



Earth's Climate and Major Biomes
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Textbook: Anne Houtman, Susan Karr and Jeneen Interlandi
Environmental Science for a Changing World, 1st, 2nd or 3rd edition
W.H. Freeman & Company, New York, NY (2013, 2015 or 2018)

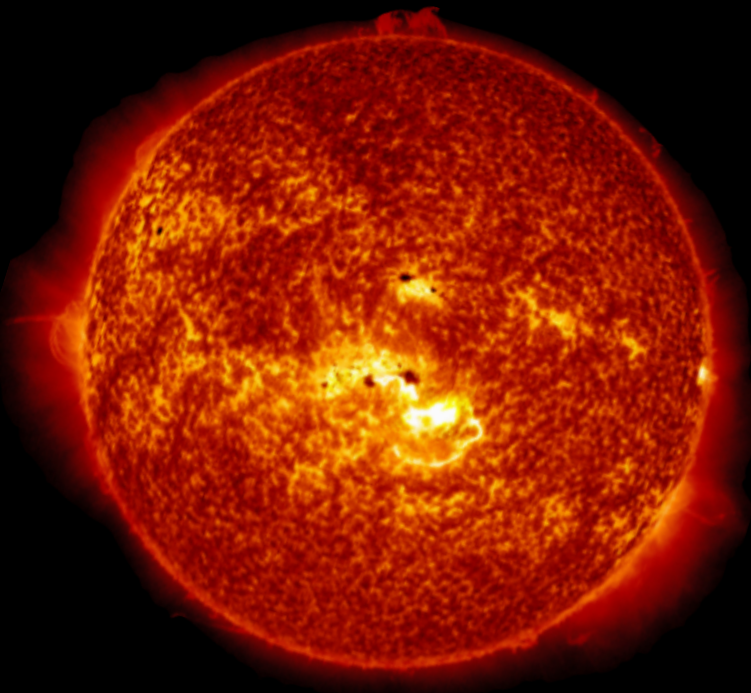
Biomes: specific portion of biosphere determined by **climate** and identified by predominant **vegetation** and organisms, which adapted to live there.

THREE broad categories based on climate and determined by predominant plants.

Marine, freshwater, and terrestrial

Biomes can be further distinguished as **ecosystems** based on interactions between specific biotic and abiotic components.

Our Sun is producing energy and new elements by the process of nuclear fusion, which can be described by Albert Einstein's famous equation $E = mc^2$



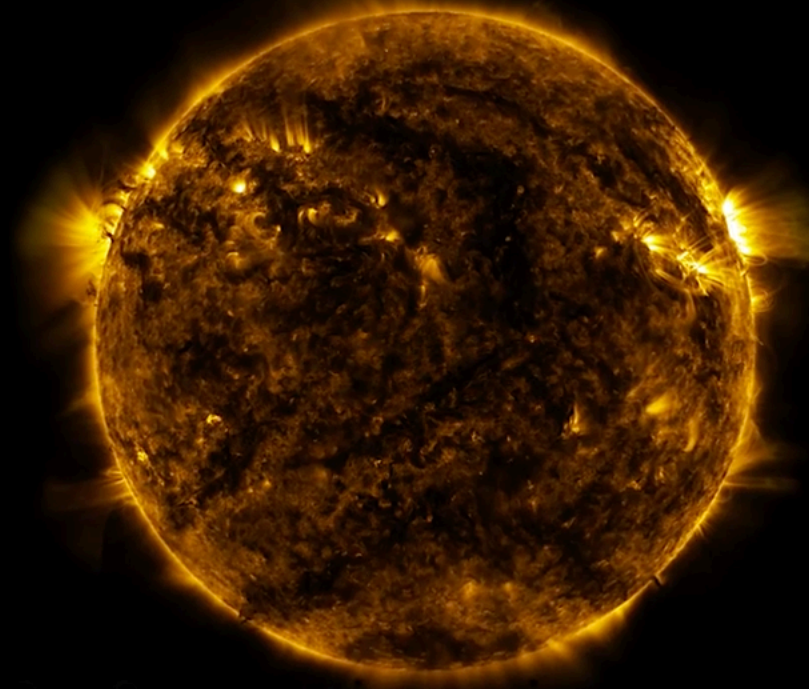
93,000,000 miles

150,000,000 km

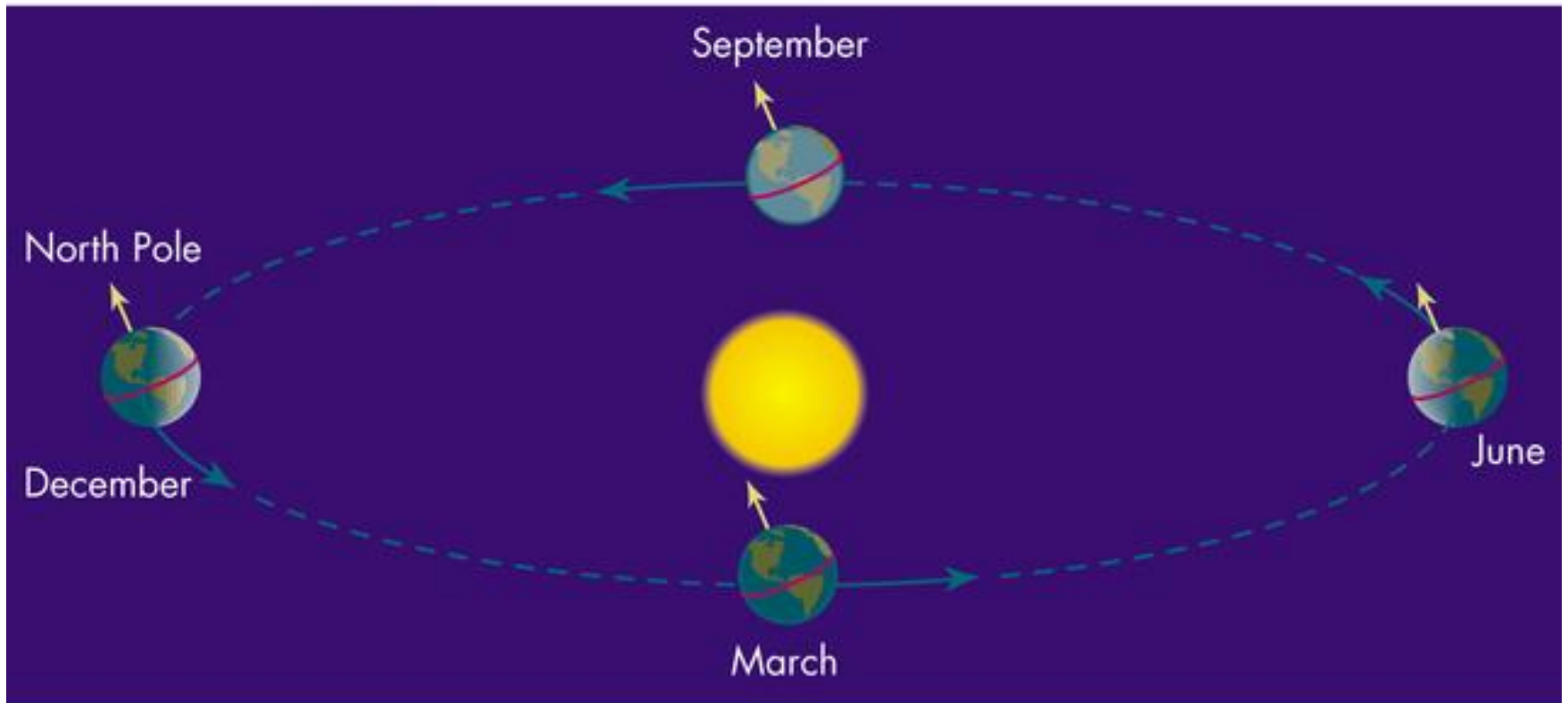
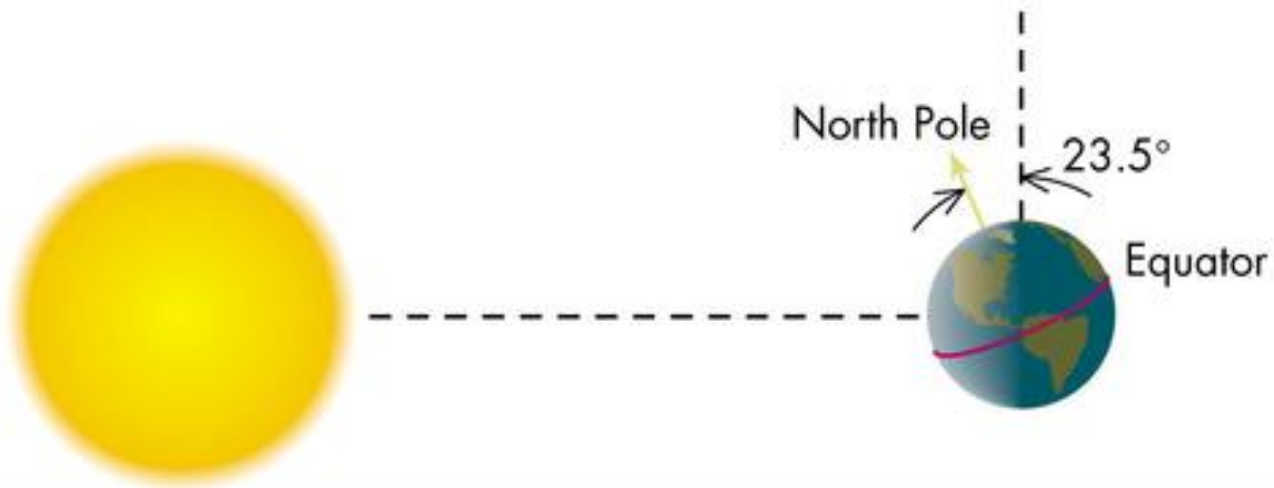


