEASED (lost) DURING:

FREEZING

SOLID  LIQUID

CONDENSATION

LIQUID  GAS

from higher K.E. to lower K.E.

**Energy stored during a phase
change is called**

Latent heat

**No change in
temperature**

(Earth Science Reference Tables : front page)

Properties of Water

Properties of Water

Heat energy gained during melting	334 J/g
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INSOLATION FROM THE SUN:

A. Insolation

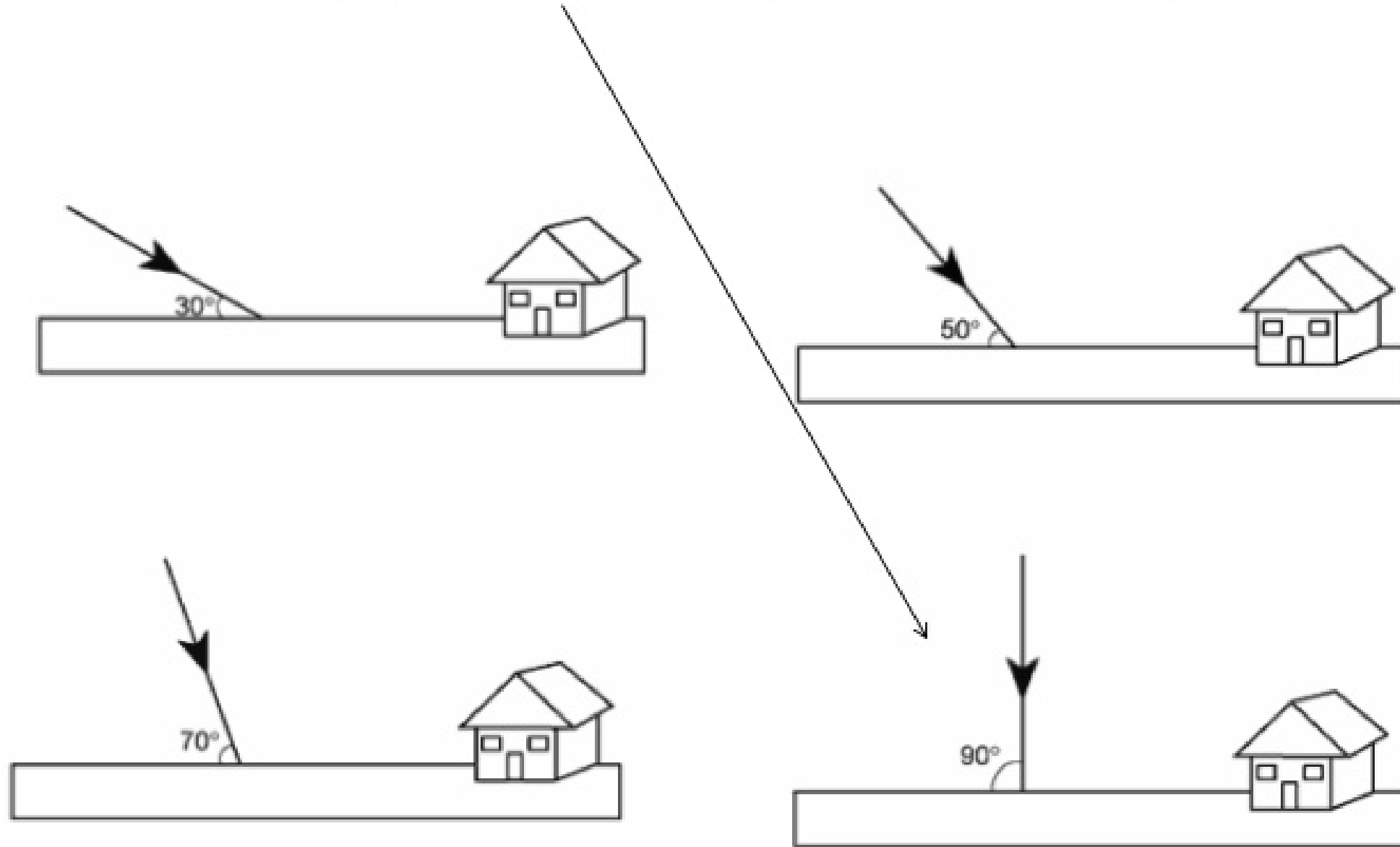
1. INcoming SOlar radiATION (radiation from the Sun)
2. Main source of energy for the Earth's atmosphere

B. Three factors affect the amount of insolation received by the Earth:

1. Angle of insolation

- a. The angle (in degrees) of the sun above the horizon (how high the sun is in the sky)
- b. A direct ray of the sun is a ray that strikes the Earth at a 90* angle.
- c. The more DIRECT (vertical) the rays (higher in the sky), the HIGHER the temperature

