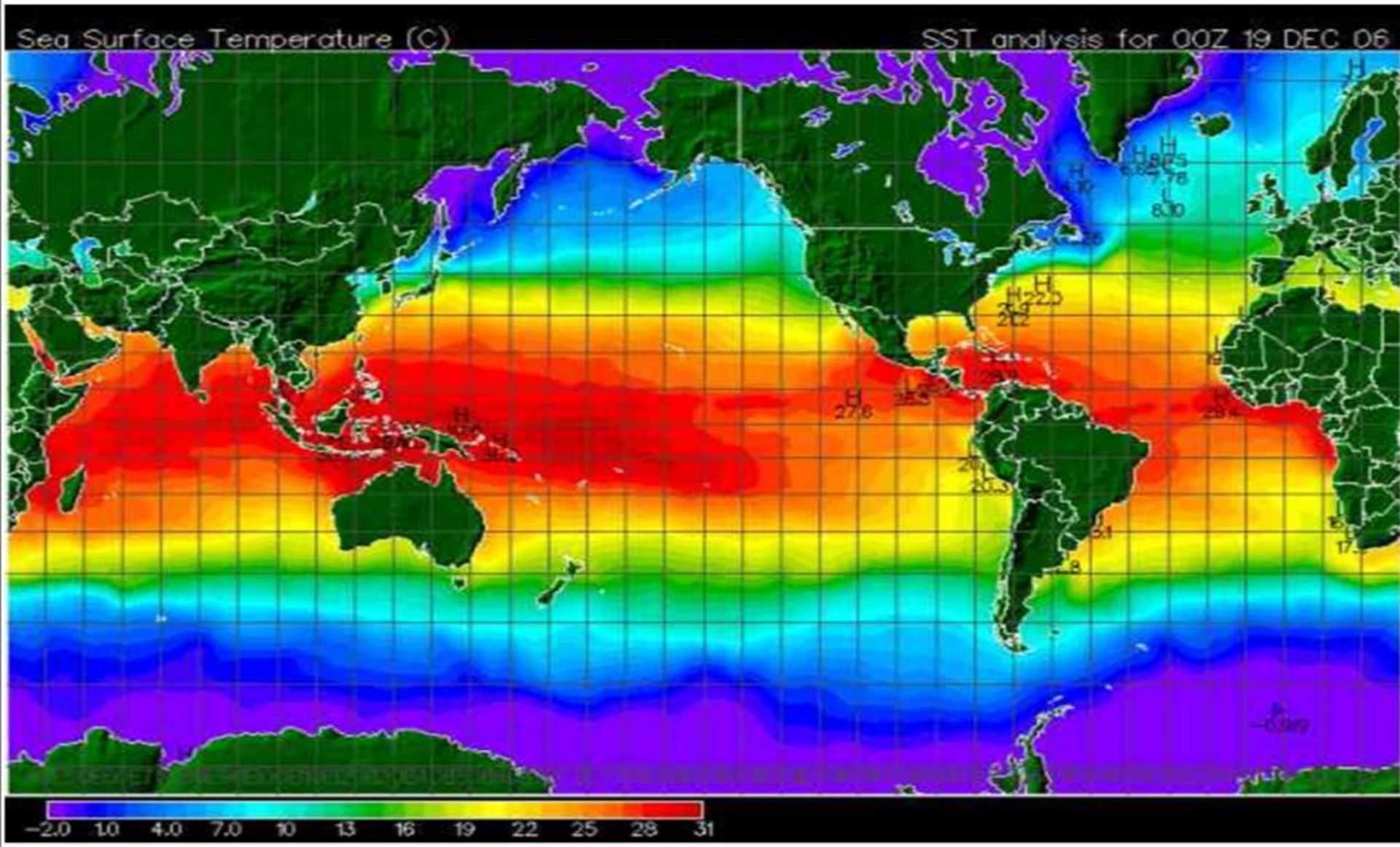
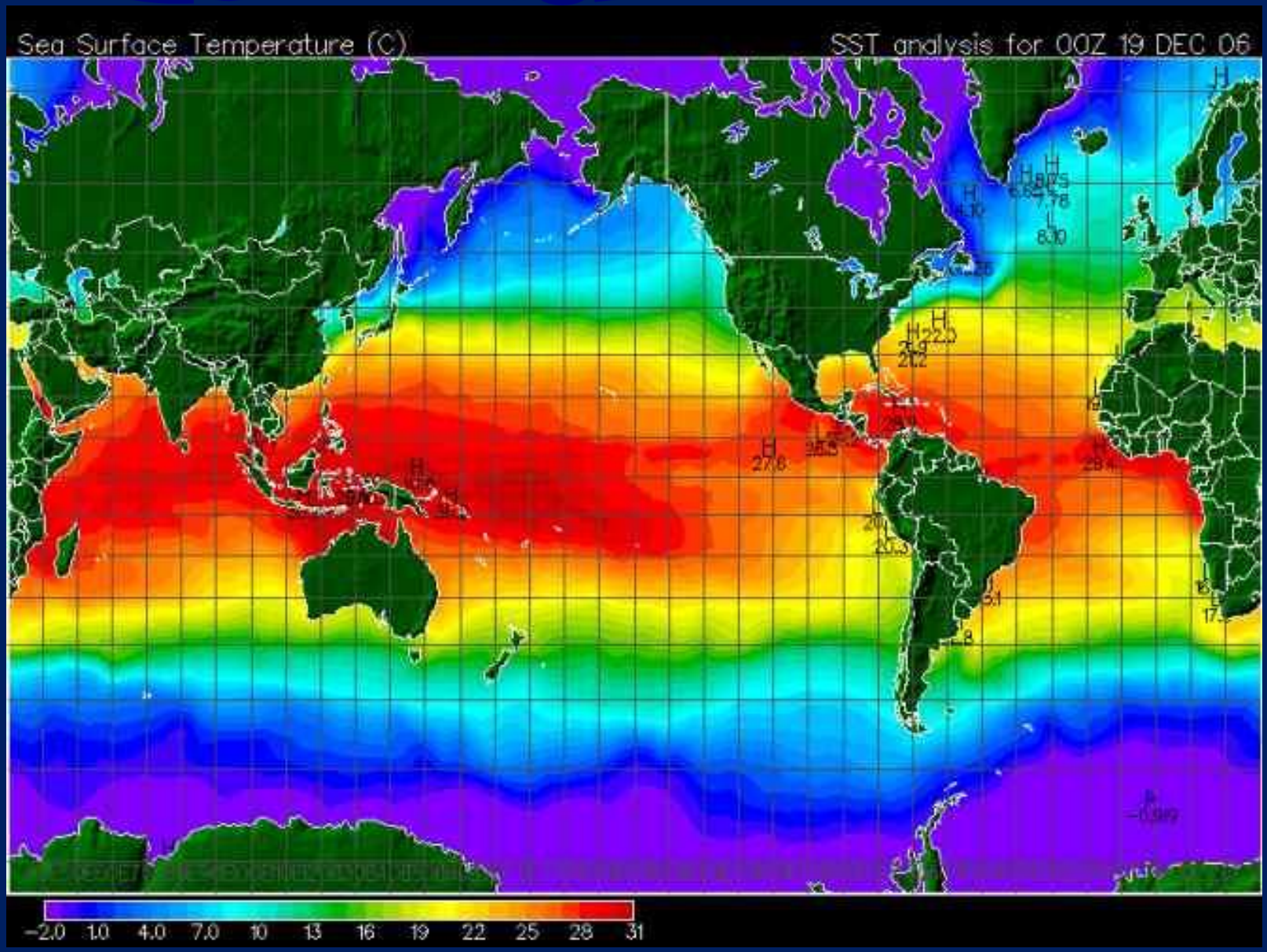
Climate and Seasons



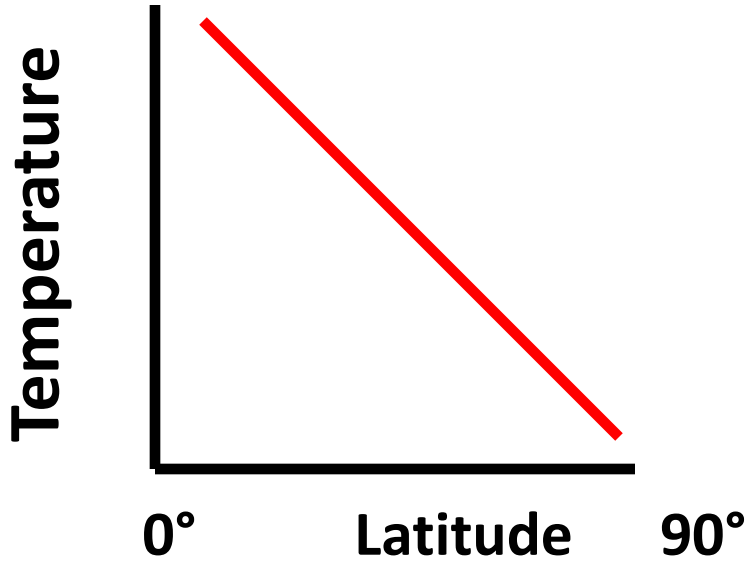
Climate Factors

Identify five factors that affect climate and explain how each affects climate.

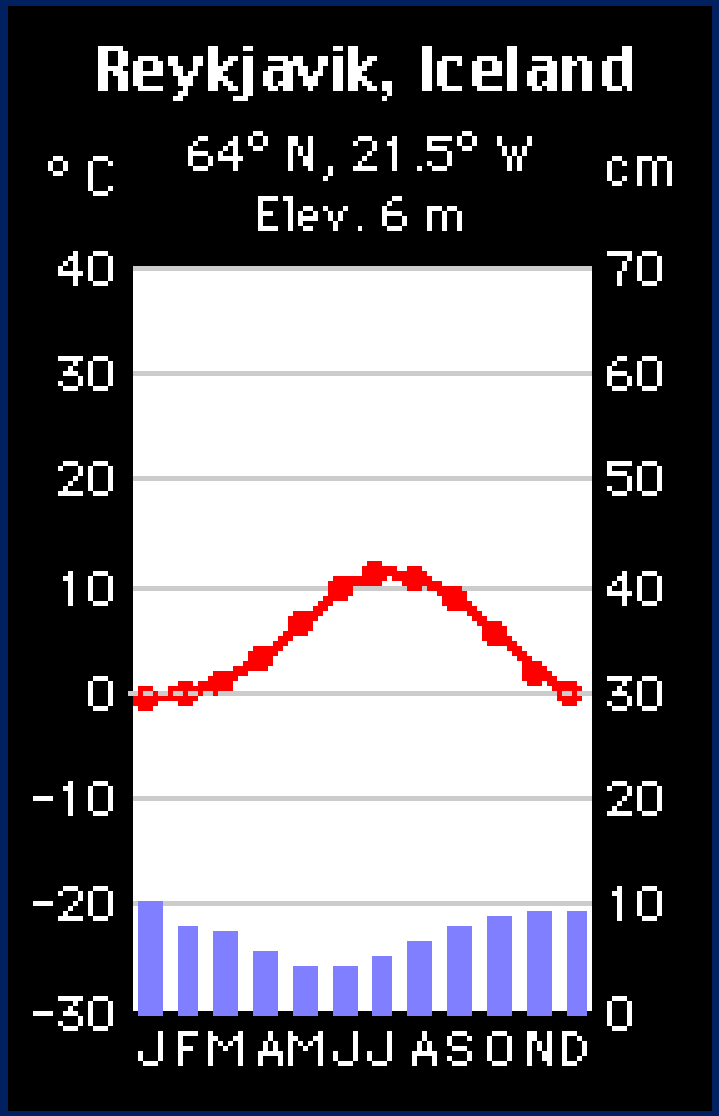
1) Latitude


Sea Surface Temperature (C)
SST analysis for 00Z 19 DEC 06
-2.0 1.0 4.0 7.0 10 13 16 19 22 25 28 31

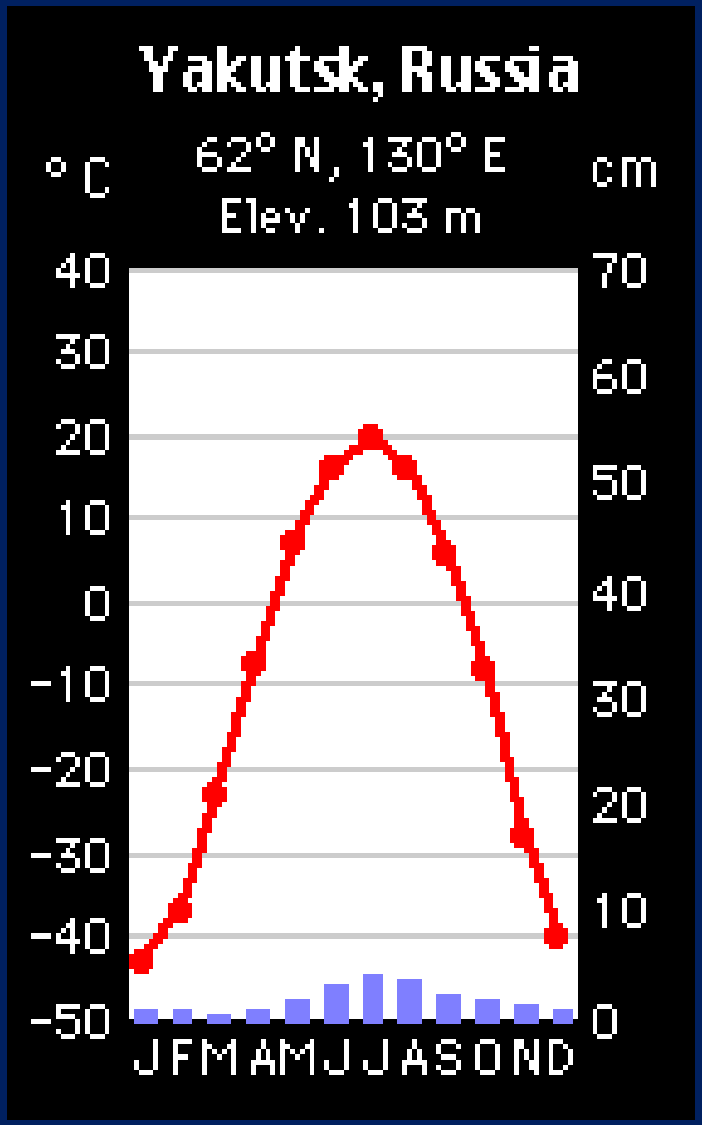
As latitude increases, the average annual temperature decreases.



2) Closeness to Large Bodies of Water



Coastal



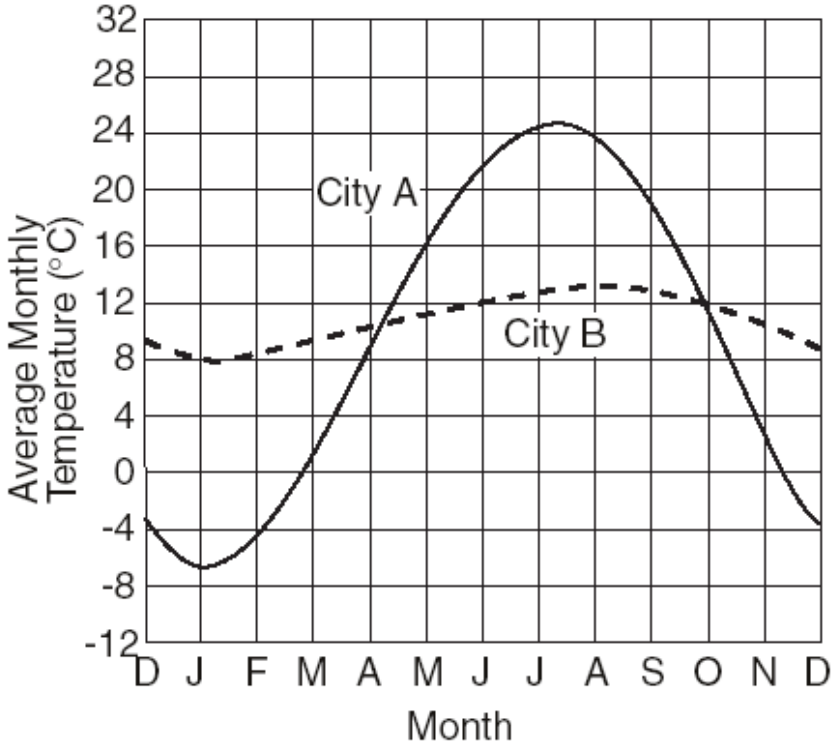
Inland

How does closeness to a large body of water affect climate?

Water **moderates** the temperature.

Cooler summers. **Warmer** winters.