Light travels at a speed (c) of 186,000 miles/second (300,000 km/second) and so it takes 8 minutes 20 seconds for light to travel from the Sun to Earth.

NASA Solar Dynamics Observatory (SDO)
provides incredibly detailed images of our sun
24 hours a day.



<http://youtu.be/GSVv40M2aks>

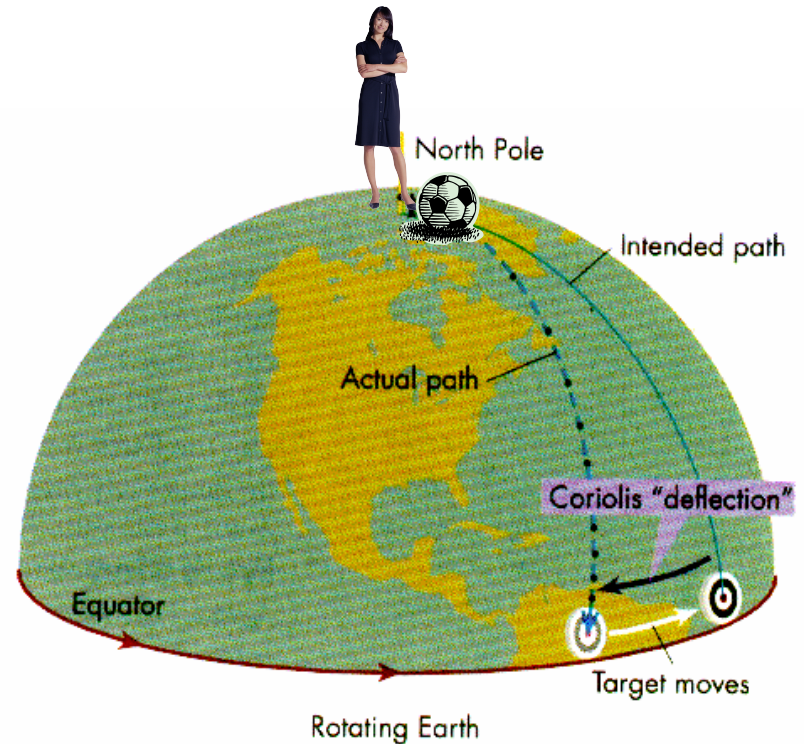


Coriolis Effect

Earth's rotation from west to east causes wind and water to swerve to right in Northern Hemisphere and to the left in Southern Hemisphere