The greatest angle of insolation gets the most sunlight



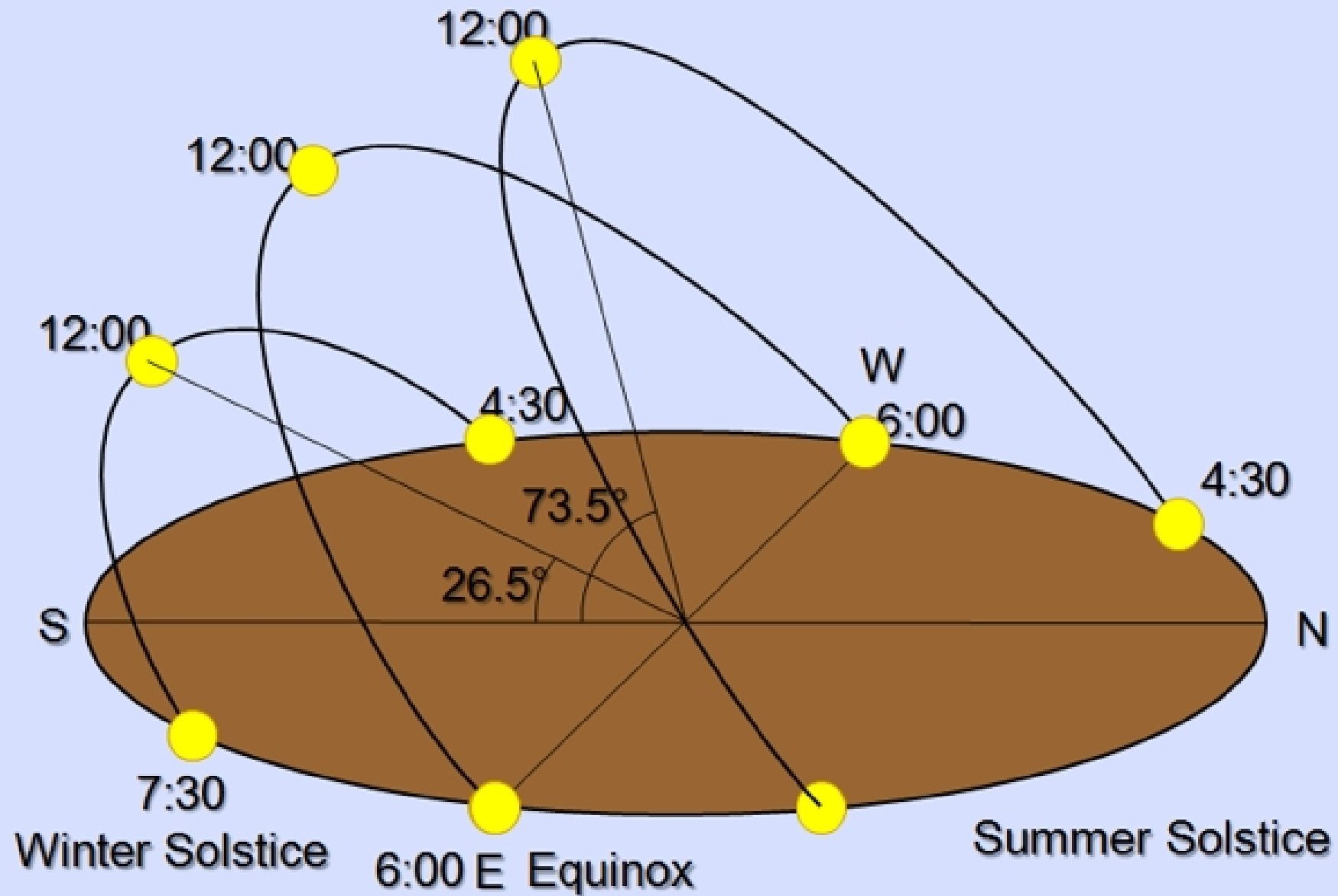
Depends on:

- Time of day

1. LOW angle at sunrise – LOW temperatures

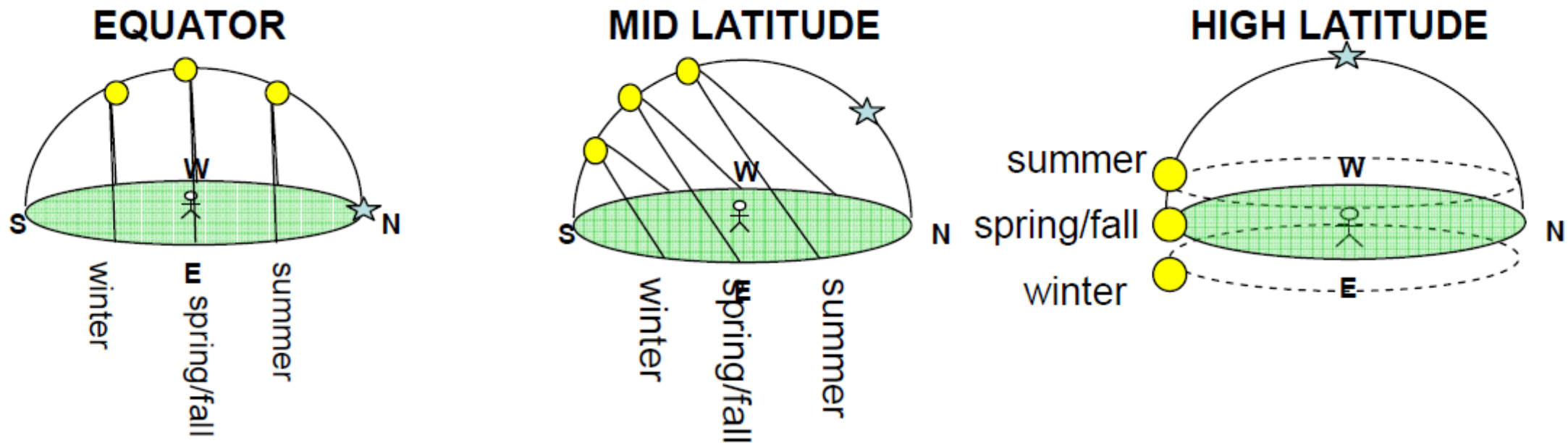
2. HIGHEST angle at solar noon - HIGHER temperatures

40°N Latitude



Latitude –

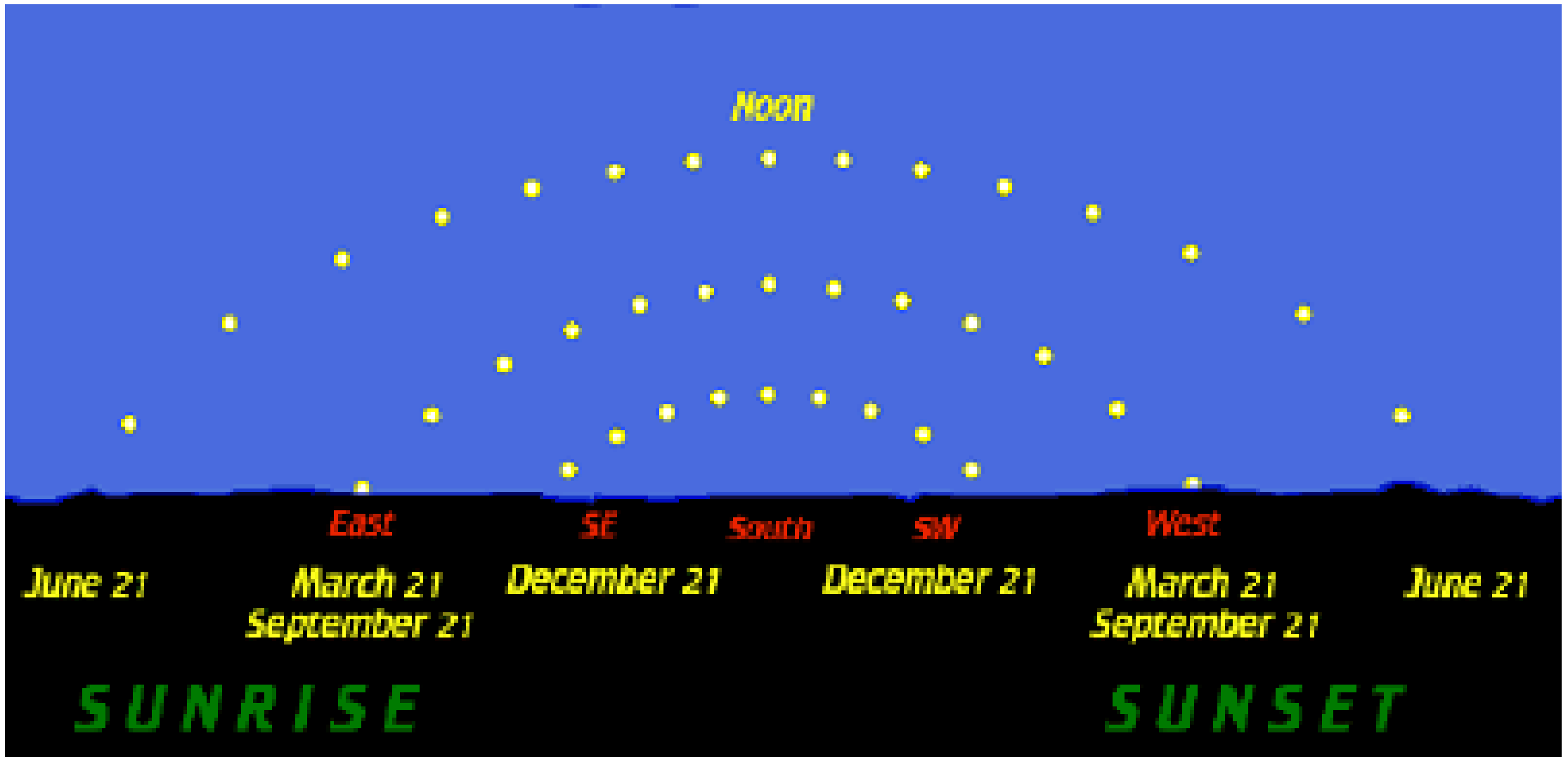
1. highest angle at equator (0°) - warmer temperatures
2. lowest angle at the poles (90°N & 90°S) – colder temperatures