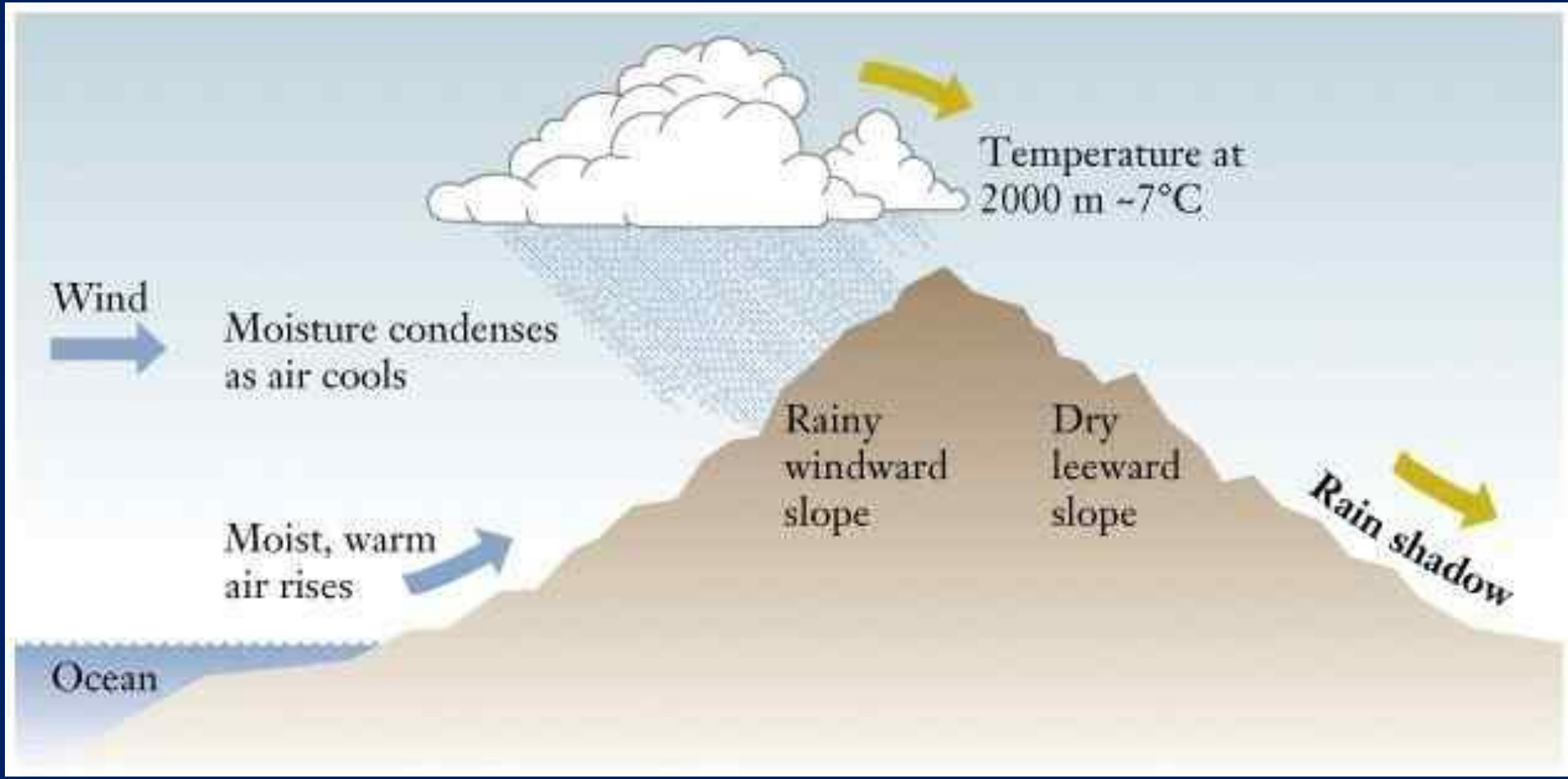
Cities A & B are located at the same latitude.



City B is closer to a large body of water.

Its temperature line is flatter (moderated, smaller temp. range).

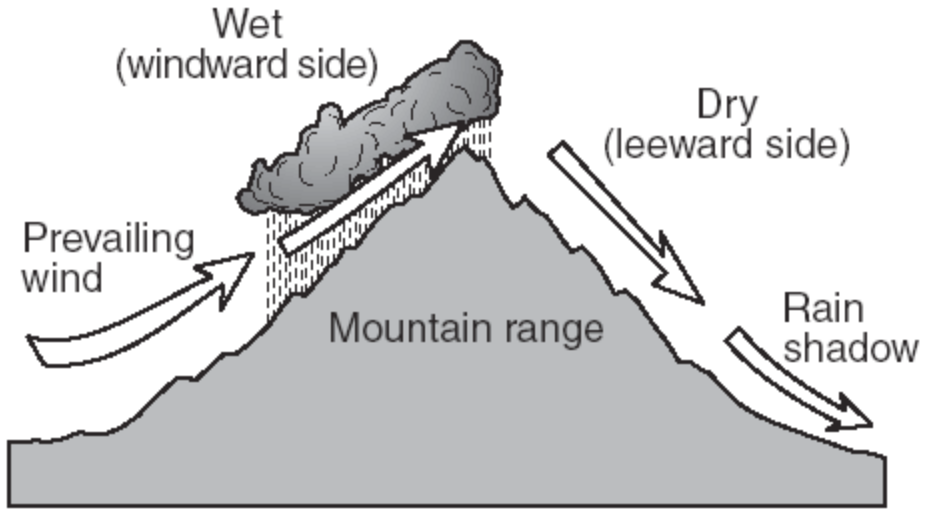
3) Orographic Effect

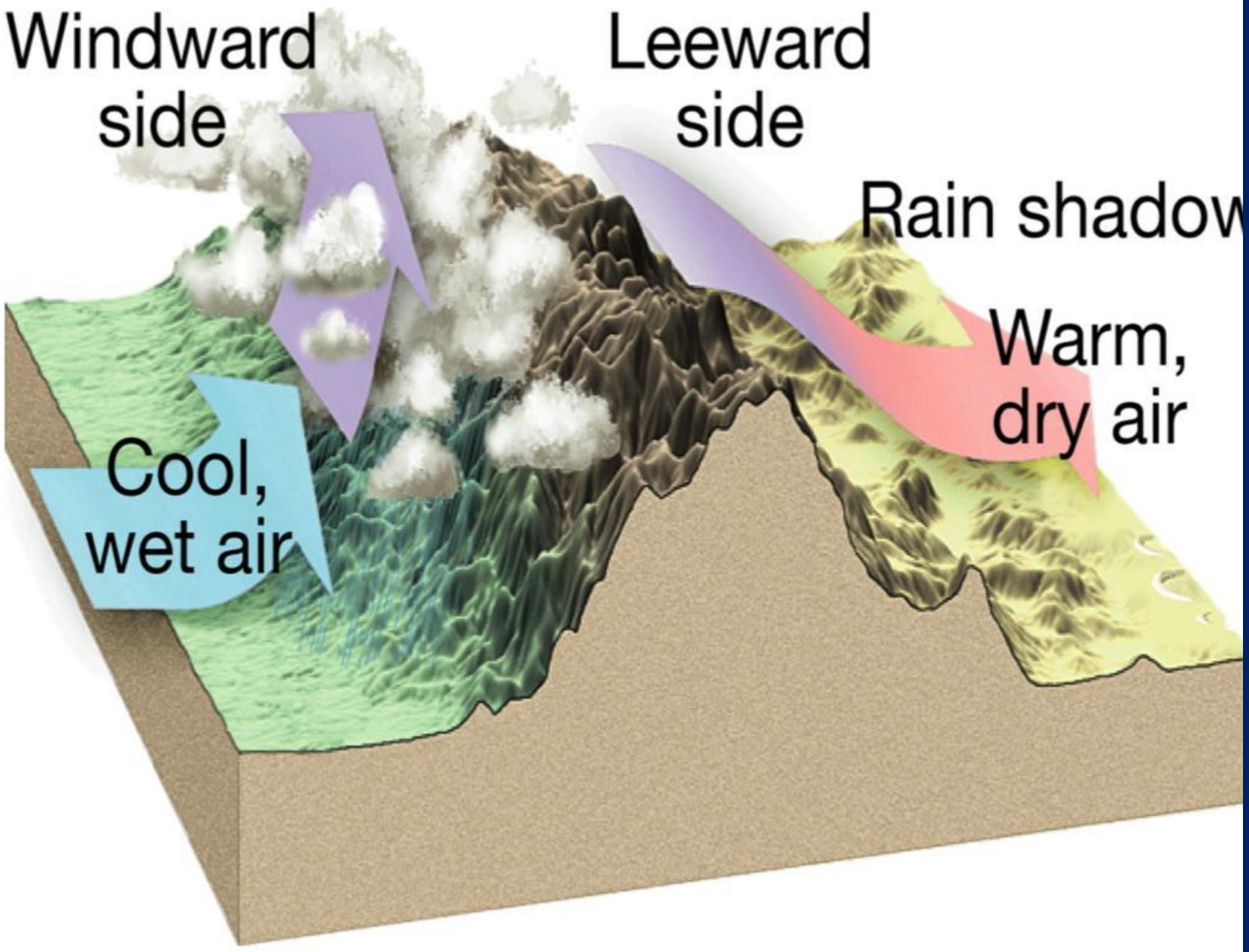


How does the Orographic Effect affect climate?

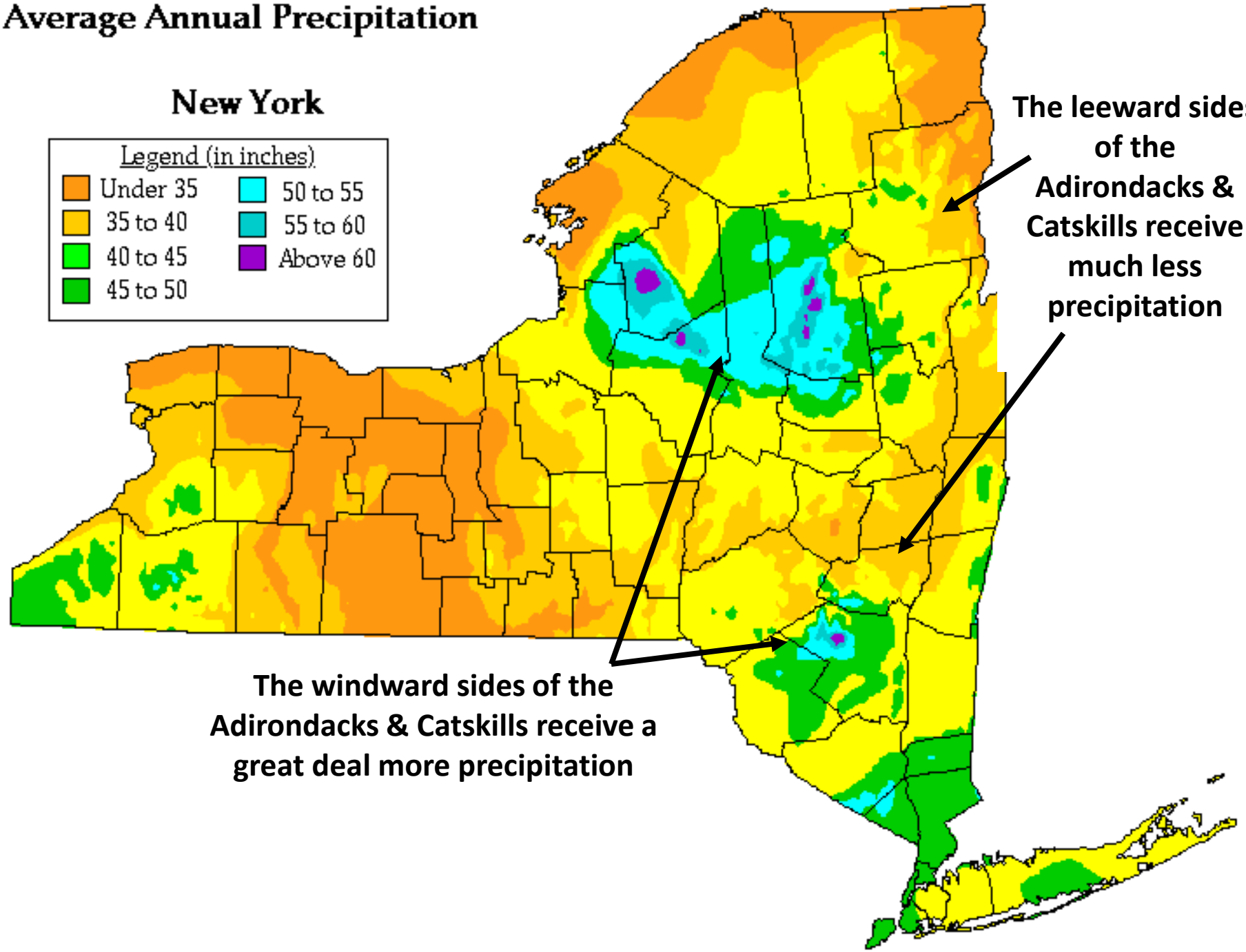
Windward Side: cool, moist

Leeward Side: warm, dry

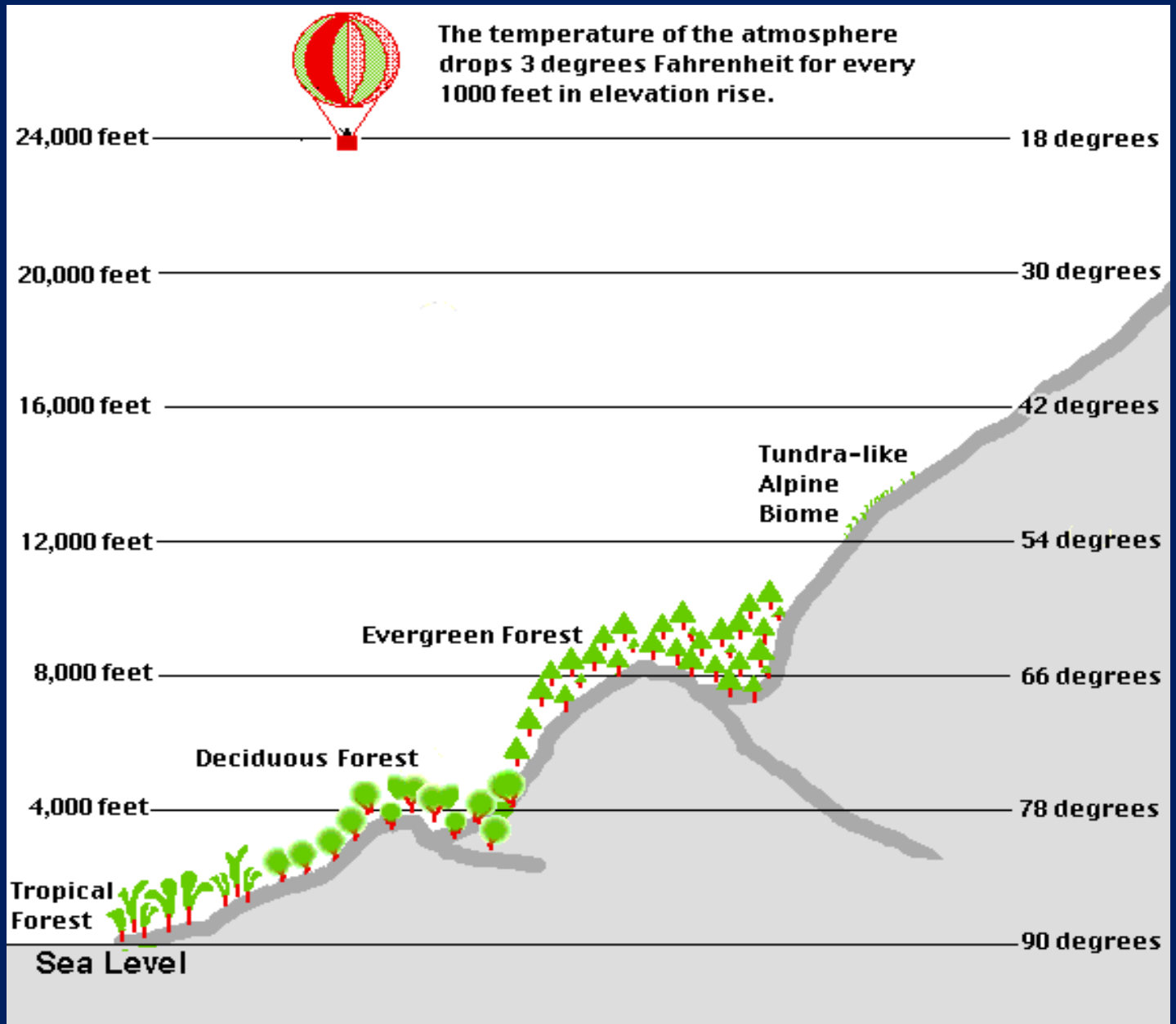



Windward side
Leeward side
Rain shadow
Warm, dry air
Cool, wet air

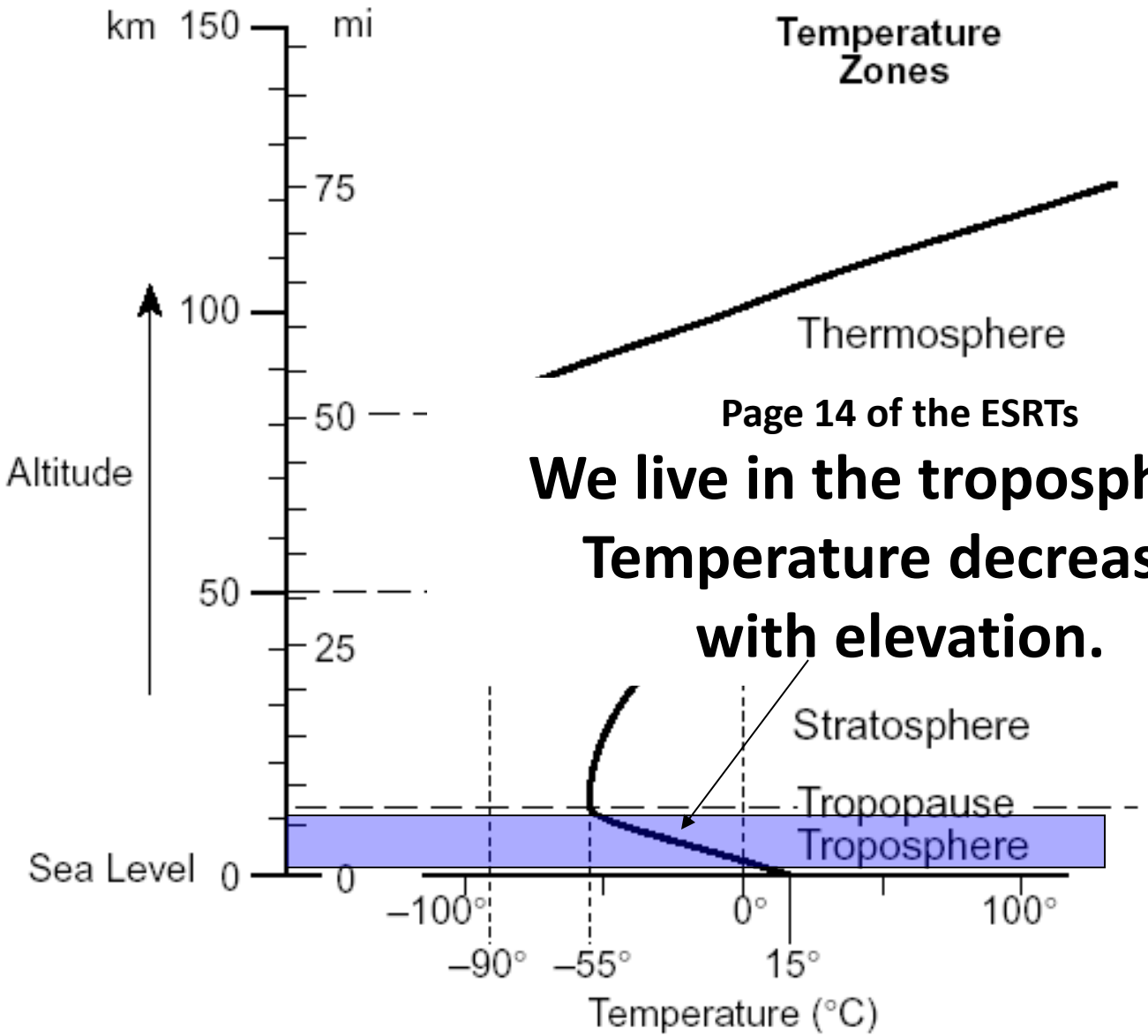
Average Annual Precipitation



4) Elevation


The temperature of the atmosphere drops 3 degrees Fahrenheit for every 1000 feet in elevation rise.
24,000 feet
18 degrees
20,000 feet
30 degrees
16,000 feet
42 degrees
Tundra-like Alpine Biome
12,000 feet
54 degrees
Evergreen Forest
8,000 feet
66 degrees
Deciduous Forest
4,000 feet
78 degrees
Tropical Forest
90 degrees
Sea Level

Elevation

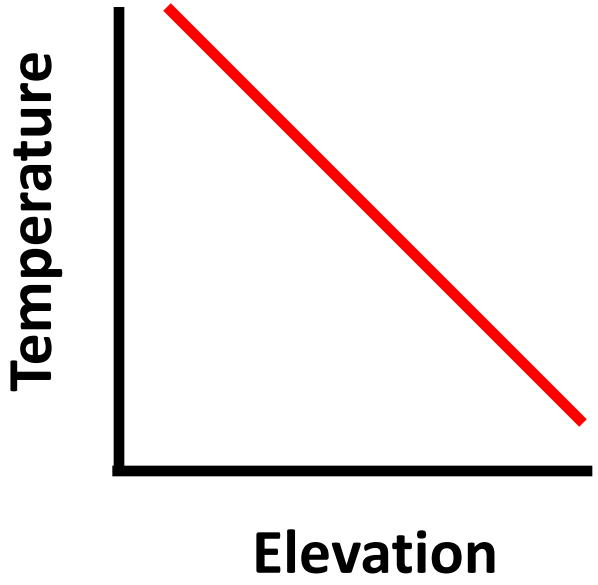


Page 14 of the ESRTs

We live in the troposphere. Temperature decreases with elevation.