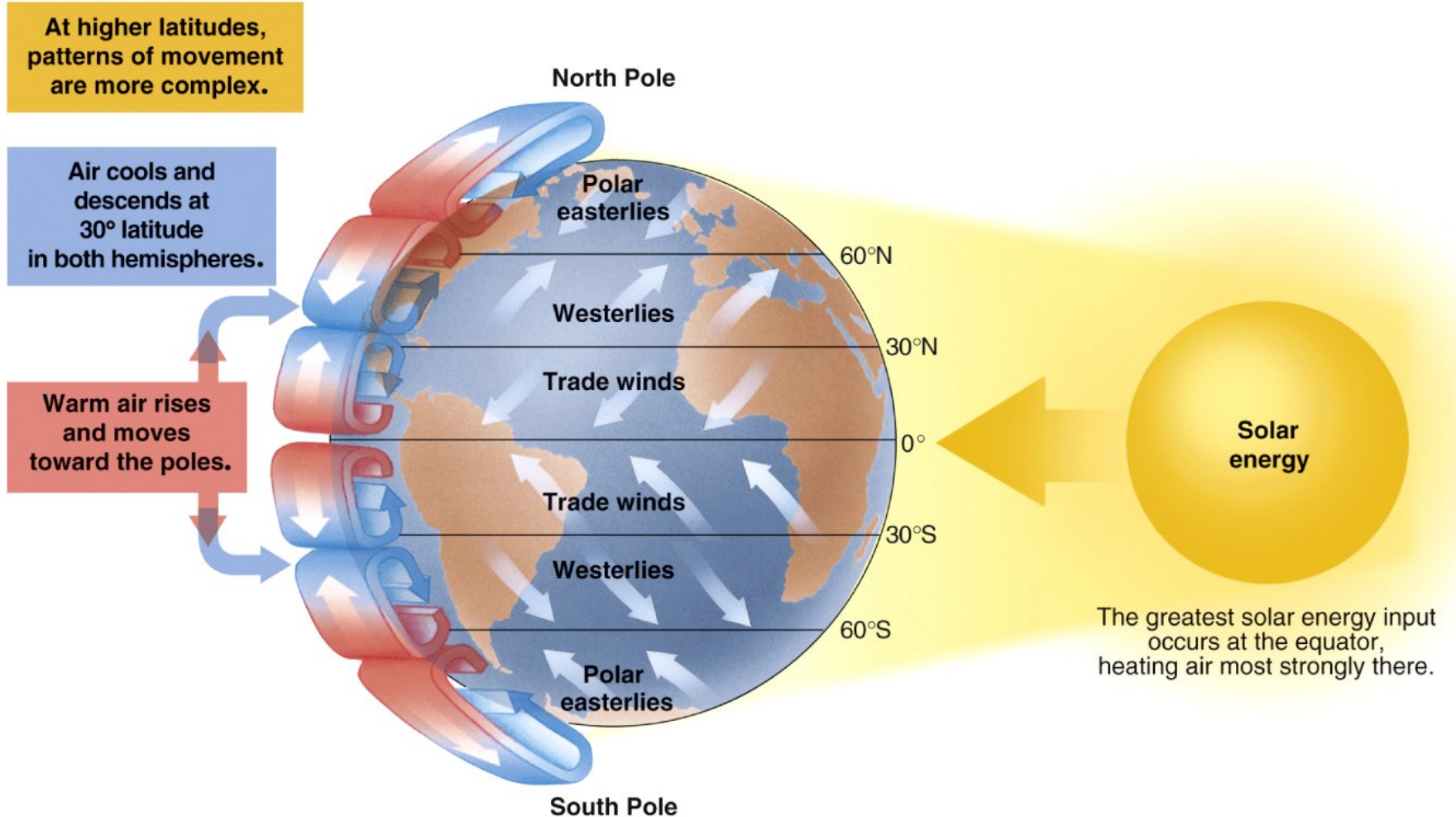
Prevailing winds

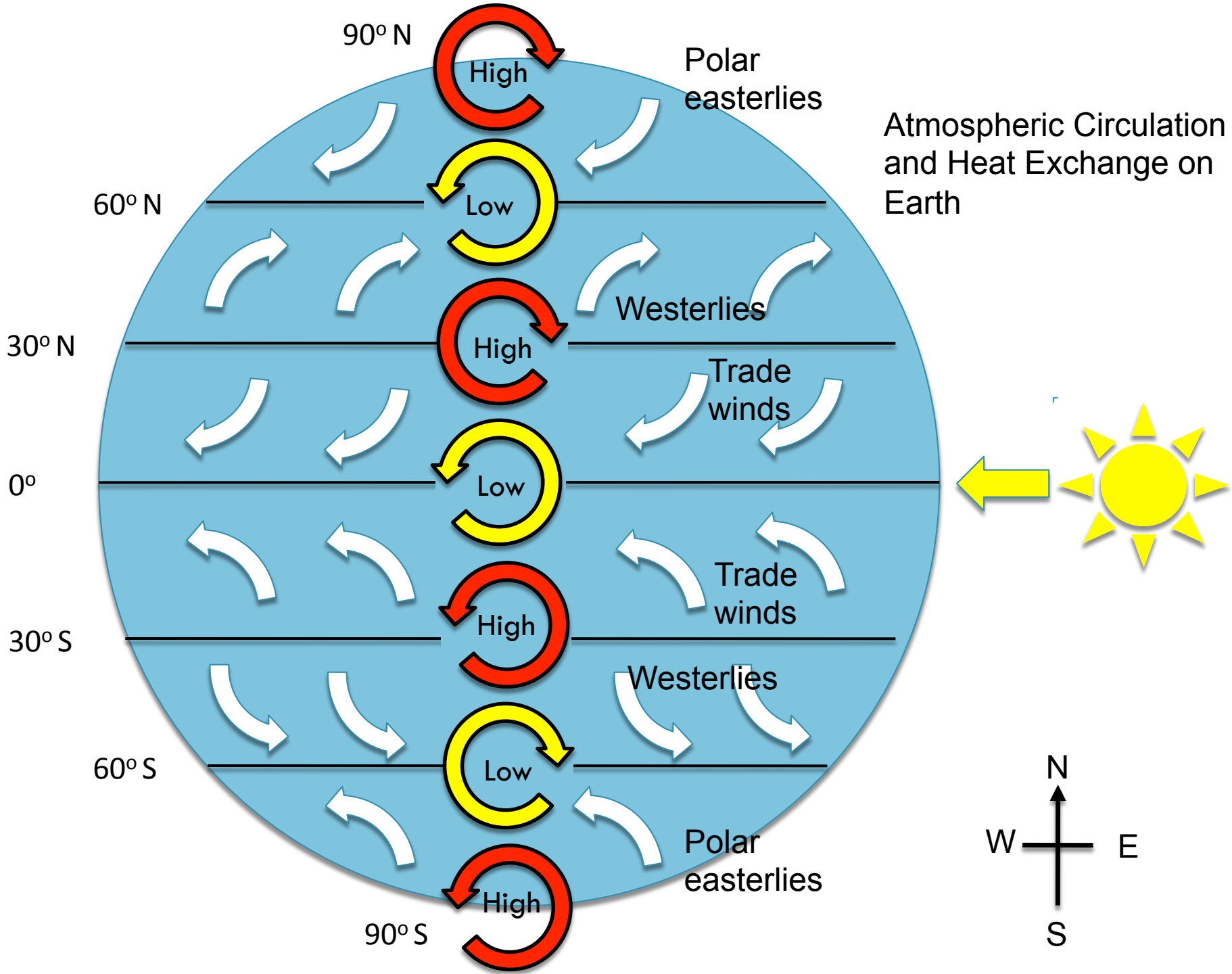
1. polar easterlies
2. westerlies
3. trade winds