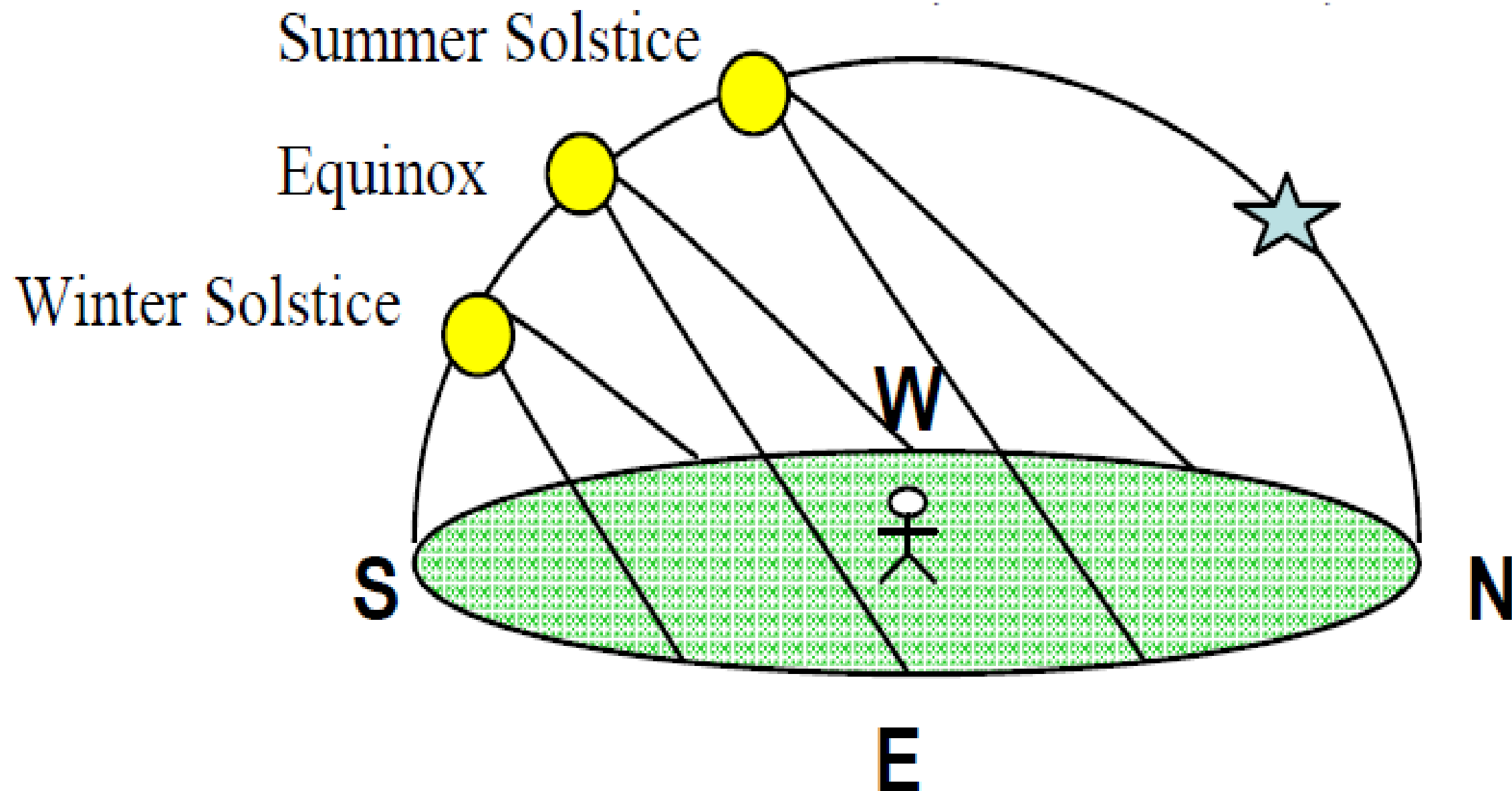


Seasons

1. lowest in the winter (December) – cooler temperatures

1. lowest in the winter (December) – cooler temperatures
2. highest in the summer (June) – warmer temperatures





2. Duration of insolation

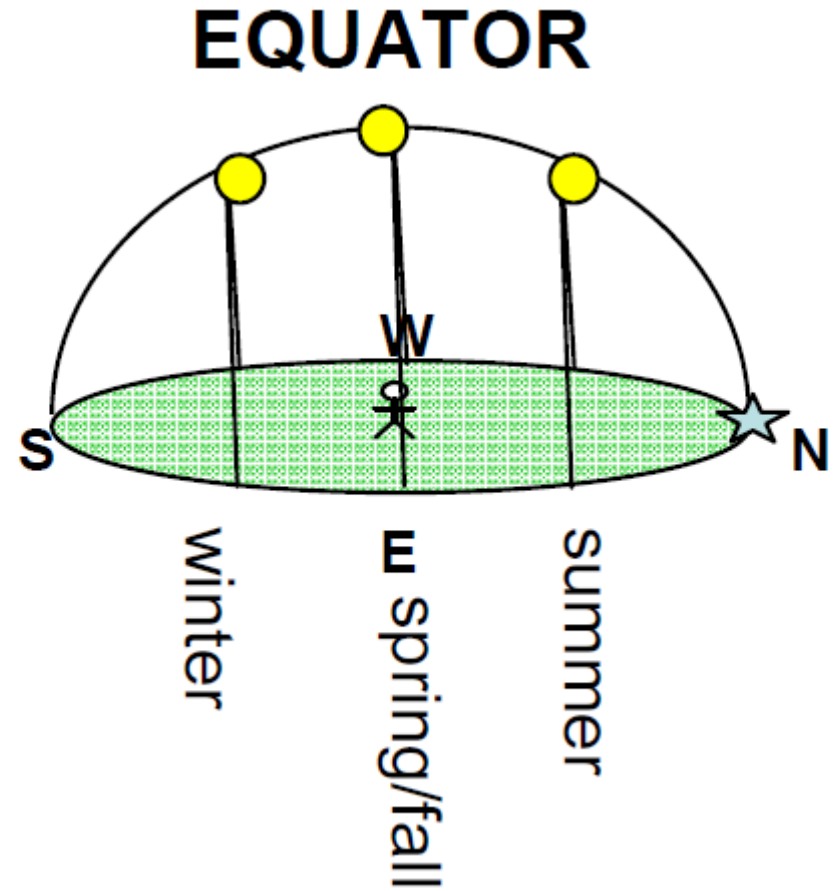
- a. How long the sun is above the horizon
- b. The **LONGER** the sun is above the horizon at a specific location, the **HIGHER** the temperatures .
- c. The more hours of the day the sun shines, the warmer the temperature.

Depends on:

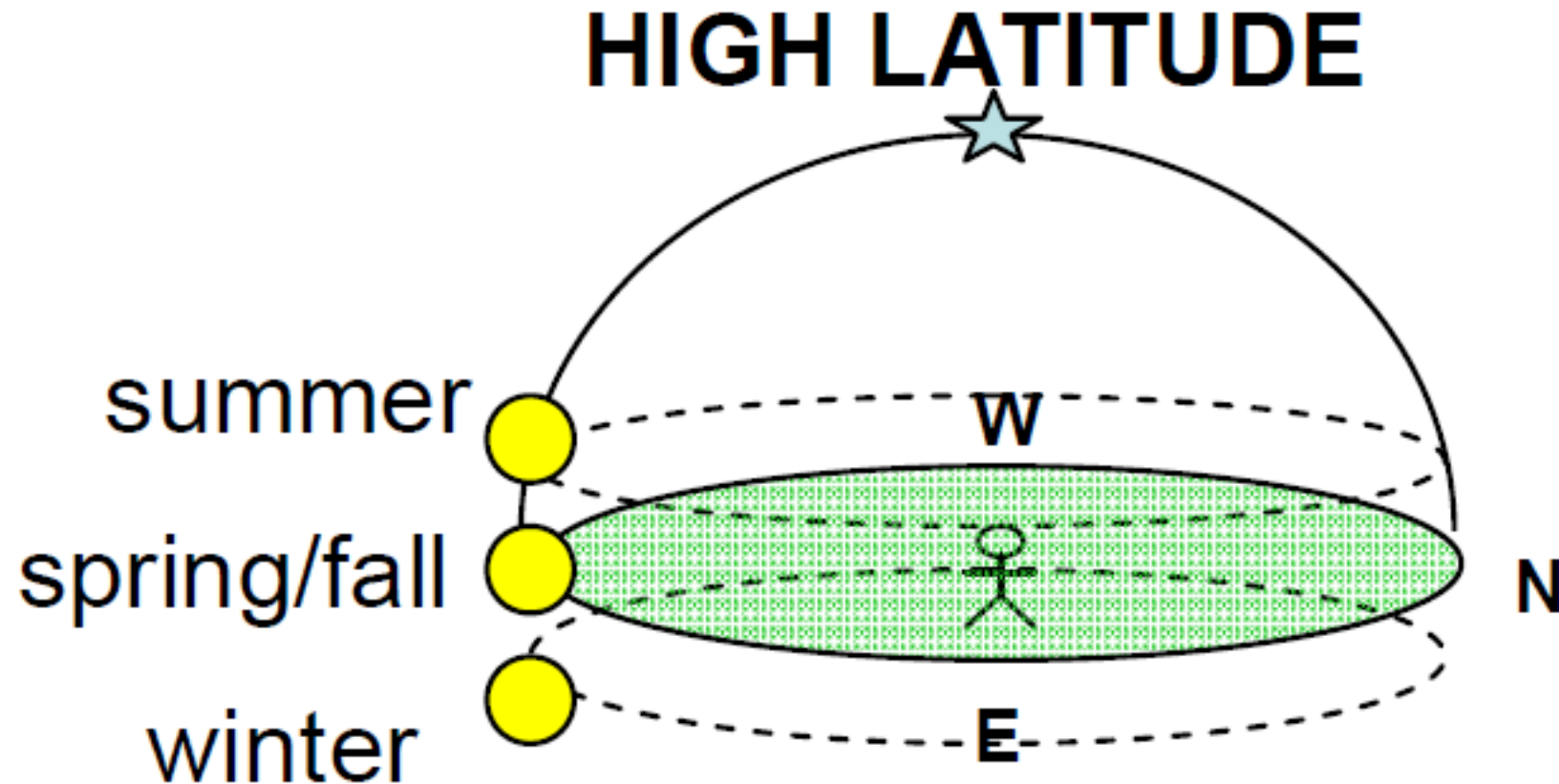
- Latitude

1. Equator (0°) –
has 12 hours of
daylight

EVERYDAY –
warmer
temperatures

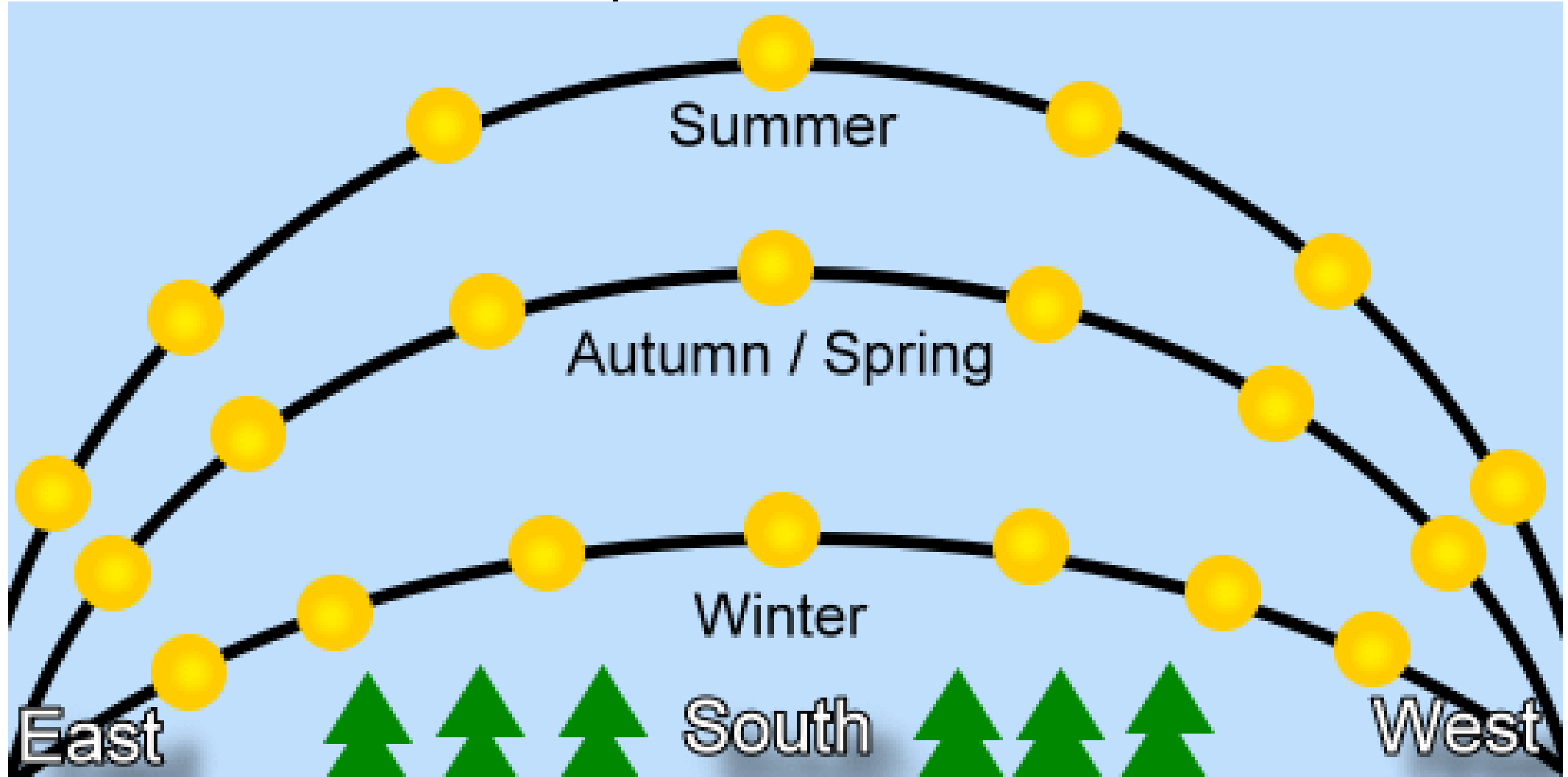


2. The poles (90°N & 90°S) – have 6 months of darkness, 6 months of daylight - colder temperatures * remember – at the poles the angle of the sun's rays is very low so it never really heats up, even with 6 months of daylight)