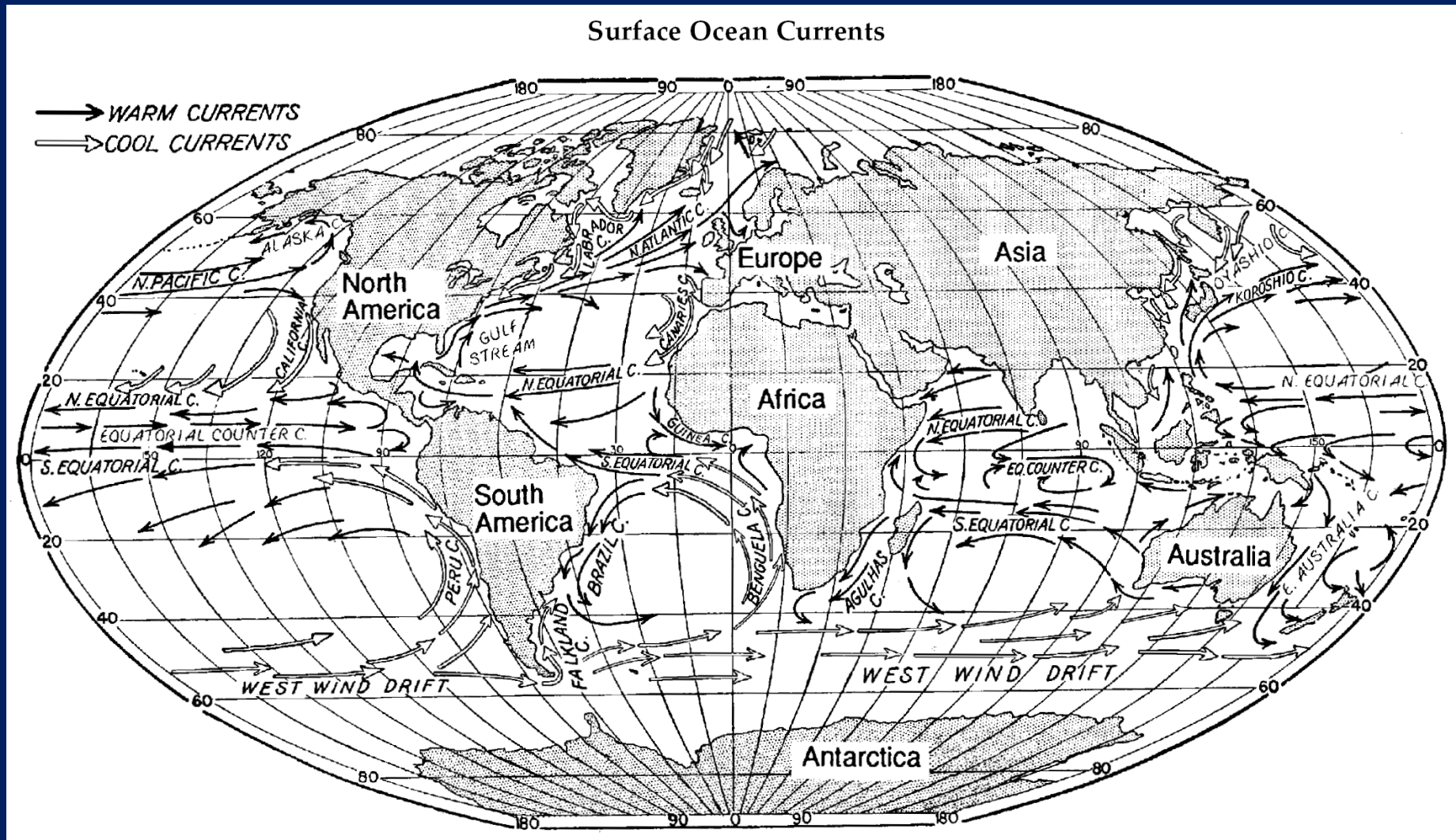
How does elevation affect climate?

As elevation increases, the average annual temperature decreases.



5) Ocean Currents

ESRT pg 4



How do ocean currents affect climate?

Warm Currents: warmer climate

Cold Currents: cooler climate

Factors that affects the Climate of an Imaginary Continent.

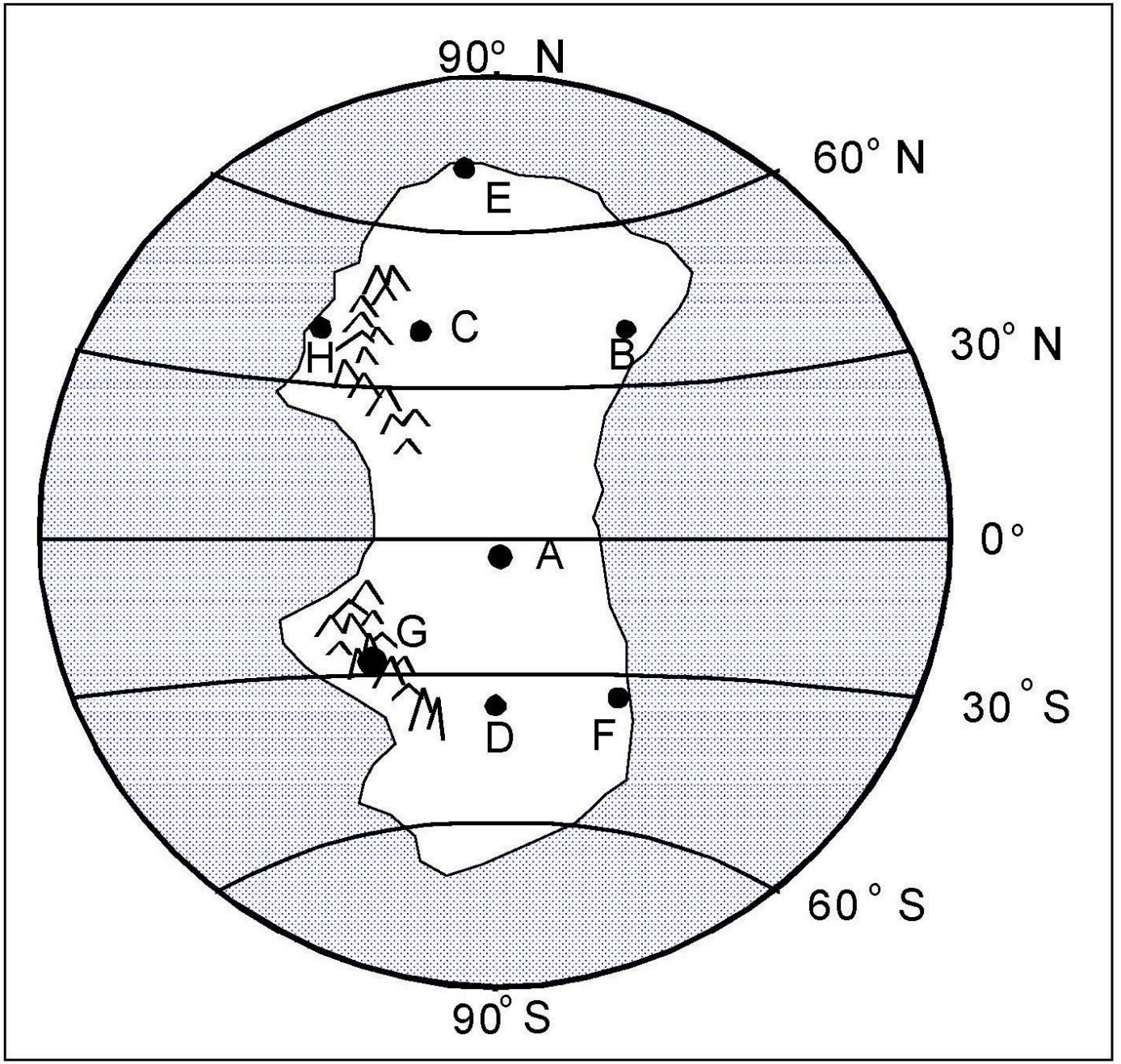


Figure 1: Continent "X." Eight cities are labeled A through H. All cities lie at sea level, except for City G, which is high in a mountain range.

PLANETARY WIND AND MOISTURE BELTS IN THE TROPOSPHERE

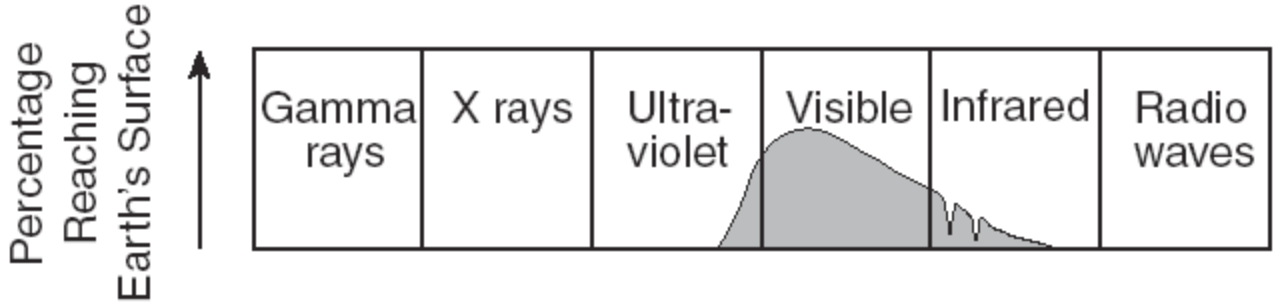
by Charles Burrows

LATITUDE	AIR: RISING or SINKING	PRESSURE: HIGH or LOW	WET or DRY	CLOUDY or CLEAR	SURFACE WINDS: DIVERGING or CONVERGING	HIGH ALTITUDE WINDS: DIVERGING or CONVERGING	JET STREAM: NONE or POLAR FRONT or SUBTROPICAL	IS THIS THE LOCATION OF A POLAR FRONT? Y or N
0°	Rising	Low	Wet	Cloudy	Converge	X	None	No
30°N and 30°S	Sinking	High	Dry	Clear	Diverge	X	Sub tropical	No
60°N and 60°S	Rising	Low	Wet	Cloudy	Converge	X	Polar	Yes
90°N and 90°S	Sinking	High	Dry	Clear	Diverge	x	None	No

BETWEEN:	90°N and 60°N	60°N and 30°N	0° and 30°N	0° and 30°S	30°S and 60°S	60°S and 90°S
WIND DIRECTION (FROM)	NE	SW	NE	SE	NW	SE

Sun's Energy & Climate

According to the graph below, what wavelength of energy does the Earth receive in the greatest intensity?



visible light

Name the primary gas which absorbs ultraviolet (UV) from the sun.

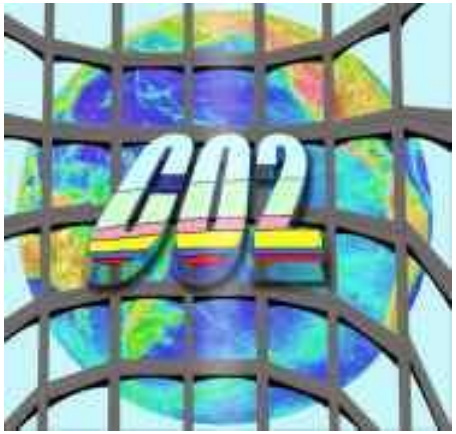
ozone

Sun's Energy & Climate

Why is the ozone layer important?

It protects the Earth from UV which damages crops and causes cancer in humans.

Name the three primary gases which absorb infrared (IR) energy



methane

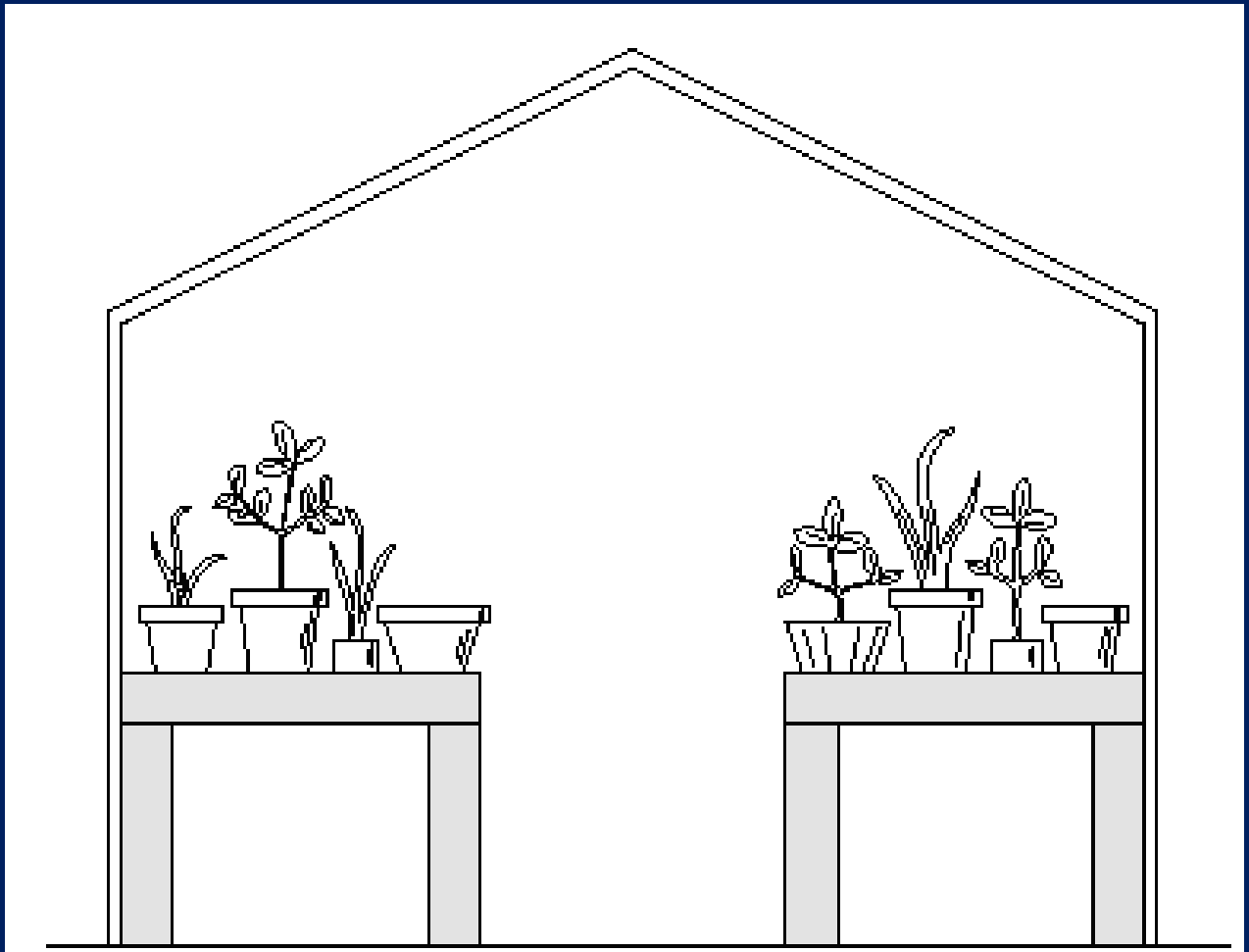
water vapor

Sun's Energy & Climate

Why is it warmer on a cloudy night than on a clear night?

Clouds (H_2O vapor) absorb IR energy radiated by the Earth. On a clear night, the IR energy escapes back into space.