http://www.youtube.com/watch?v=_36MiCUS1ro

Atmospheric Circulation and Heat Exchange

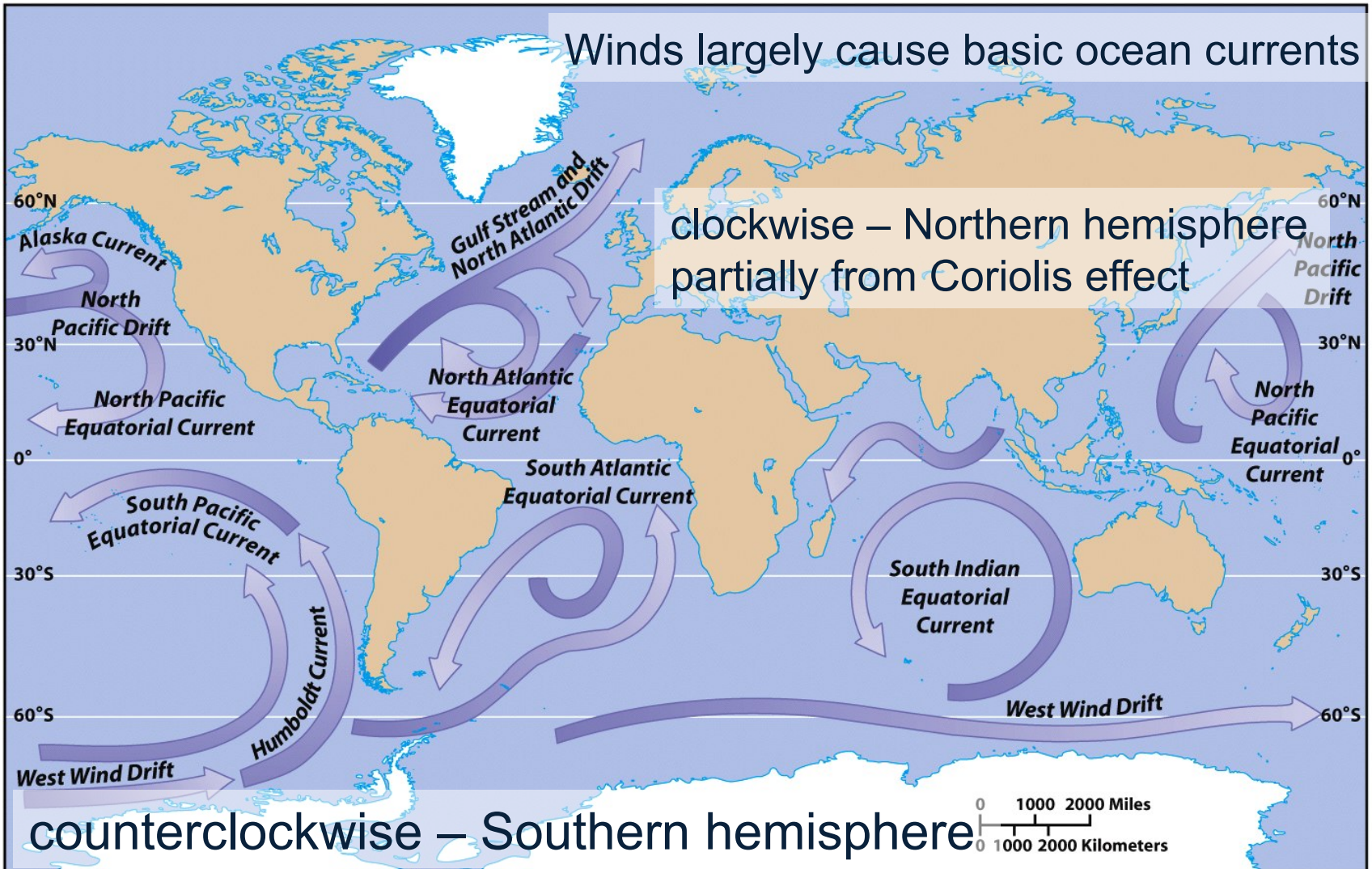




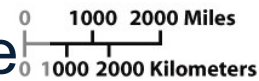
Surface Ocean Currents

Winds largely cause basic ocean currents

clockwise – Northern hemisphere
partially from Coriolis effect

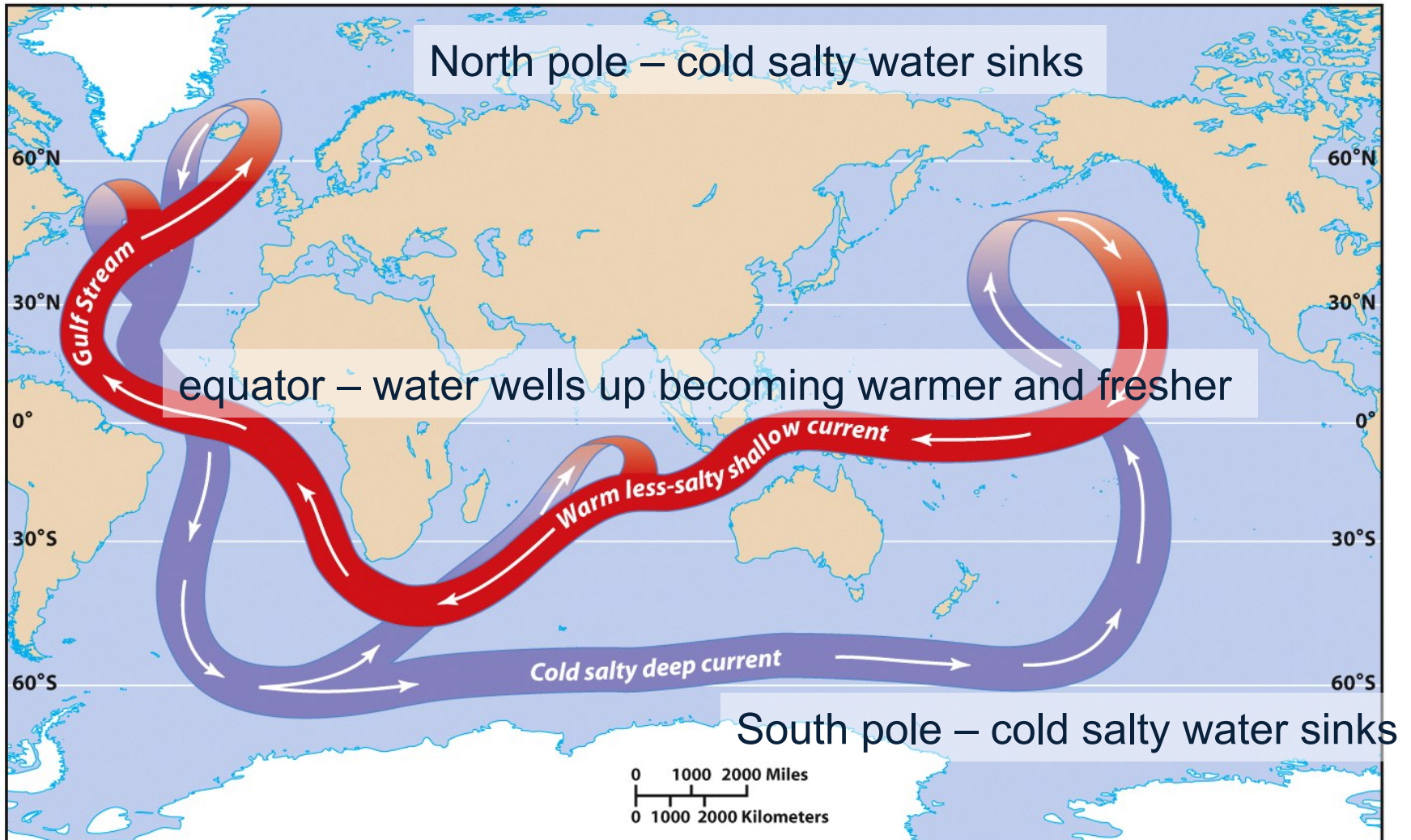


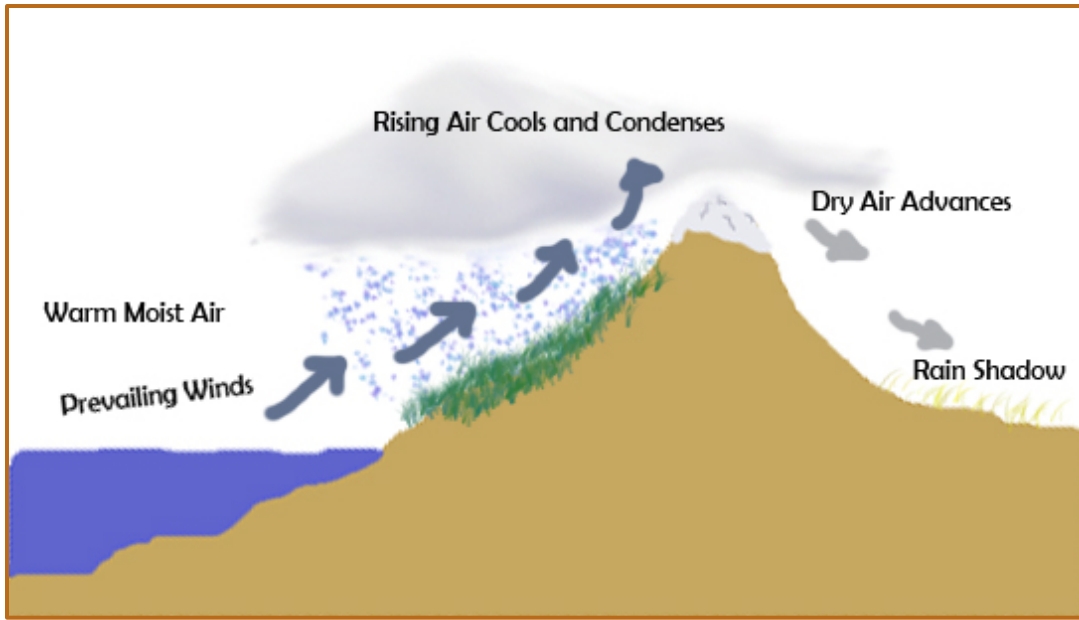
counterclockwise – Southern hemisphere



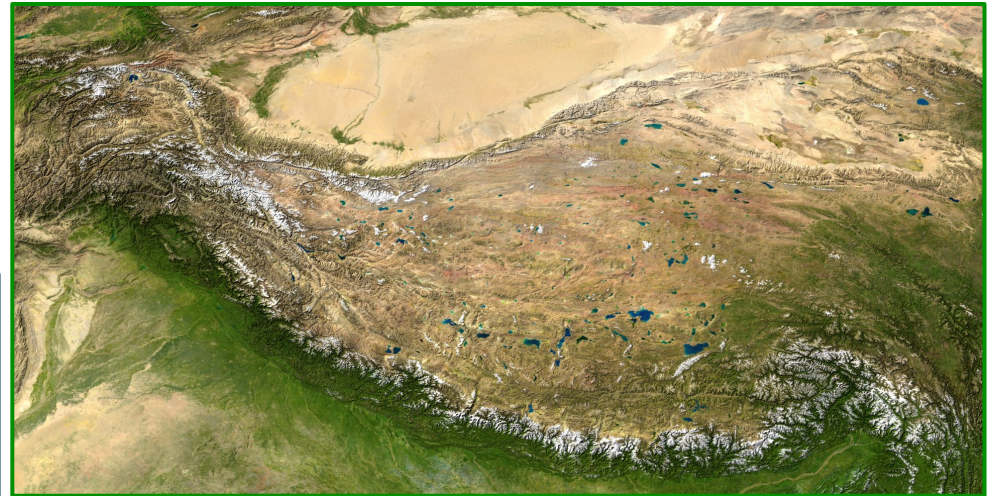
Ocean Conveyor Belt

Video: <http://svs.gsfc.nasa.gov/cgi-bin/details.cgi?aid=3658>





Orographic precipitation and the Rain shadow effect

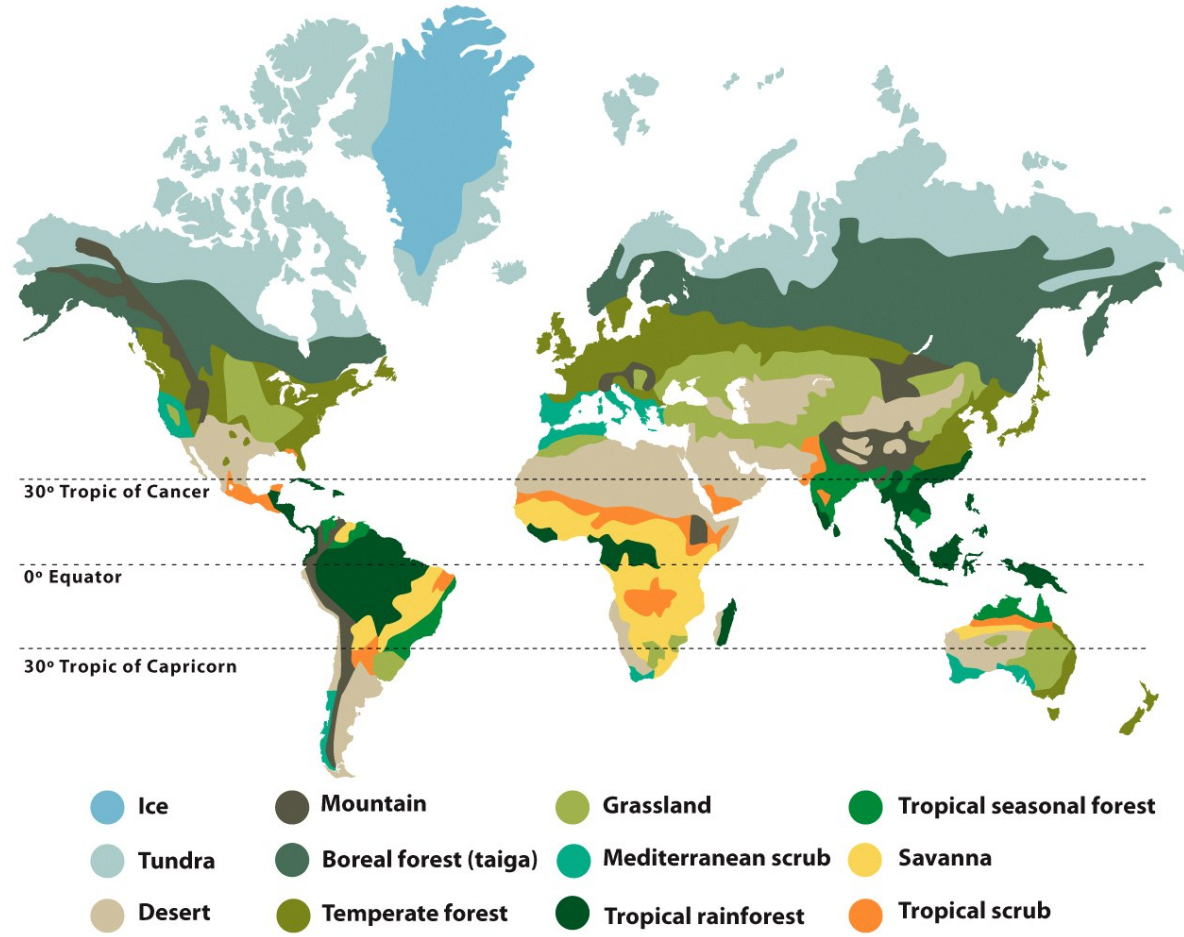


Himalayas and the Tibetan Plateau



Temperature varies with latitude and altitude

(decreasing T with increasing latitude and altitude)



Earth's Major Biomes defined by temp and precipitation

What did past biomes look like?

Nova Video, Arctic dinosaurs and secrets in leaves (Chapter 3):

Recreating past climates by examining leaf fossils

Watch (22:00-28:30): <https://www.youtube.com/watch?>