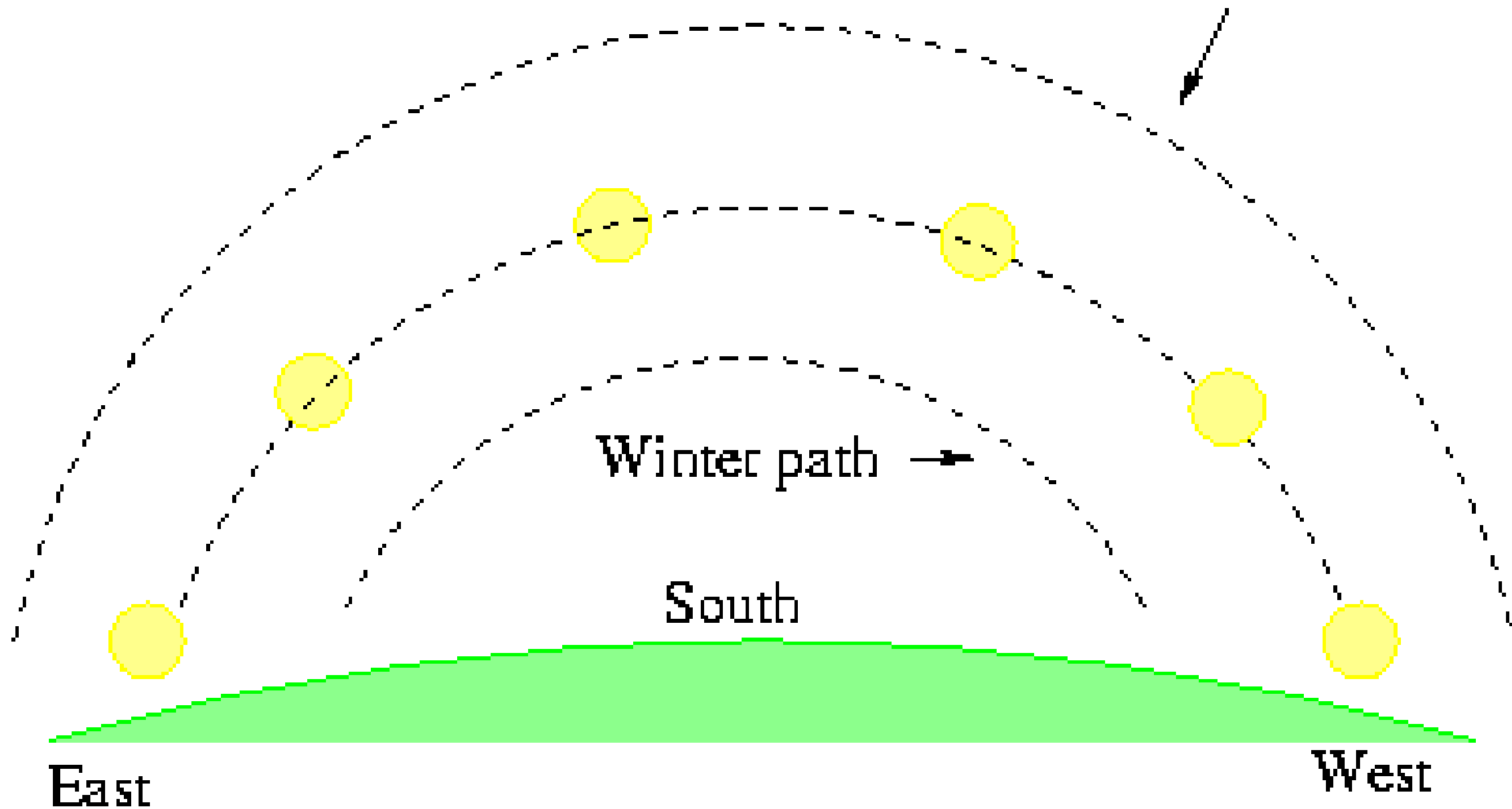


Seasons

1. Summer - “longer” days – duration of insolation is longer – warmer temperatures –
2. Winter – “shorter” days - duration of insolation is shorter – cooler temperatures



Northern Hemisphere Summer path



Atmospheric Transparency

a. How much insolation reaches Earth's surface

b. Depends on reflection, refraction, or absorption of insolation

c. Clouds:

- during the day, clouds block insolation, no sun, no heat - therefore cooler temperature**
- if it is sunny during the day and cloudy at night, the clouds insulate Earth (like a blanket) and helps keep the surface warm - therefore warmer temperature**

Specific Heat –

- LAND has a lower specific heat so it heats up and cools down FAST
- WATER has a high specific heat so it heats up and cools down SLOW

Interaction of Insolation and Earth's Surface:

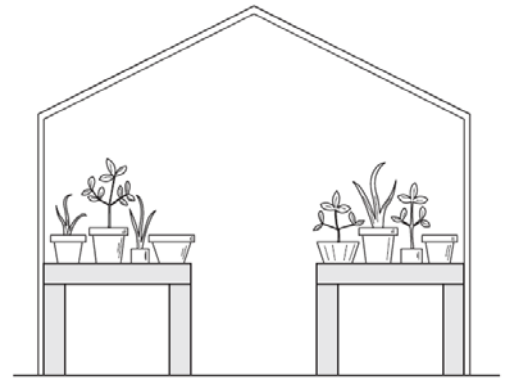
1. When sunlight reaches the Earth it can interact it can be:

- a. REFLECTION - when the sun's rays reflect back into the atmosphere.
- b. REFRACTION - The ray is bent and travels in a new direction
- c. SCATTERED - in various directions
- d. ABSORBED - The suns ray is taken in by the surface.

Factors Affecting Absorption of Insolation:

1. COLOR - darker colors absorb more energy.
2. SPECIFIC Heat – Lower SH, faster heating and cooling
3. SURFACE AREA- rough surfaces have more surface area and will absorb more energy.
4. Type of Surface – Land heats and cools quickly, water heats and cools slowly.
5. A good ABSORBER of electromagnetic energy (HEAT) is a good RADIATOR of electromagnetic energy
6. In other words if an object heats fast, it will cool down fast.

THE GREENHOUSE EFFECT



1. Short wave radiation like VISIBLE LIGHT passes through the glass of a greenhouse and is ABSORBED by the objects inside the greenhouse.
2. These objects RE-READIATE the energy as INFRARED, which gets reflected back into the greenhouse and warms the air.

3. In Earth's atmosphere, there are many gases that act like the glass of a greenhouse and **TRAP** long-wave radiation, keeping it in the Earth's Atmosphere. These gases are:

- CO_2
- H_2O
- Methane
- Nitrous Oxide
- absorb infrared that is re-radiated from the surface of the Earth. Therefore, holding that heat in the atmosphere and raising the global temperature.