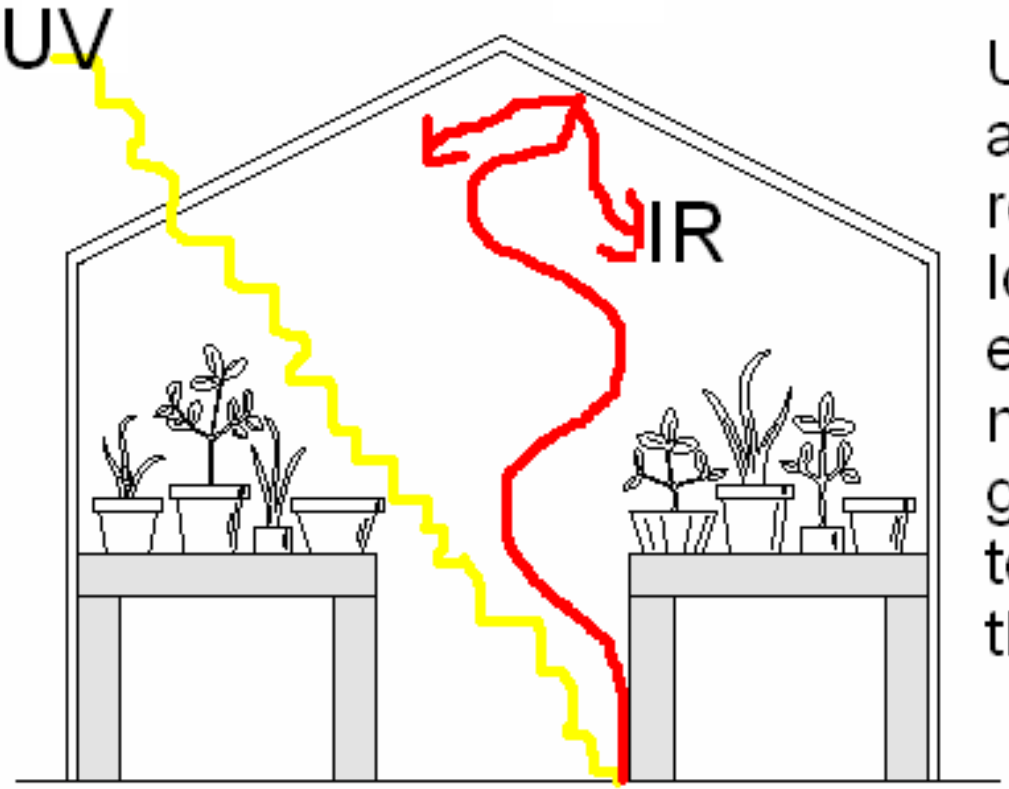
Explain the greenhouse effect. Include a diagram which shows the change in wavelength.



Explain the greenhouse effect. Include a diagram which shows the change in wavelength.

DEMO #2

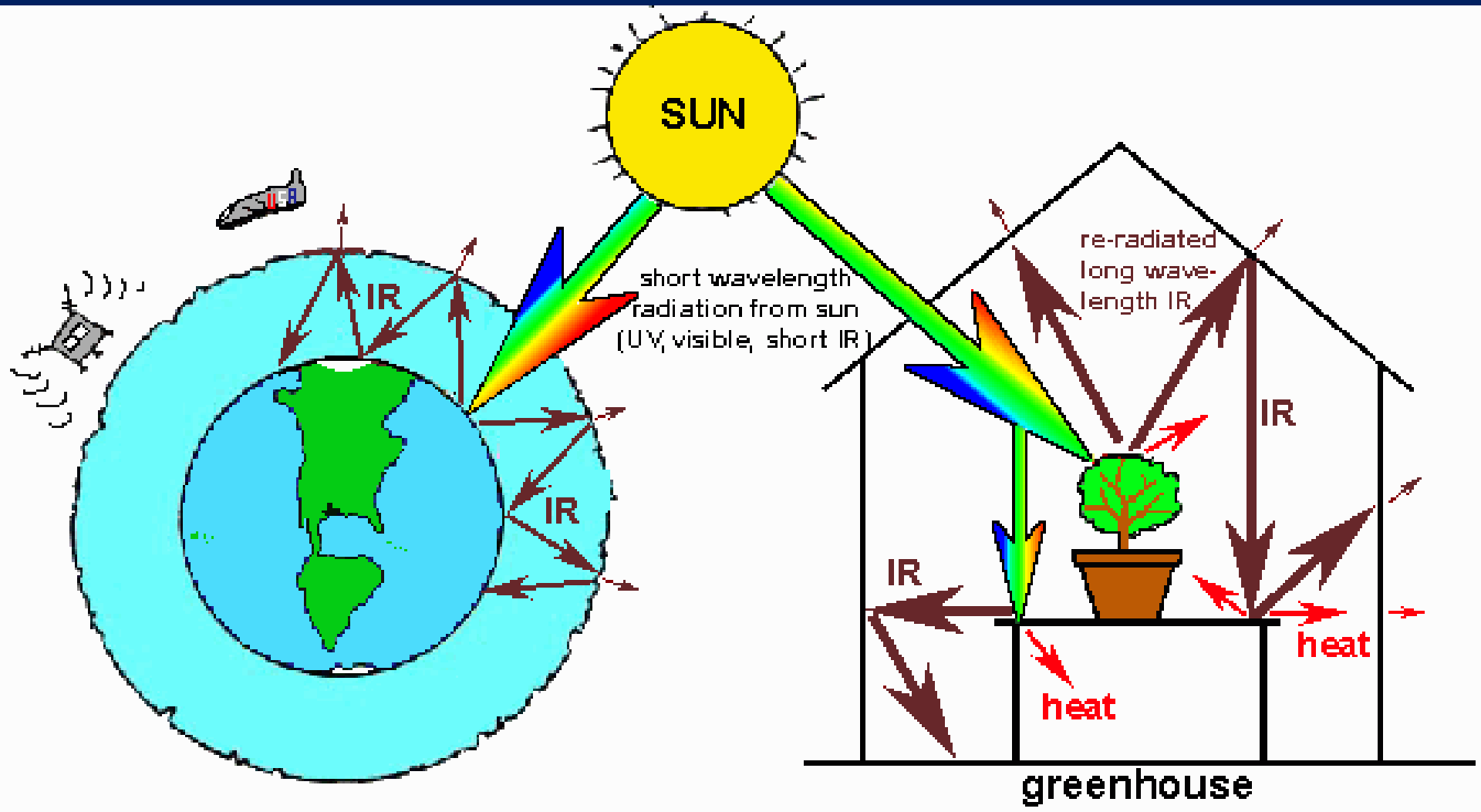
Short wave UV energy from the Sun can easily go through glass



Greenhouse

UV energy is absorbed and re-radiated as long-wave IR energy which can not go through the glass. The temperature therefore goes up.

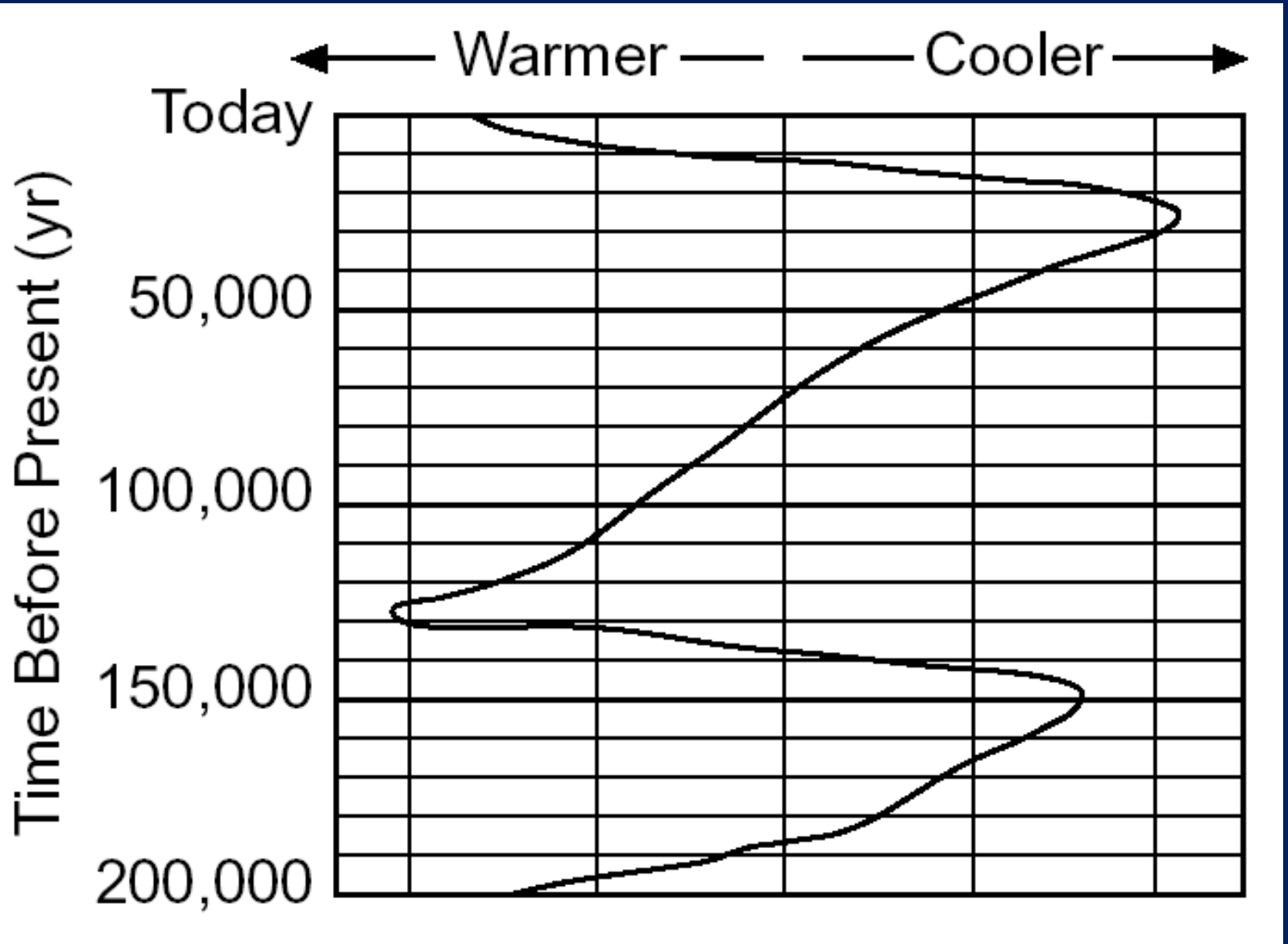
Just like a greenhouse, the gases in the atmosphere ---especially CO_2 --- absorb re-radiated infrared energy.



Graphic Design: Michael Ernst, The Woods Hole Research Center ©

Climate Change

Ice Ages


Warmer
Cooler
Today
50,000
100,000
150,000
200,000
Time Before Present (yr)

Ice Ages

Ice Ages are cyclic.

The last one occurred ~12,000 years ago

The exact cause of what triggers an ice age is not known

Global Warming

Muir and Riggs Glaciers

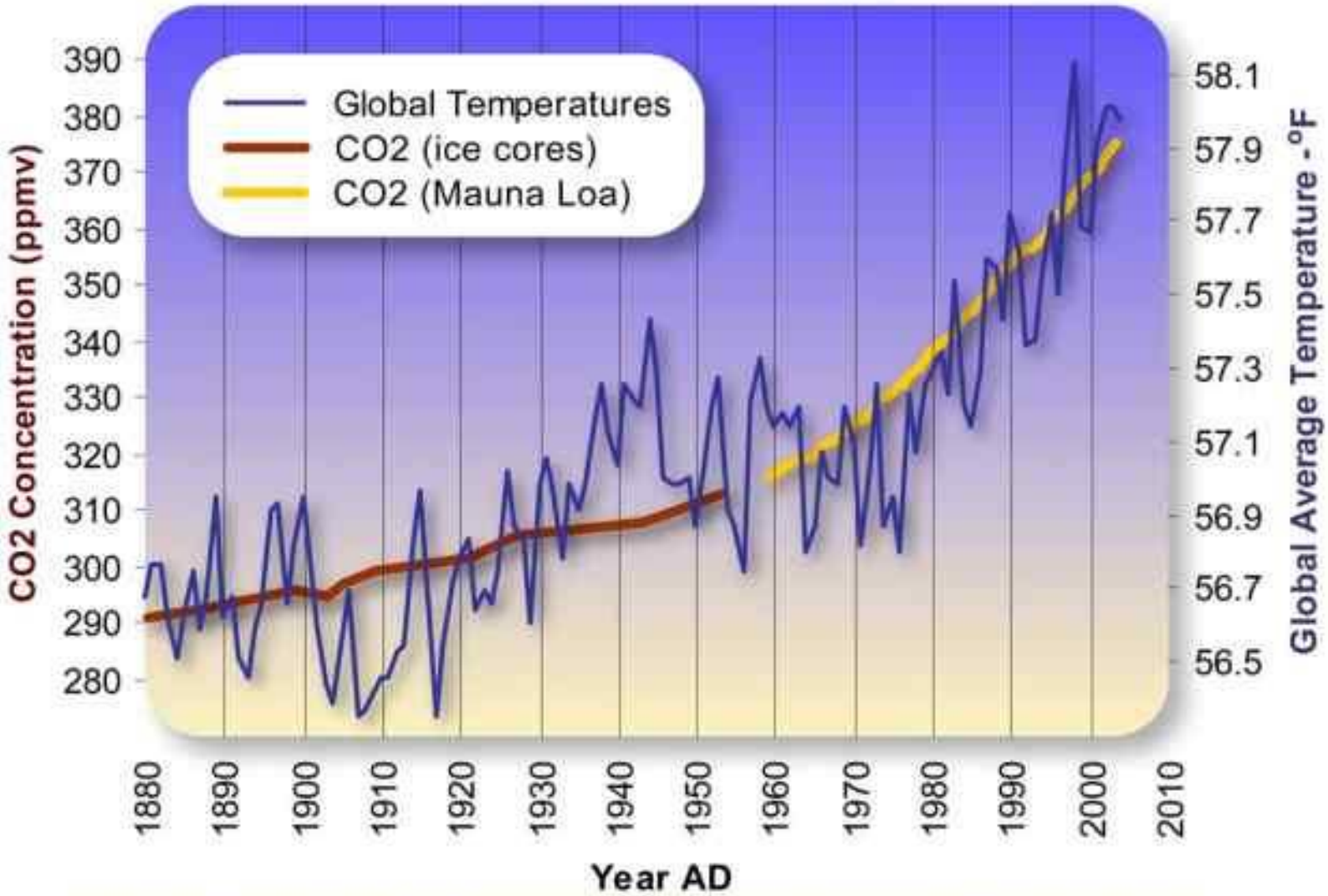
Global Warming

Average global temperatures
are increasing.
Glaciers are melting.
Ocean levels are rising.

Warming is natural.

Humans are speeding up the process
through increased levels of
carbon dioxide (CO_2)

Global Average Temperature and Carbon Dioxide Concentrations, 1880 - 2004



Data Source Temperature: ftp://ftp.ncdc.noaa.gov/pub/data/anomalies/annual_land.and.ocean.ts

Data Source CO2 (Siple Ice Cores): http://cdiac.esd.ornl.gov/ftp/trends/co2/siple2.013

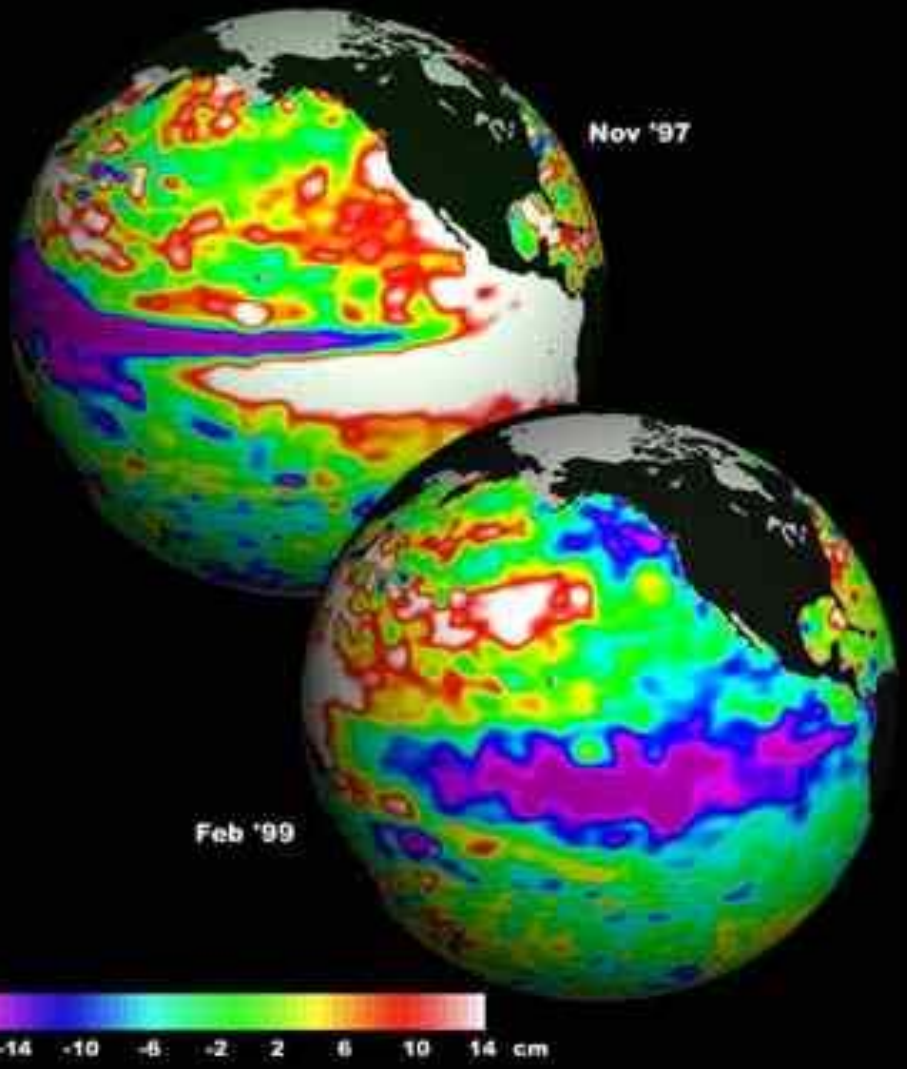
Data Source CO2 (Mauna Loa): http://cdiac.esd.ornl.gov/ftp/trends/co2/maunaloa.co2