[v= 4 eXXQiRLg&t=1319s](https://www.youtube.com/watch?v=4eXXQiRLg&t=1319s)

TERMS TO KNOW:

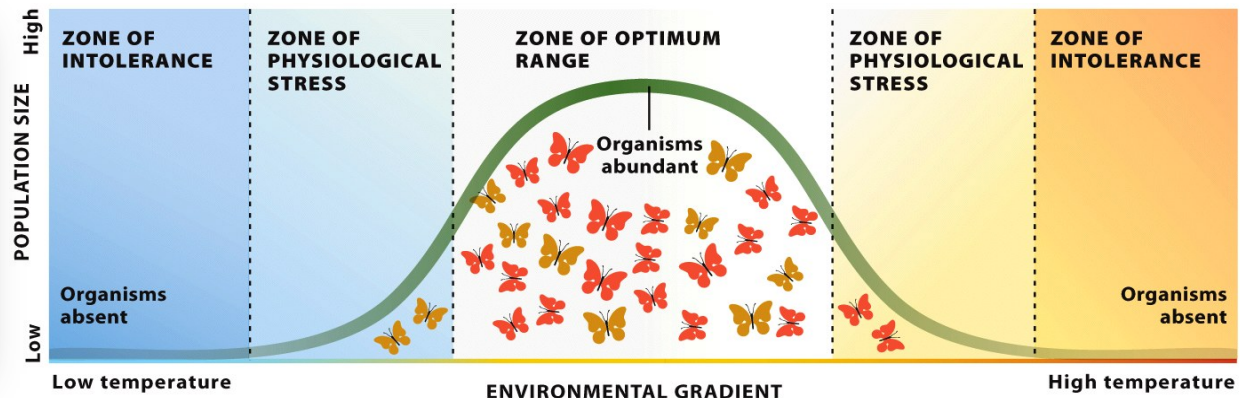
- Limiting factor
- Range of tolerance



Each biome requires consideration of **interactions** between plant and animal species as well as **nutrient** requirements.

Most **desert** biomes fluctuate from extreme cold at night to high temperatures during the day. By comparison, **rainforests** need consistently warm temperatures. *Hence, ocean buffer in Biosphere 2.*

Each organism must maintain **homeostasis** within a narrow range. In Biosphere 2, tolerances needed to be maintained within a closed system.



Populations have a range of tolerance for each environmental factor—light, water, salinity, nitrogen.

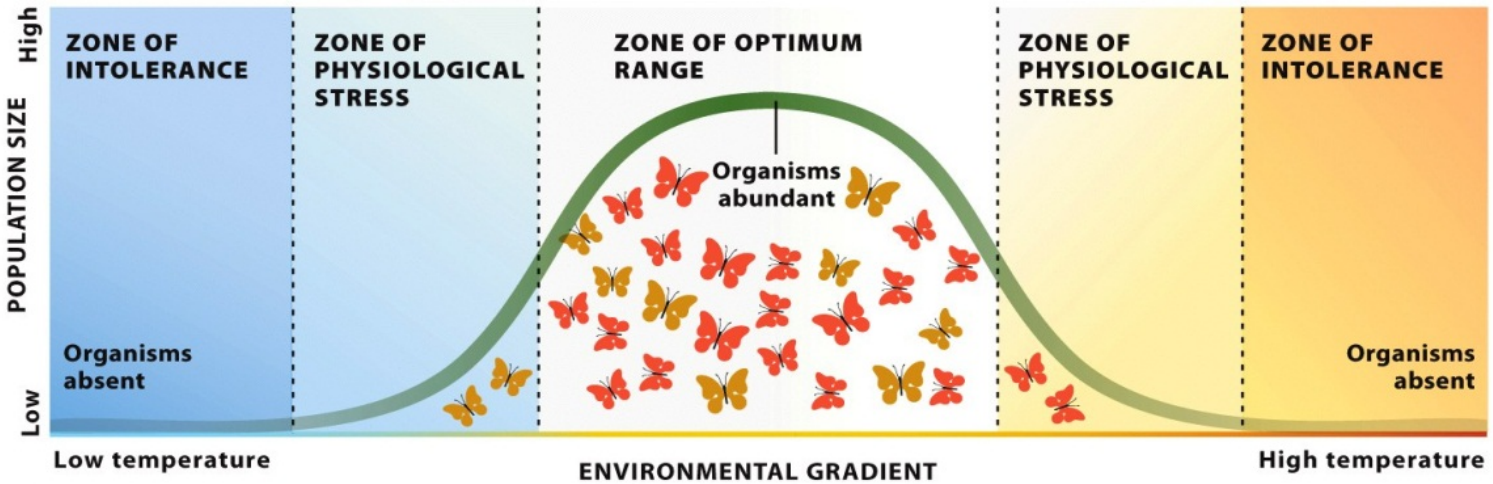
Each species has an upper and lower limit of tolerances beyond which the organism cannot survive

On the spectrum

This is determined

The optimum

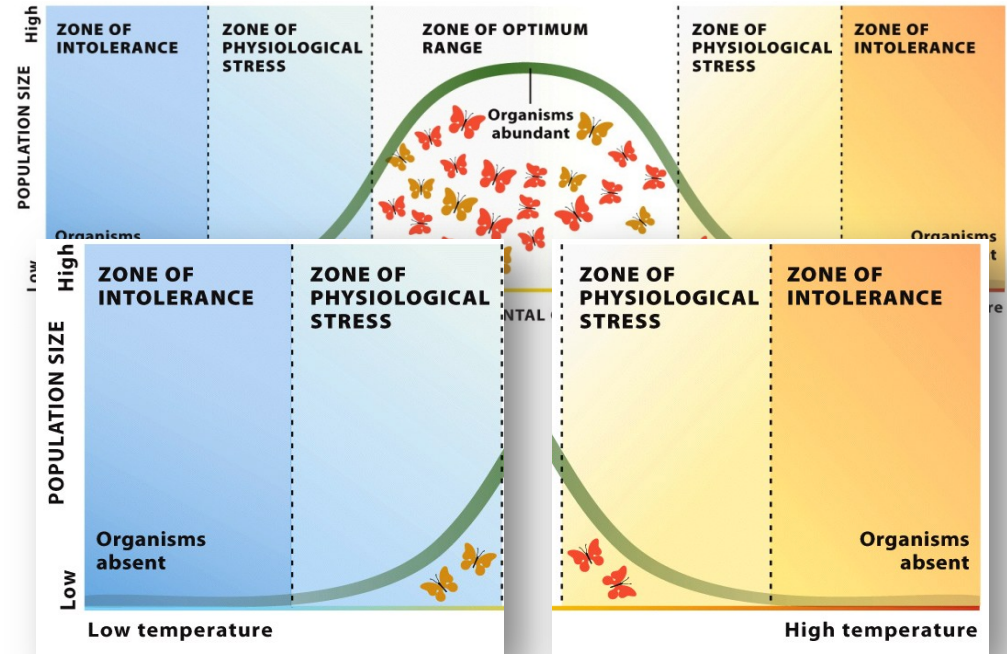
is in the middle and will vary somewhat among individuals within a population.