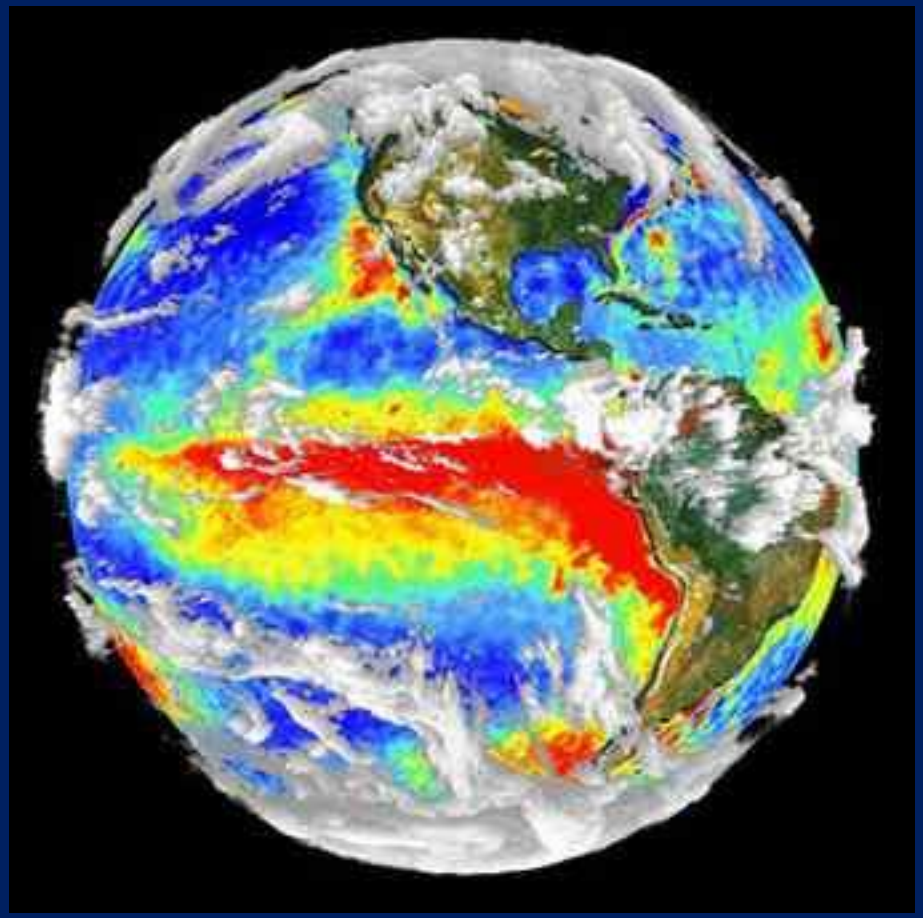
Graphic Design: Michael Ernst, The Woods Hole Research Center


1928
2004


NORTH
POLE
Since 1979, more than
20% of the Polar Ice Cap
has melted away.
ARCTIC SEA
ICE BOUNDARY IN 1979
PHOTO: NASA ©2003 NRDC

El Niño / La Niña



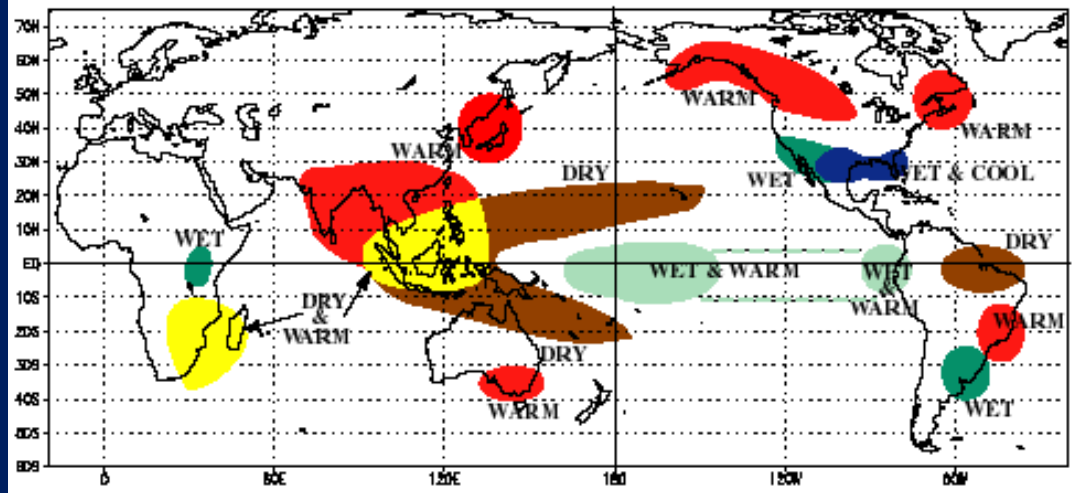


El Niño

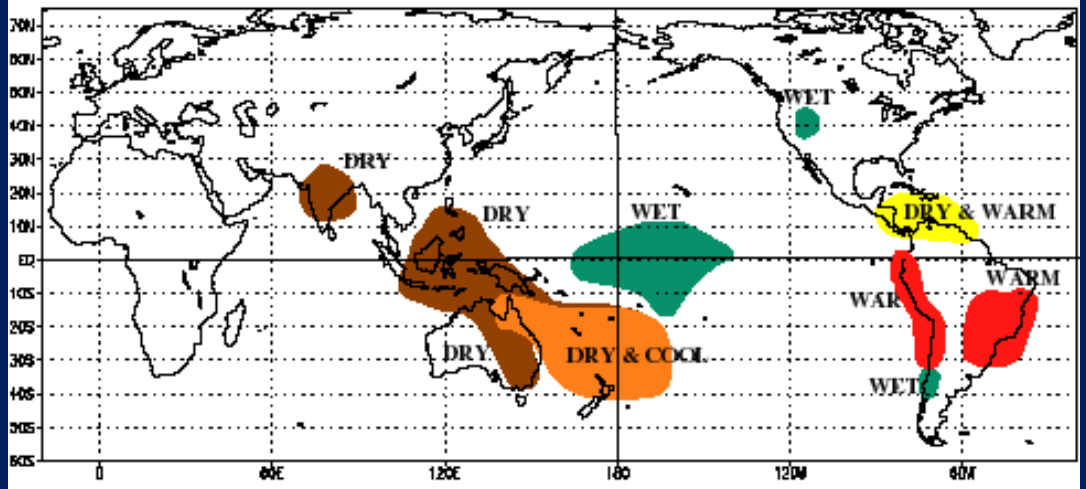
A warming of the Pacific Ocean.

Winters:
West = Stormy
South = Cold, wet
Northeast = warmer

WARM EPISODE RELATIONSHIPS DECEMBER - FEBRUARY



WARM EPISODE RELATIONSHIPS JUNE - AUGUST



Climate Prediction Center
NCEP

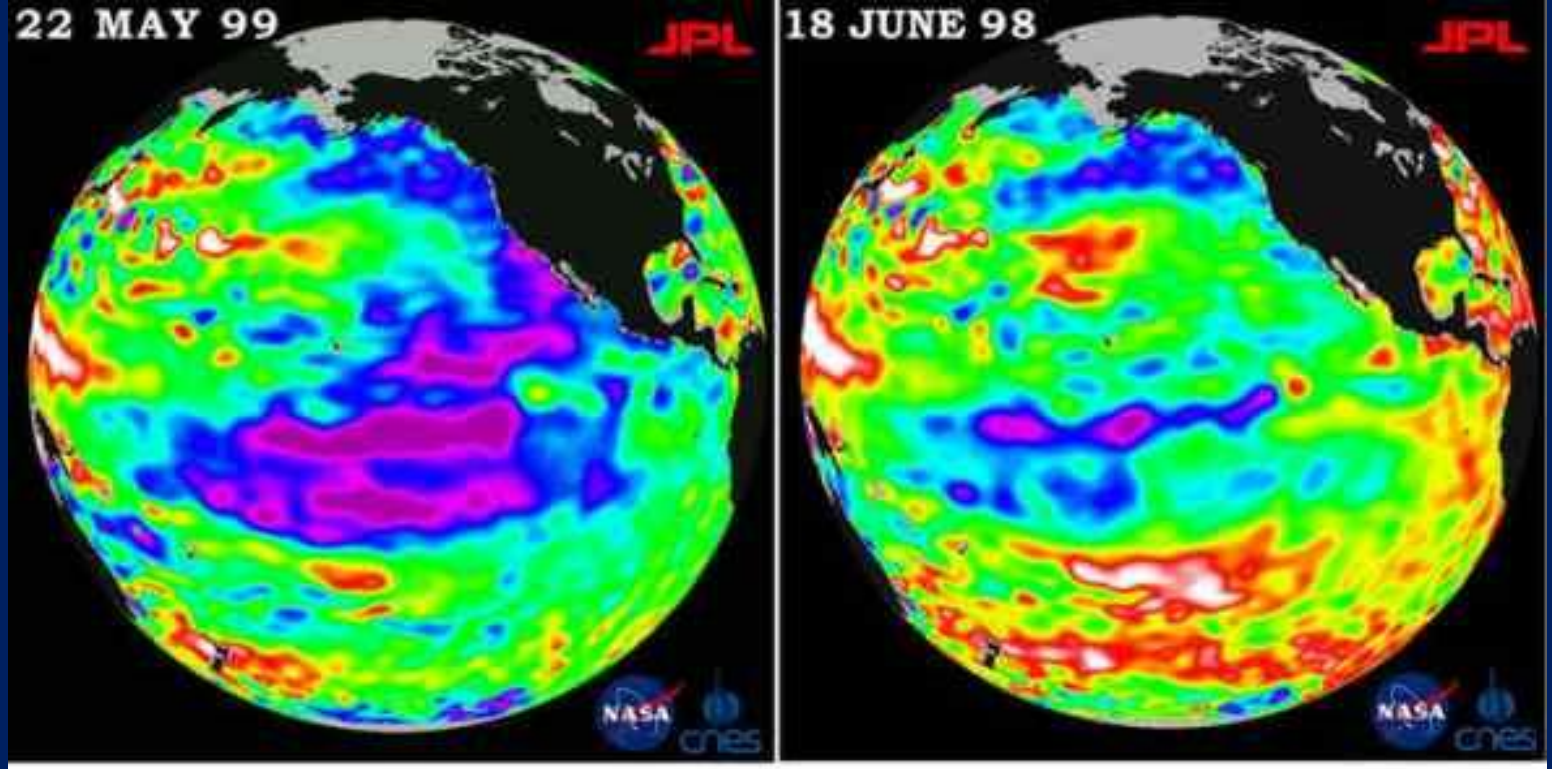


Fig.13 A very strong La Nina is pictured on the left; a weak La Nina event can be seen on the right

La Niña

A cooling of the Pacific Ocean.

Dry in southeast. Cool, wet in northwest.

Seasons

Reasons for the Seasons

Tilt of Earth's axis **23.5 °**

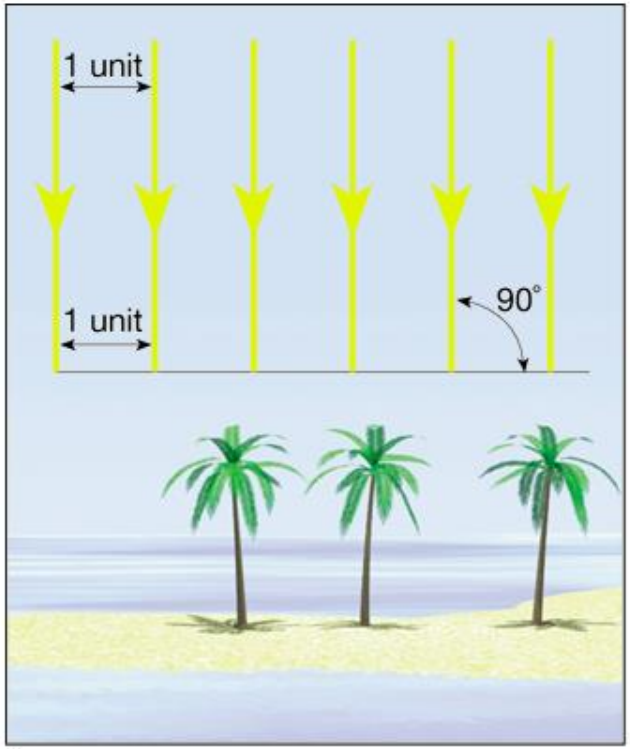
Cause different latitudes to ha
of day light and more direct su

Insolation:

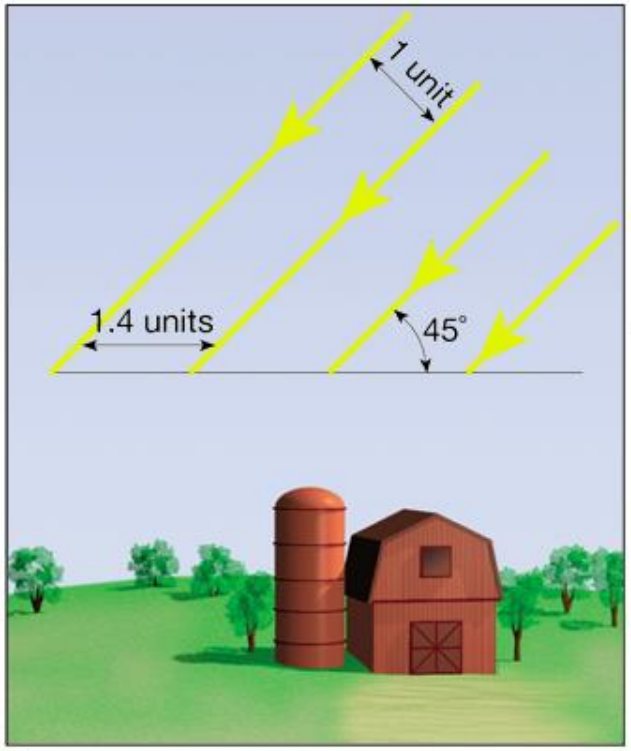
- Greater angle and duration of insolation = warmer temperatures.

- Greatest angle of incidence is 90 °

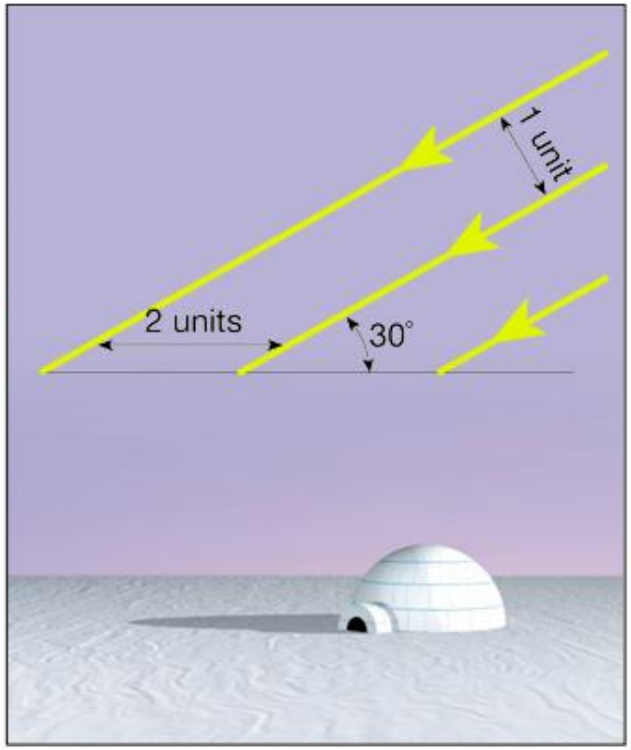
- Found at the Equator



A.



B.

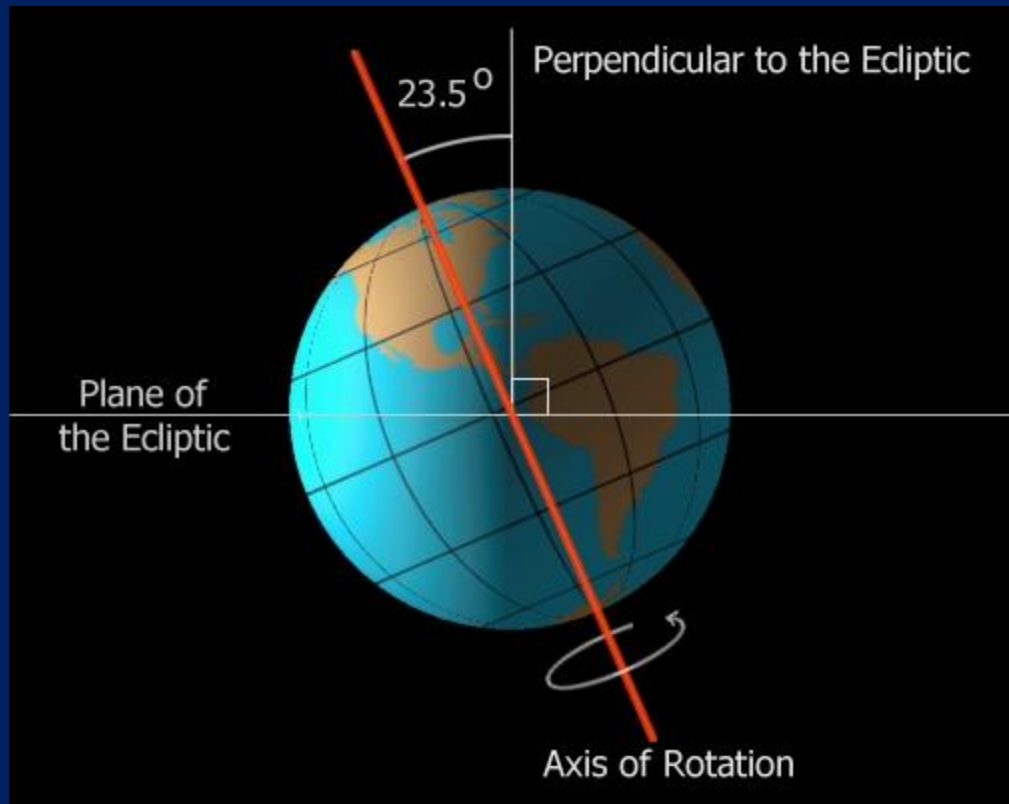


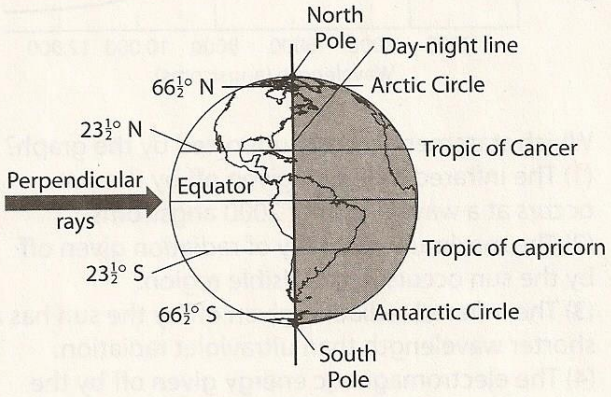
C.

For the northern hemisphere

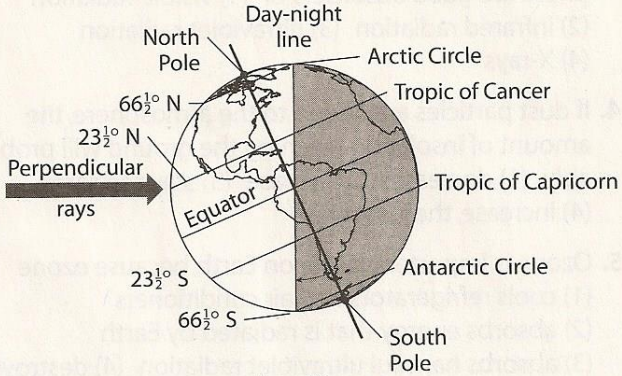
Summer: Northern Hemisphere is tilted toward to sun = greatest amount of insolation.

Winter: Northern Hemisphere tilted away from sun = least amount of insolation.

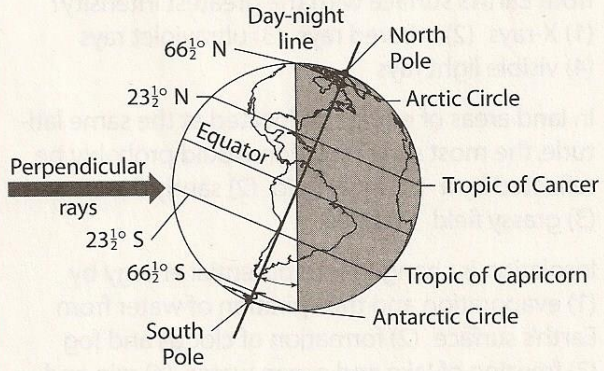




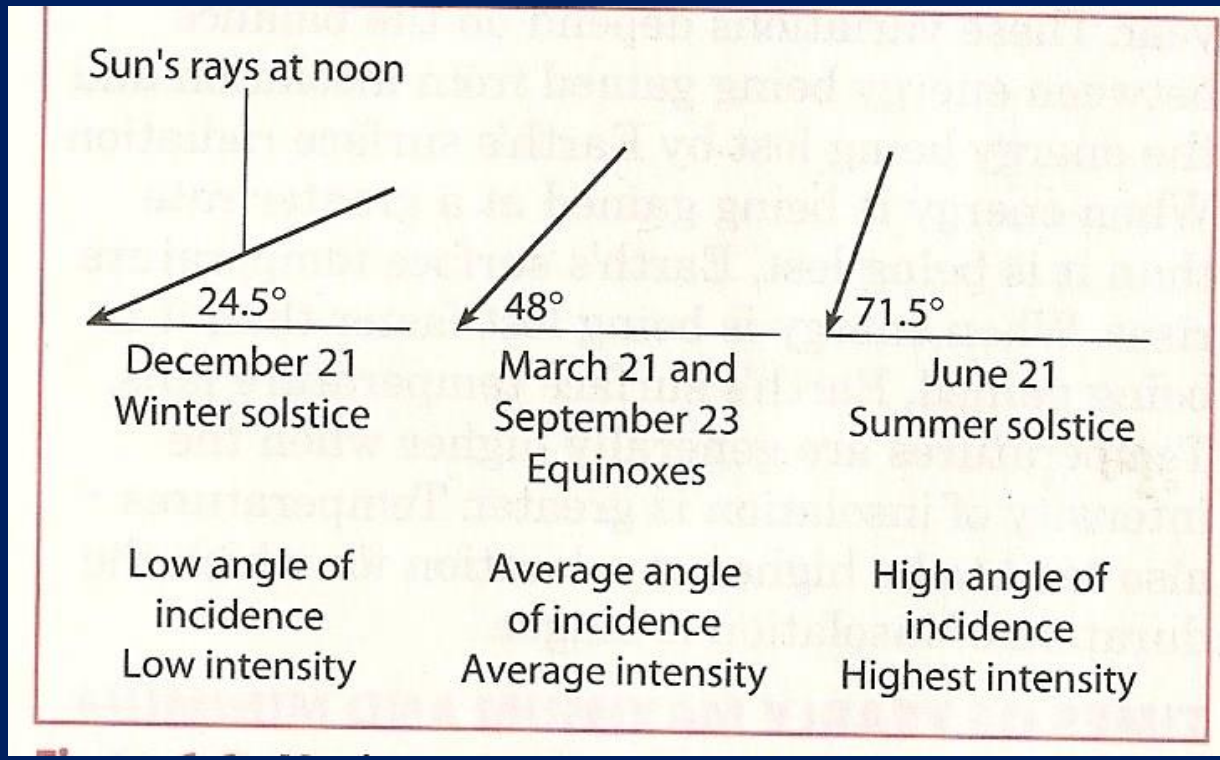
March 21 and September 23
Equinoxes



June 21
Summer solstice

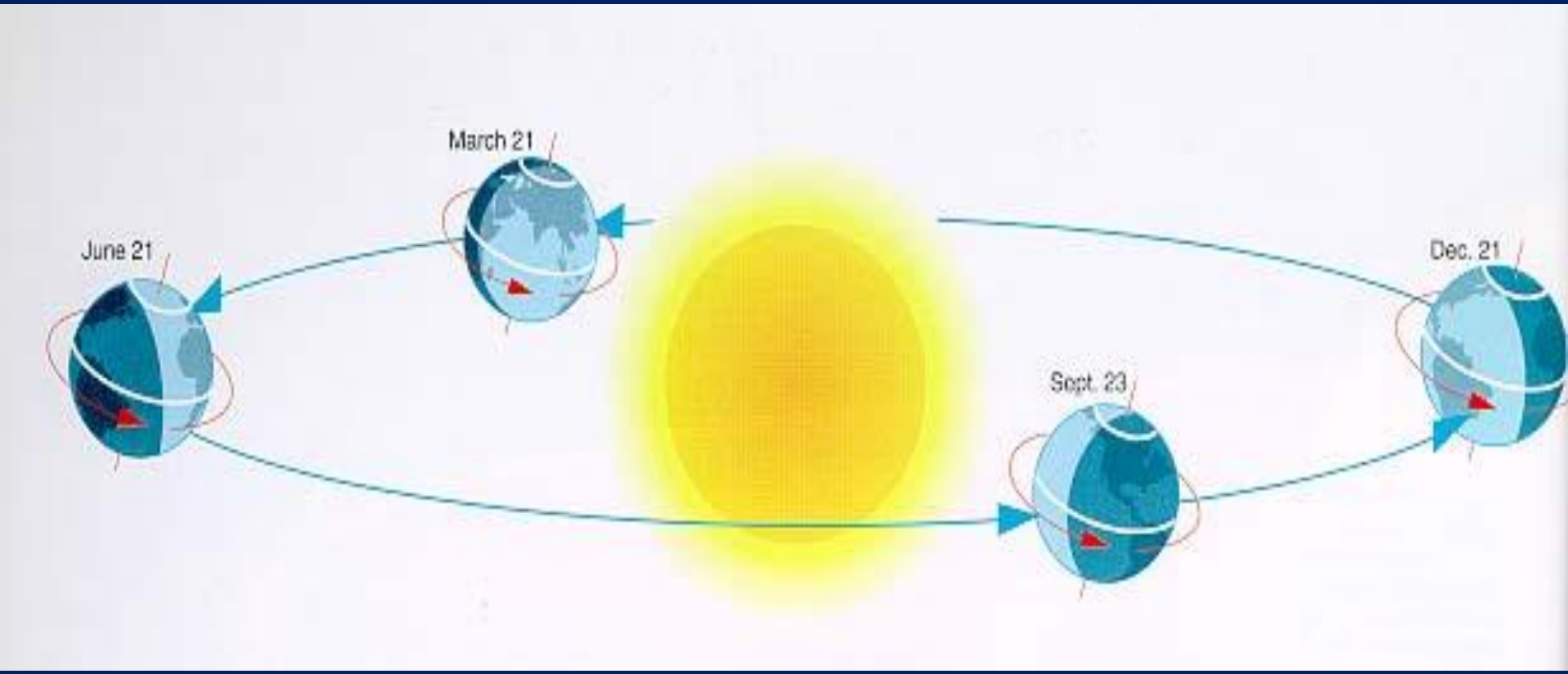


December 21
Winter solstice



Revolution around the Sun

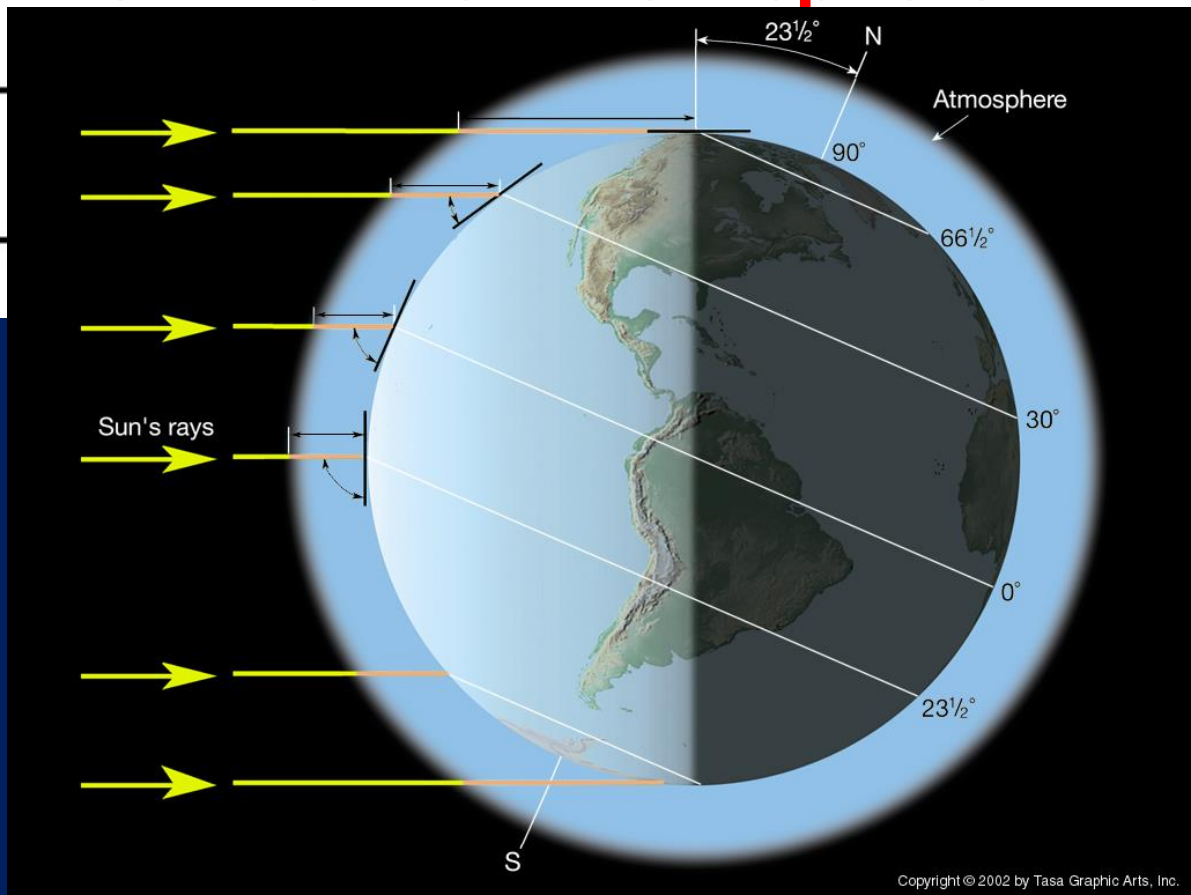
Earths orbit around the sun.



Earth's Tilt Increases ?

- Earth's direction of tilt changes as Earth revolves around the sun.

- If the northern hemisphere is tilted towards the sun = summer time in northern hemisphere



Altitude of the Noon Sun & Path through the Sky

solar noon

- When the sun reaches its highest point in the sky

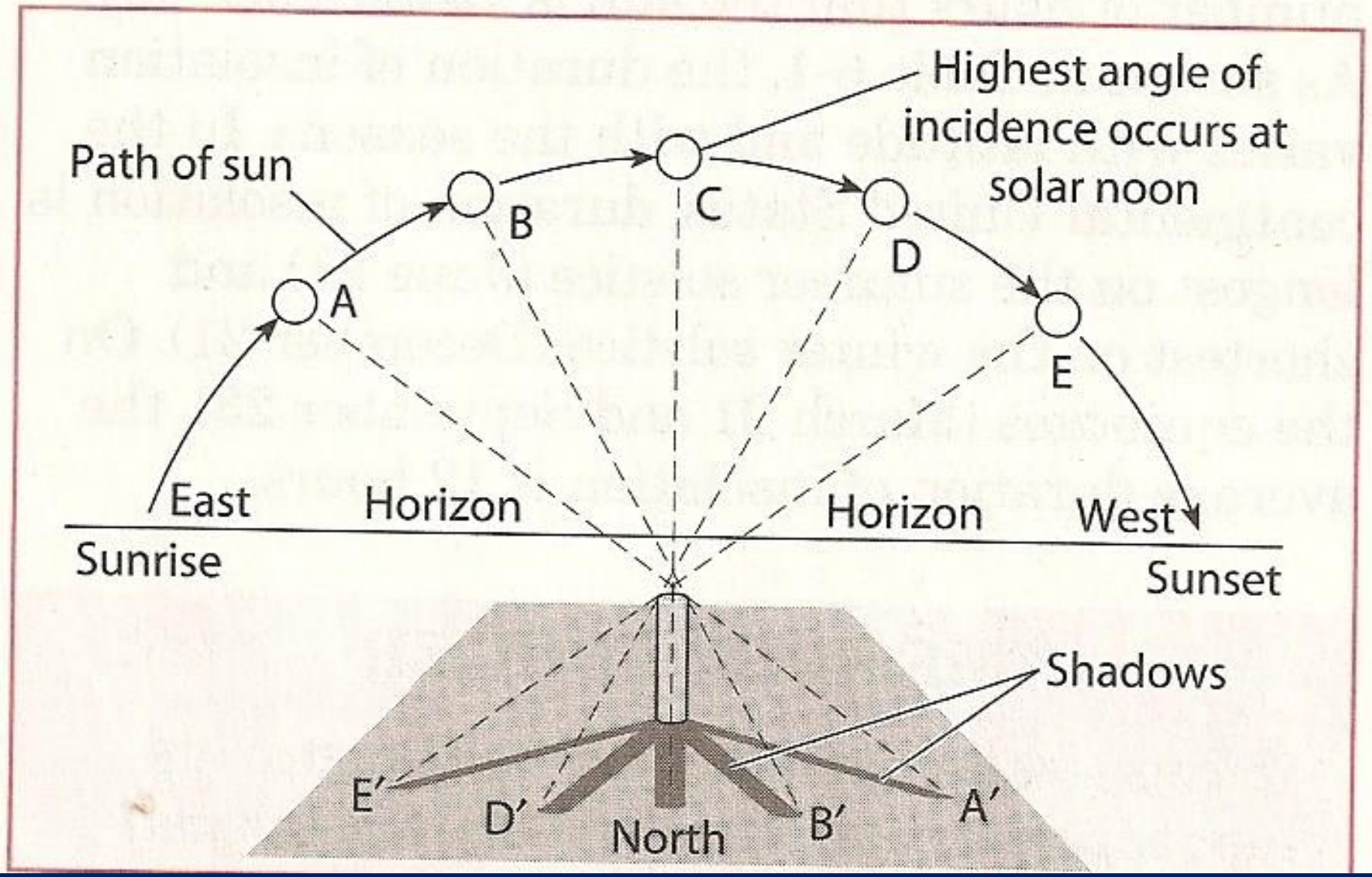
- NEVER directly overhead in New York

Sun is always to the south in the Northern Hemisphere

Shadow

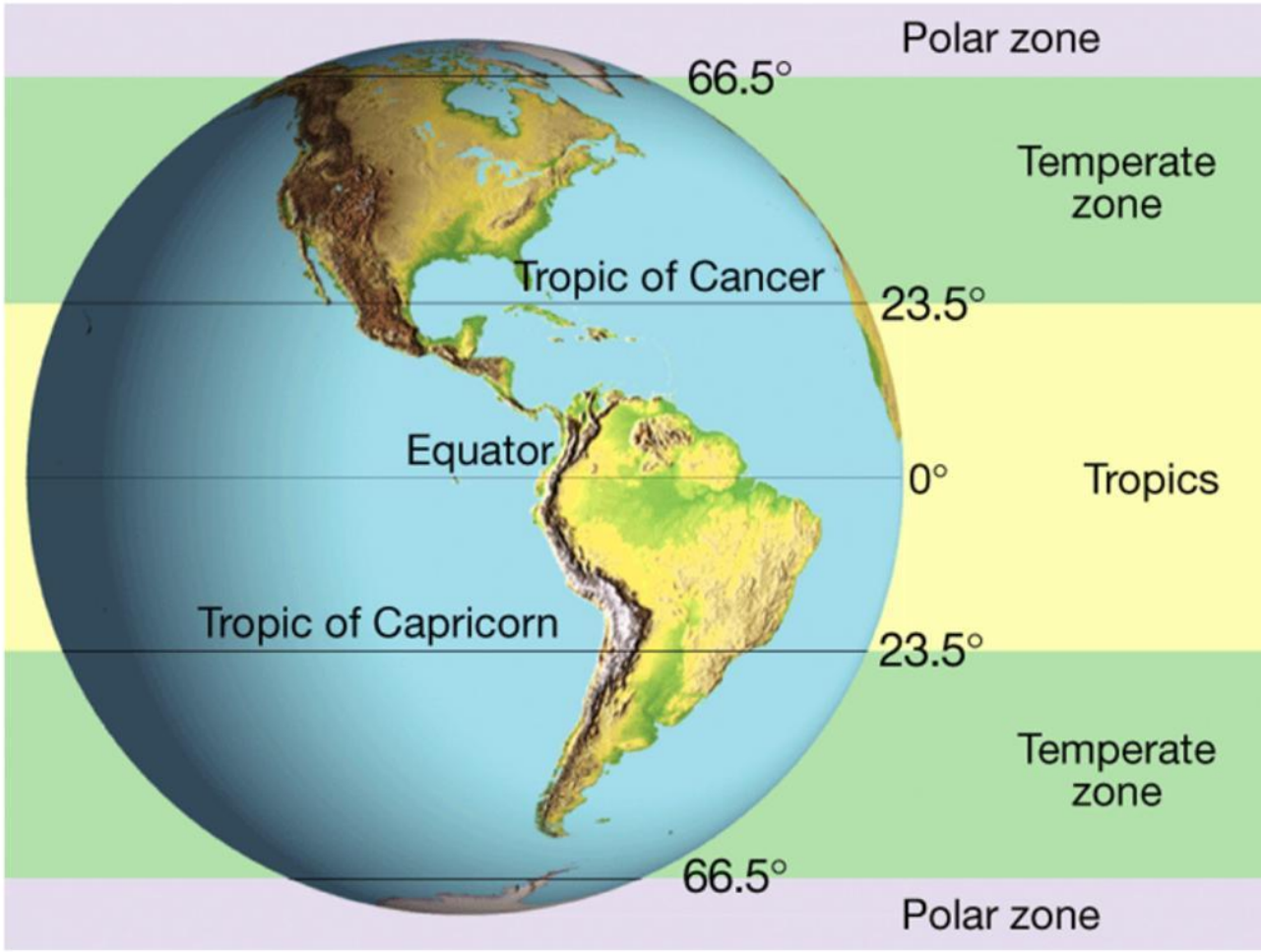
- Longer when the sun is lower in the sky.