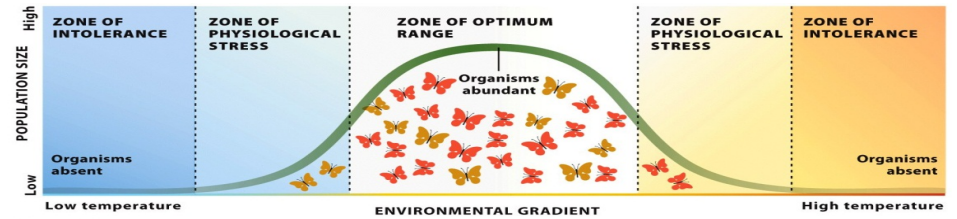
Each species has an upper and lower limit of **tolerances** beyond which the organism cannot survive.

On the lower/upper end of the spectrum is the absolute minimum for survival of a factor. This is where **limiting factors** determine survival.

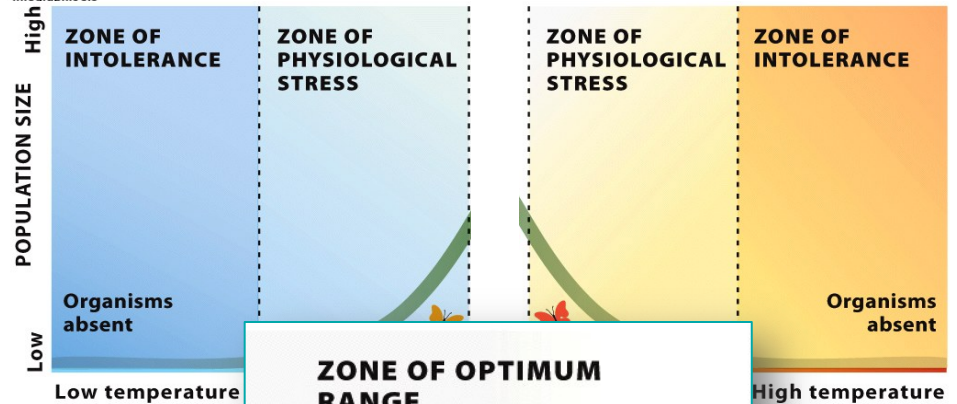
Individuals that tolerate or thrive at edges offer chance to adapt or **evolve** with changing conditions.



The **optimal level** is somewhere in the middle and will vary somewhat among individuals within a population.



Infographic 6.6



Frozen Frogs that do something miraculous

Psychrophile (cryophile) – organisms that live at temperatures $< 10^{\circ}\text{C}$

<https://www.youtube.com/watch?v=TYJv-wxwvLw>



Wood frog from Ohio.

EXAMPLES OF TERRESTRIAL BIOMES



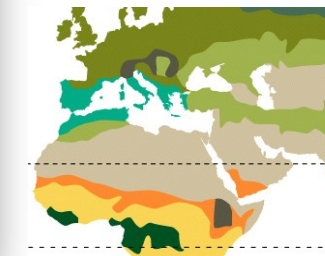
Mediterranean scrub



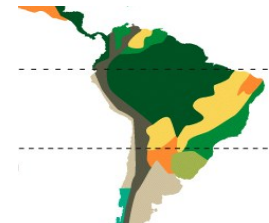
Tundra



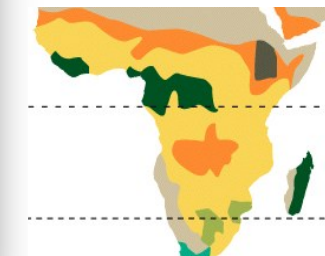
Desert



Tropical rainforest



Savanna



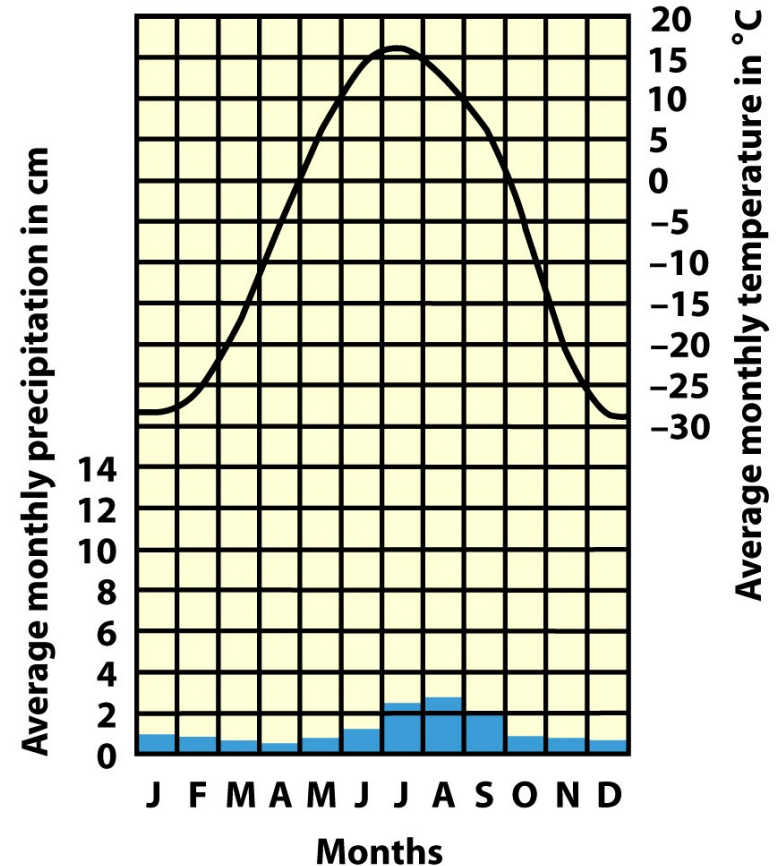
Boreal forest



Arctic tundra



Arctic Tundra

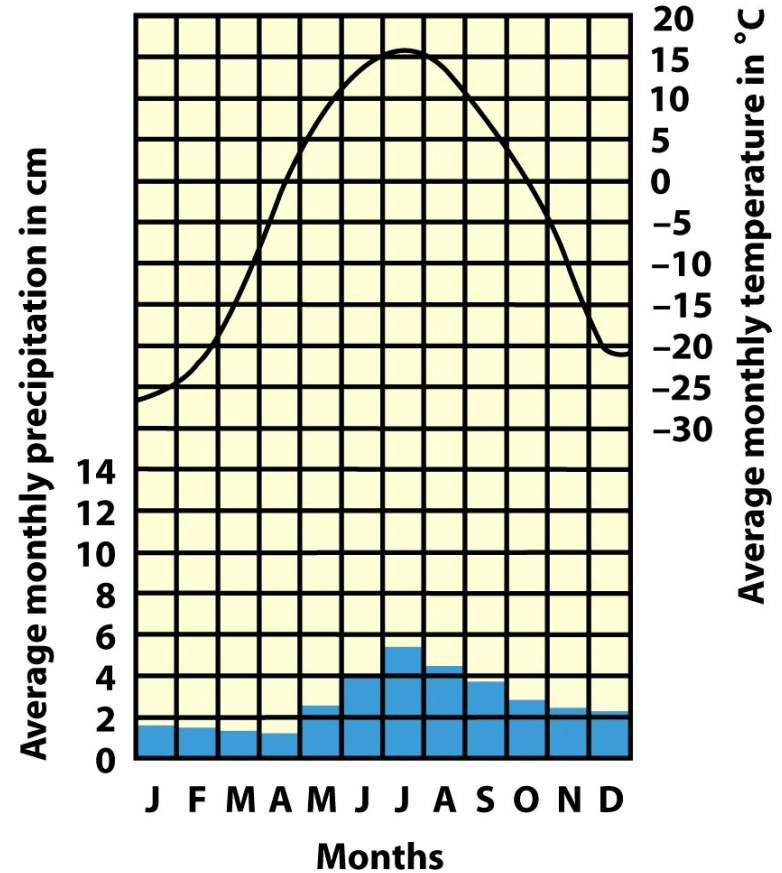


1. Treeless biome in the far north that consists of boggy plains covered by lichens and mosses.
2. Southern Hemisphere has no tundra.
3. Characterized by harsh cold winters, little precipitation and short summers.