- Direction at noon depends on latitude.


Highest angle of incidence occurs at solar noon
Path of sun
A
B
C
D
E
East
Horizon
Horizon
West
Sunrise
Sunset
Shadows
E′
D′
North
B′
A′

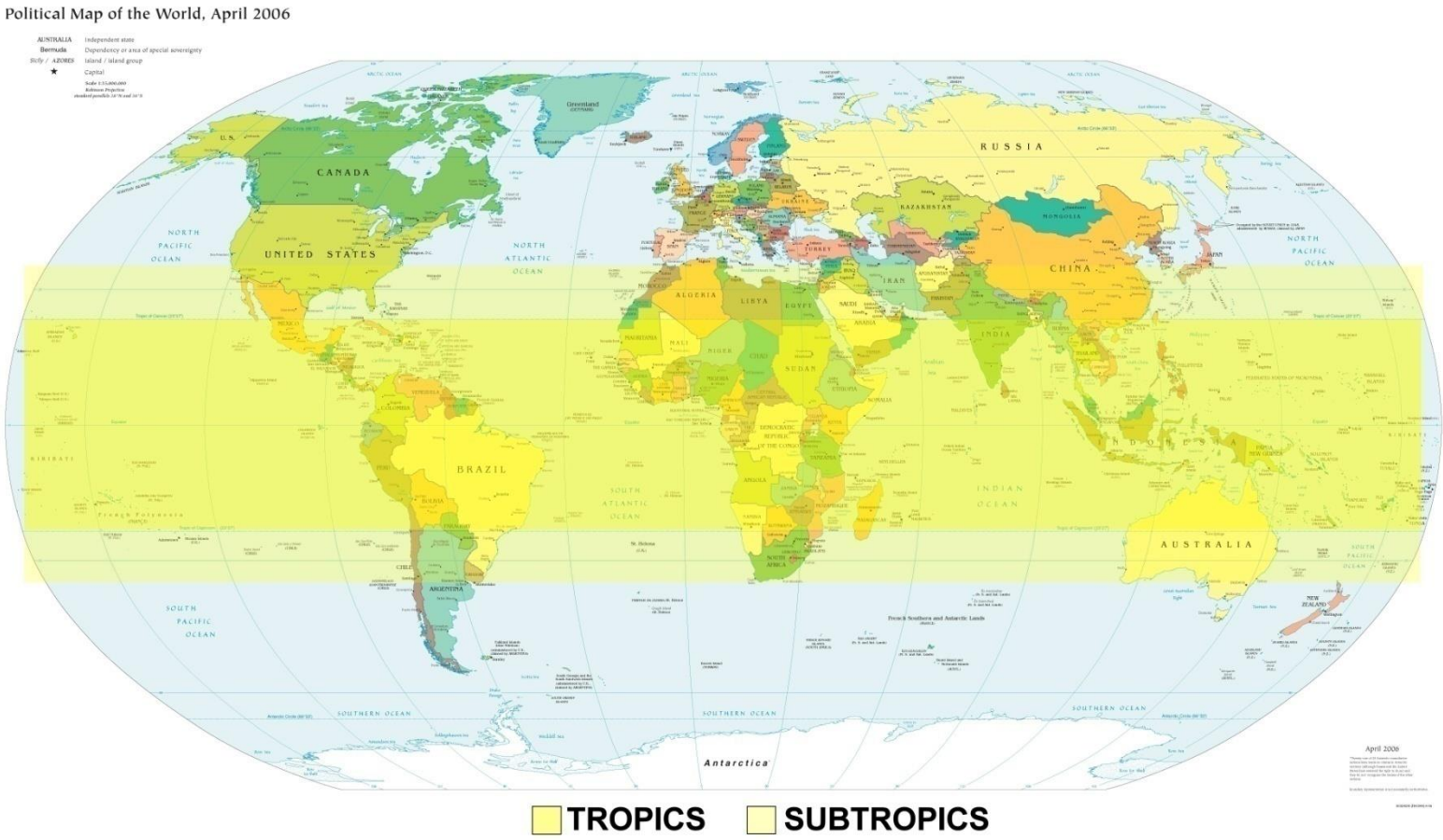
What is meant by "within the tropics"?

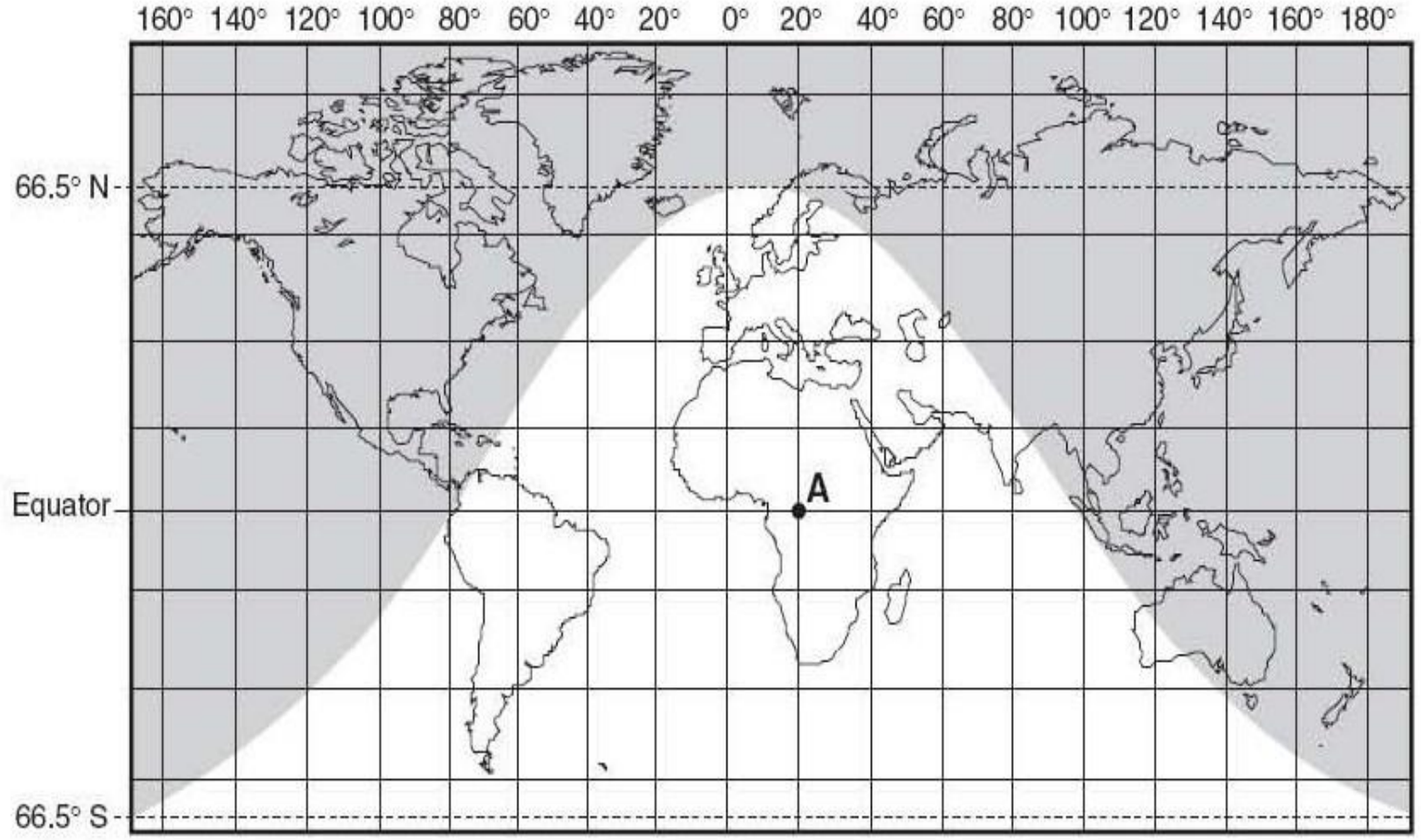
Any location between 23.5 ° N and 23.5 ° S of the Equator.



What determined where the Tropic of Cancer and the Tropic of Capricorn would be located on Earth's surface?

The last place North or South of the Equator where the sun is directly overhead (23.5 ° N and South of Equator)



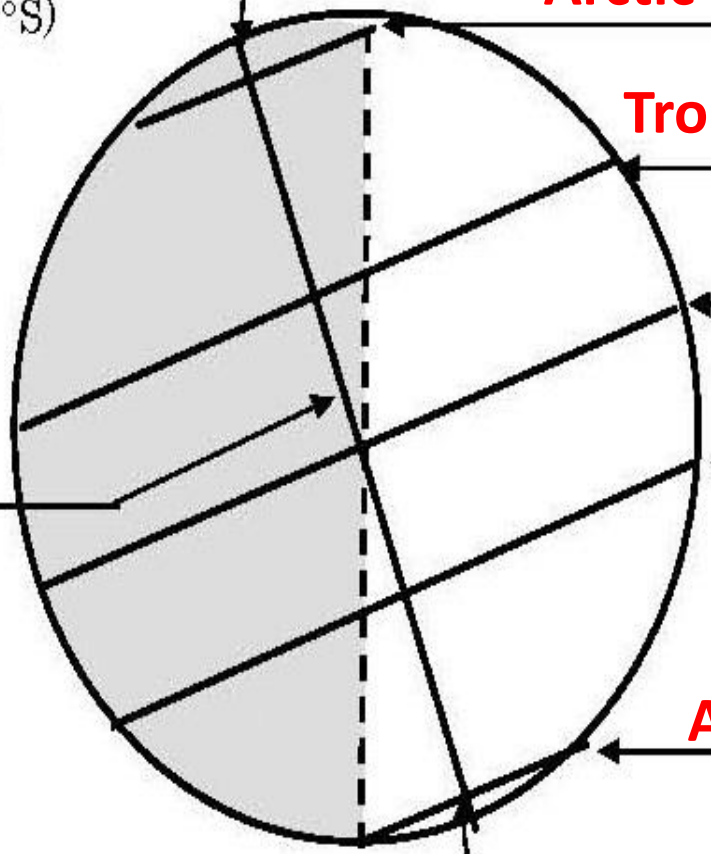


Direct ray of the sun

- Also known as sun's vertical rays.
- Occurs when sun is directly overhead (at zenith)
- Never occurs in New York State

Locations on Earth: Label the diagram below using the following locations.

Equator (0°)
North Pole (90°N)
South Pole (90°S)
Tropic Cancer (23 ½ °N)
Tropic of Capricorn (23 ½ °S)
Axis of rotation
Antarctic Circle (66 ½ °S)
Arctic Circle (66 ½ °N



North Pole (90 ° N)

Arctic Circle (66.5 ° N)

Tropic of Cancer (23.5 ° N)

Equator (0 °)

Tropic of Capricorn (23.5 ° S)

Axis of rotation

Antarctic Circle 66.5 ° S)

South Pole (90 ° S)

Name	**Date**	**# of hours of daylight N.Y.**	*# of hours of daylight North Pole*	*# of hours of daylight South Pole*	**Point of Sunrise**	**Point of Sunset**	**Altitude of Noon Sun** (high-med-low)	**Latitude of Vertical Rays**
Summer Solstice								
Autumnal Equinox								
Winter Solstice								
Vernal Equinox								

The sun rises in the _____ and sets in the _____. Therefore, at sunrise, one's shadow will point
At sunset, one's shadow will point _____

At Solar Noon at our location, one's shadow will always point _____.

When will the sun be directly overhead at Solar Noon at our location? _____
Why?

On what day of the year is the Sun lowest in the sky at Solar Noon?	**03/22**	**06/22**	**09/22**	**12/22**
On what day of the year is the Sun highest in the sky at Solar Noon?	**03/22**	**06/22**	**09/22**	**12/22**
On what day of the year is the angle of insolation greatest at our location?	**03/22**	**06/22**	**09/22**	**12/22**
On what day of the year is the angle of insolation least at our location?	**03/22**	**06/22**	**09/22**	**12/22**
On what day of the year is the duration of insolation greatest at our location?	**03/22**	**06/22**	**09/22**	**12/22**
On what day of the year is the duration of insolation least at our location?	**03/22**	**06/22**	**09/22**	**12/22**
On what day of the year will one have their longest shadow at Solar Noon in NY?	**03/22**	**06/22**	**09/22**	**12/22**
On what day of the year will one have their shortest shadow at Solar Noon in NY?	**03/22**	**06/22**	**09/22**	**12/22**

When is the earth closest to the Sun?	**03/22**	**06/22**	**09/22**	**12/22**
When is the earth furthest from the Sun?	**03/22**	**06/22**	**09/22**	**12/22**

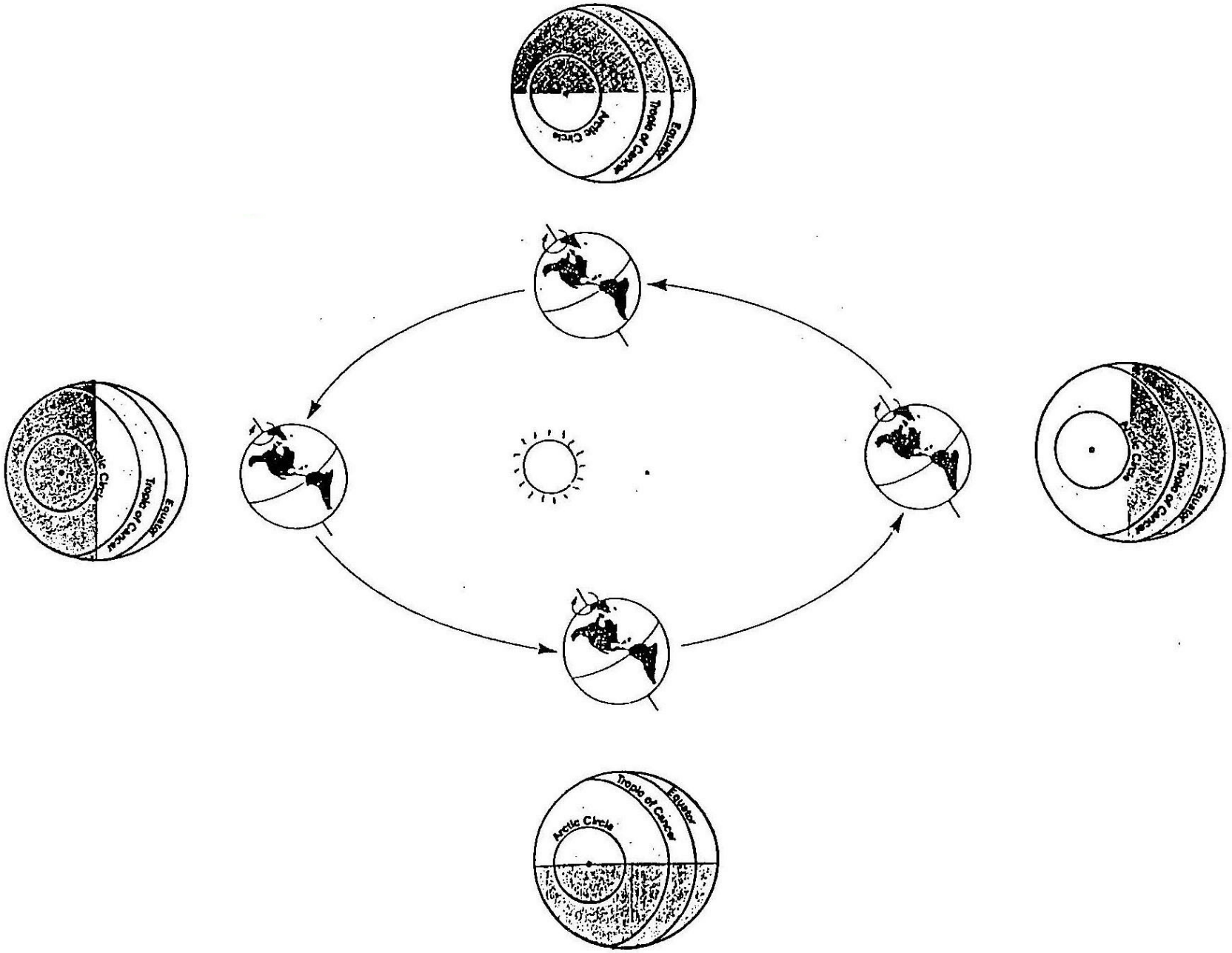
Why is it colder then during the winter?

What are the reasons for the seasons?

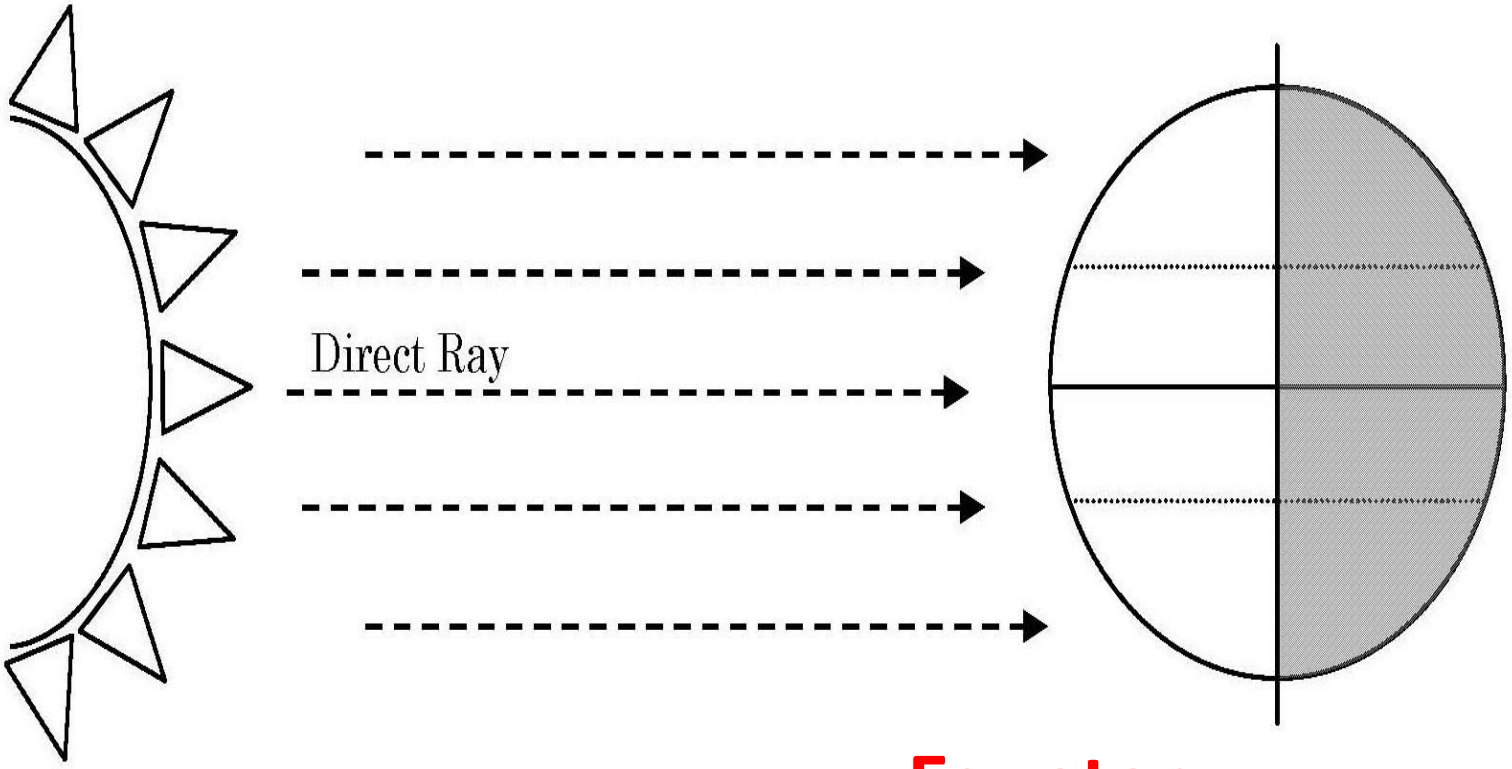
Earth revolves around the Sun in a yearly cycle of _____ days.

As Earth revolves, its axis always points in the same direction.

365



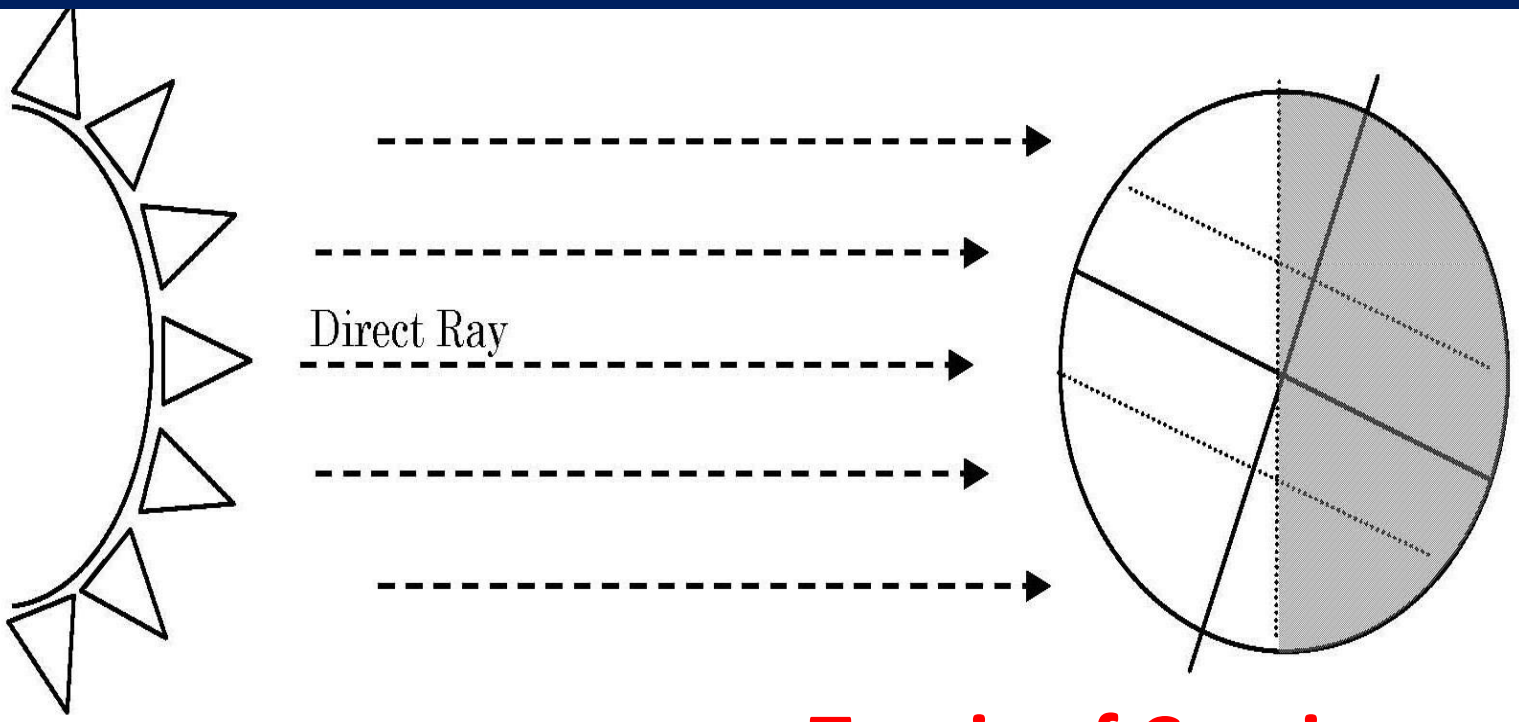
Angle of Insolation/ Angle of Incidence



At what location is the direct ray of the sun? **Equator**

What seasons could this be? **Spring** or **Fall**

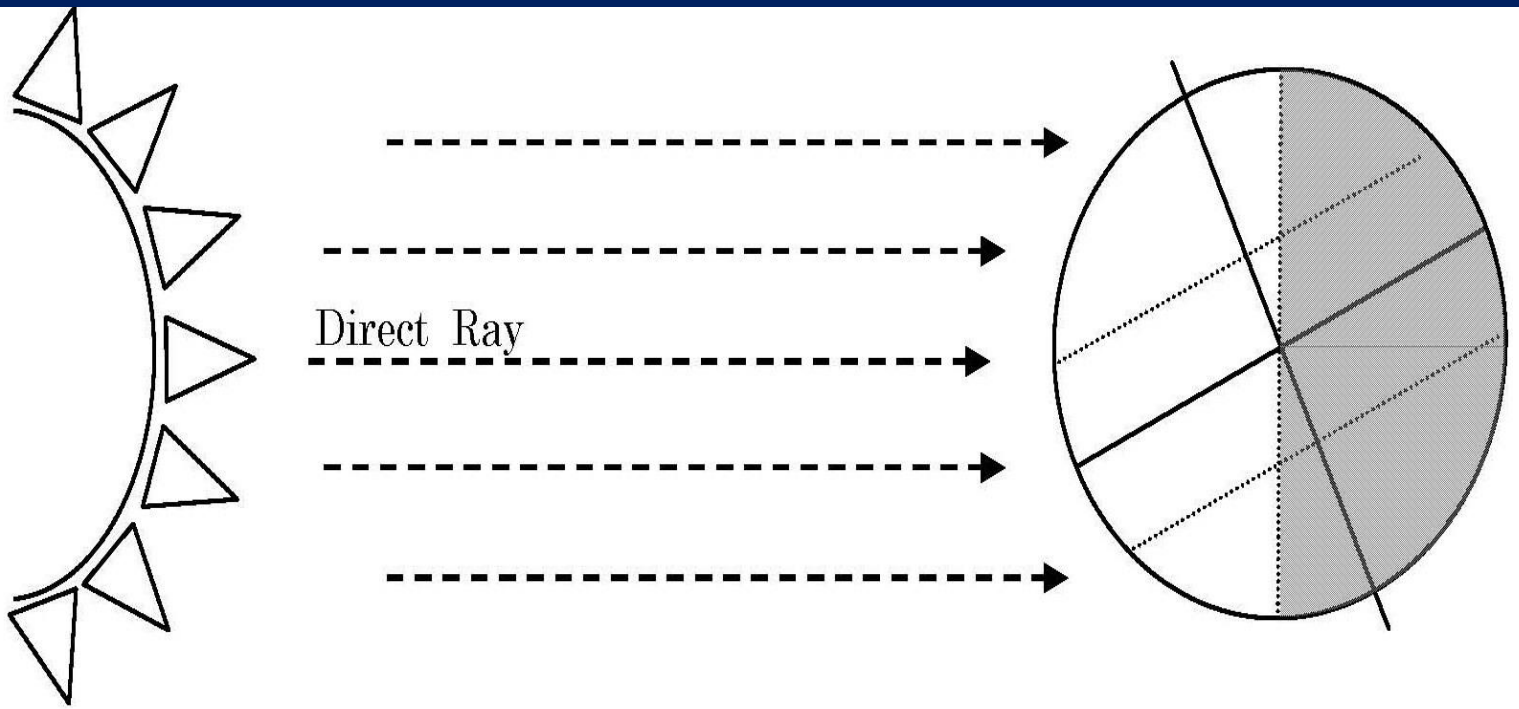
Angle of Insolation/ Angle of Incidence



At what location is the direct ray of the sun? **Tropic of Capricorn**

What season would this be? **Winter**

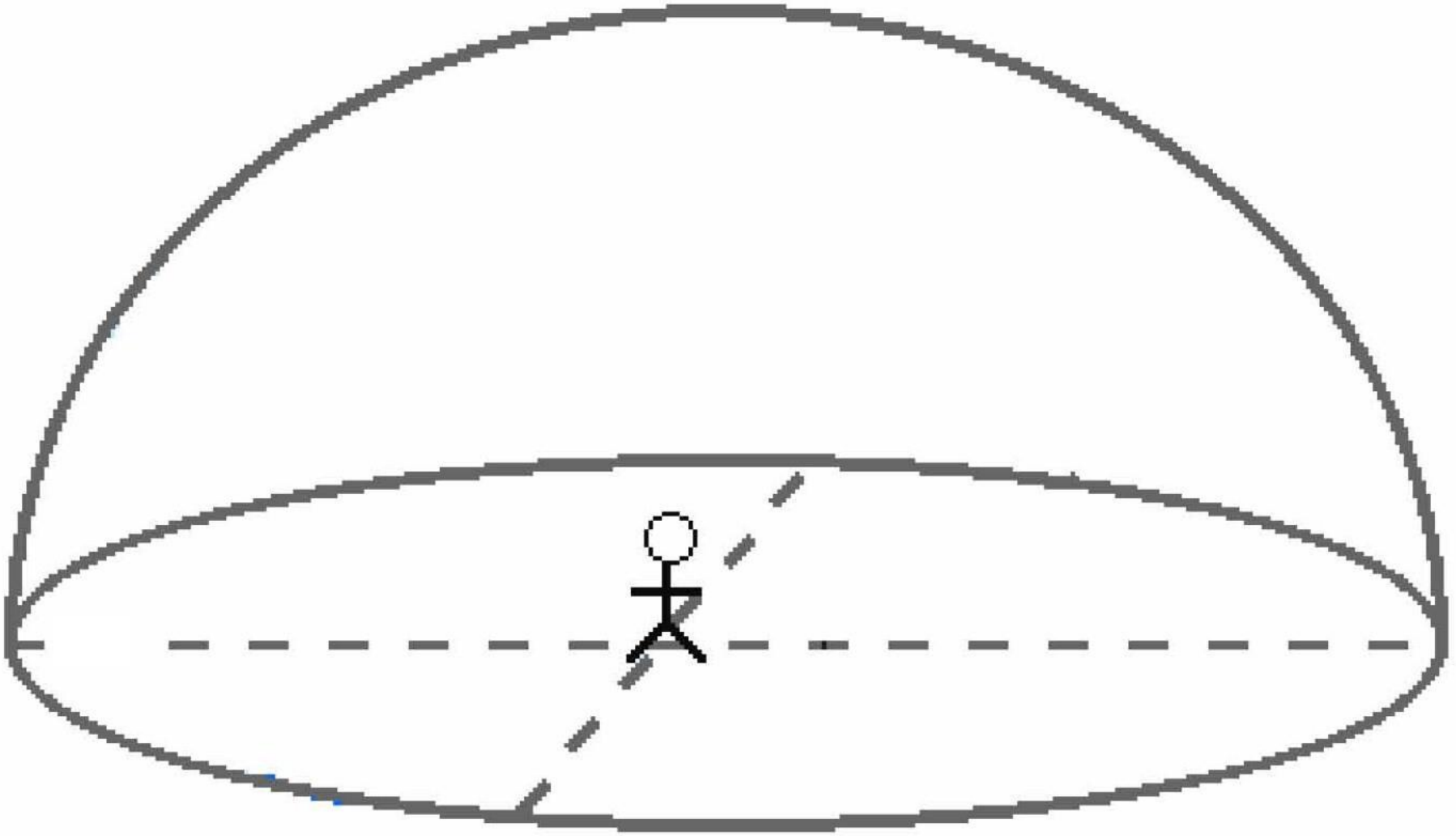
Angle of Insolation/ Angle of Incidence

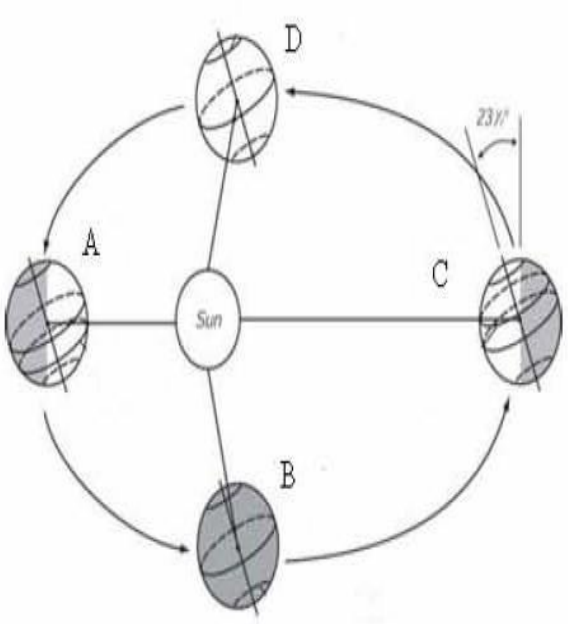


At what location is the direct ray of the sun? **Tropic of Cancer**

What season would this be? **Summer**

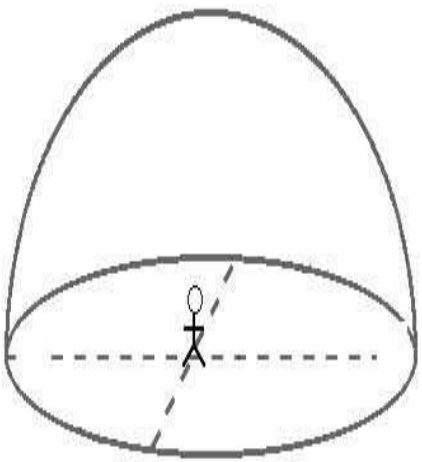
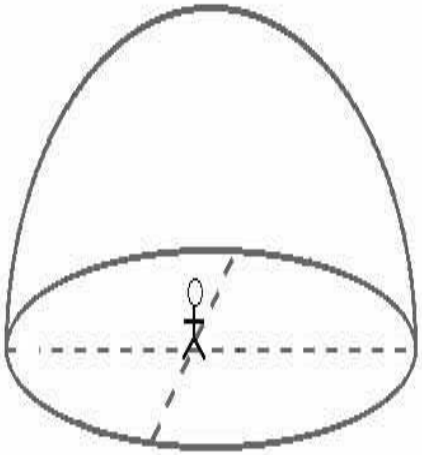
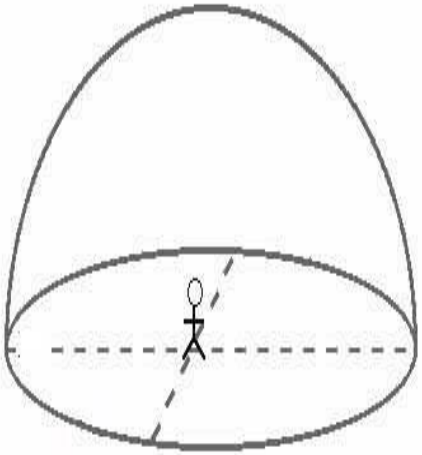
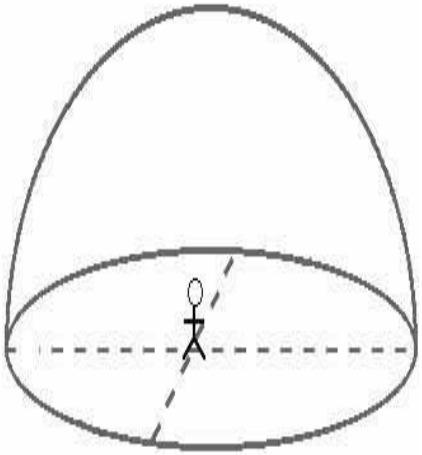
Draw the path of the Sun across the sky for each of the dates of the equinoxes and solstices for NY State.





	Date	Where the Sun is directly overhead	Altitude of Sun at Solar Noon at our location	Duration of Insolation at our location	Duration of Insolation at the North Pole	Duration of Insolation at the South Pole
A						
B						
C						
D						

NY STATE PATH OF SUN

Spring	Summer	Fall	Winter
			

- End