Video arctic summer many bird species depend on this biome:

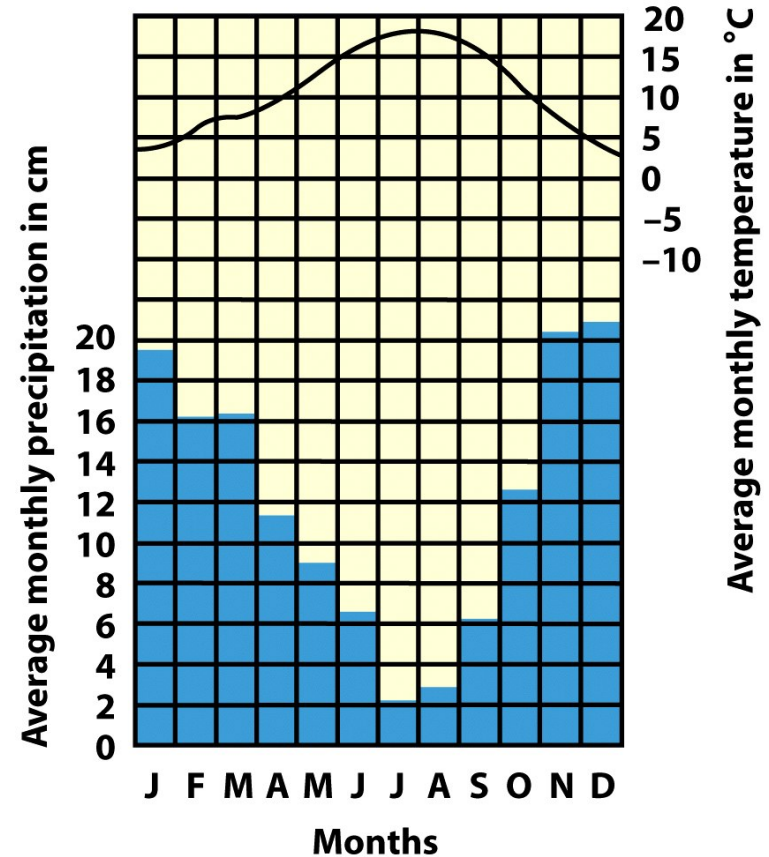
<https://wosu.pbslearningmedia.org/resource/nat08.living.reg.resou.summer/nature-earth-navigators-arctic-summer/#.WY3RT8aZMQ8>

Boreal Forest (Taiga)



1. Just south of tundra, cold to cool temperatures.
2. Southern hemisphere has no boreal forest.
3. Northern coniferous forest across North American and Eurasia.
4. Acidic, mineral poor soils, permafrost deep under soil.
5. Little precipitation.

Temperate Rain Forest

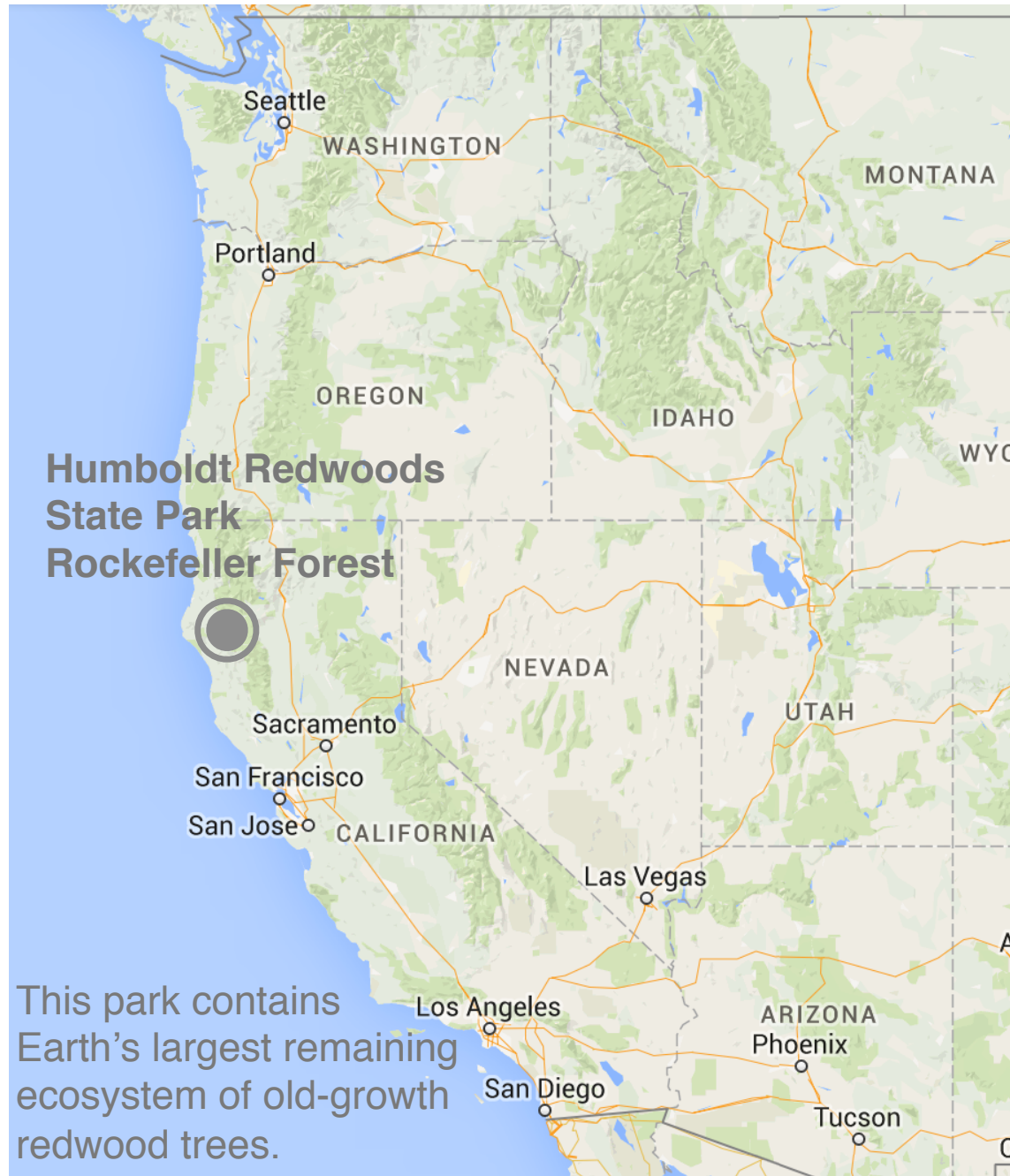


1. Pacific Northwest of North America, southeastern Australia, southern South America.
2. Temperature fairly constant due to proximity to coast.
3. Winters are mild and summers are cool.
4. Soils have high organic content, but cool temperature decrease activity to bacteria and fungi to decompose material therefore soil is nutrient poor.
5. High annual precipitation (200-380 cm).

This is a redwood tree that was named the Stratosphere Giant. It is about 112 meters (370-feet) tall and about 2,500 years old.



<http://www.npr.org/blogs/krulwich/2011/04/08/135206497/the-worlds-tallest-tree-is-hiding-somewhere-in-california>



This park contains Earth's largest remaining ecosystem of old-growth redwood trees.

370 feet



The Stratosphere Giant California

316 feet

305 feet



Statue of Liberty
New York City



Big Ben
London

Coastal Redwoods California Rockefeller Forest

The James, Tallest building
on the OSU campus
Opened in 2014
300-feet tall
A few years old

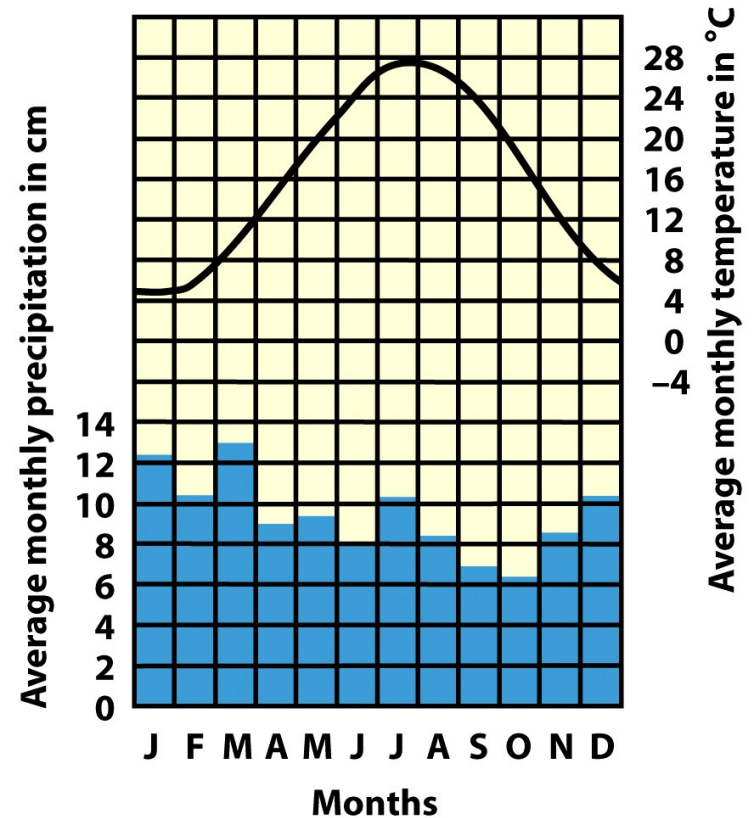
Redwood Tree
350-feet tall
2,000+ years old



Video Canadian temperate rain forest:
[http://video.nationalgeographic.com/
video/canada_canadianrainforest](http://video.nationalgeographic.com/video/canada_canadianrainforest)



Temperate Deciduous Forest

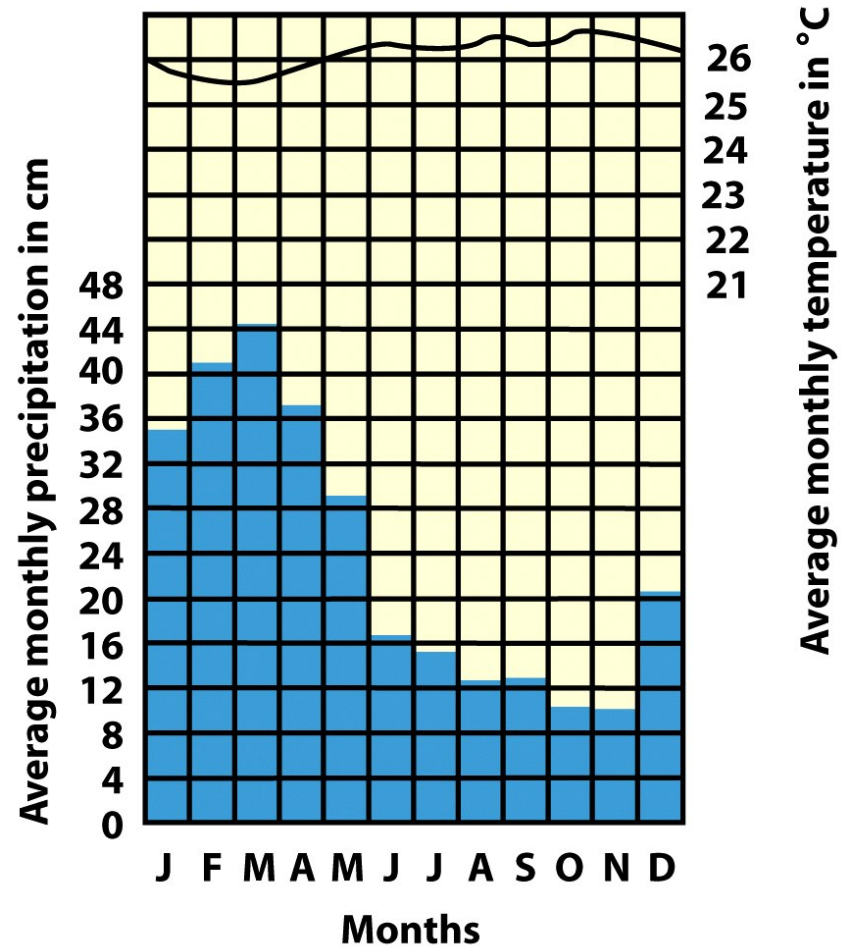


1. Columbus, Ohio.
2. Deciduous hardwood trees forming dense canopy overlies saplings and shrubs.
3. Warm temperatures in summer months and cool temperatures in winter.
4. Topsoil typically rich in organic matter and deep clay-rich lower layer.
5. Annual precipitation ranges from 75-125 cm.

Video on sustainable logging:

<http://video.nationalgeographic.com/video/sustainable-logging>

Tropical Rain Forest



1. Species-rich forest.
2. Warm temperatures year round.
3. Found in Central American, South America, Africa, Southeast Asia.
4. Little organic matter due to high temperatures, which leads to active bacteria and fungi and detritus-feeding insects (ants, termites) that rapidly decompose organic matter.
5. Annual precipitation high typically 200-450 cm.

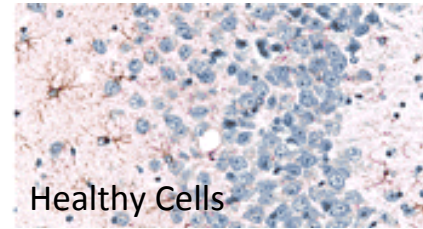
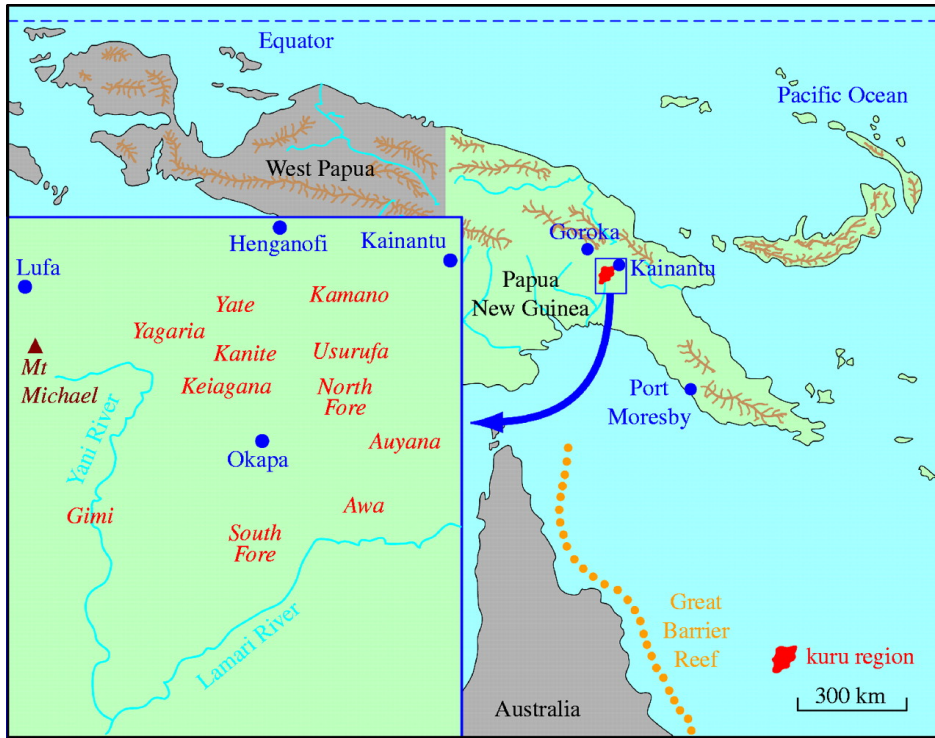
Tropical rainforest



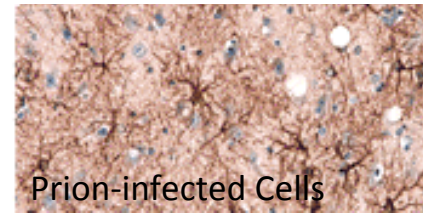
Paraguay's Fading Forest

<https://www.nytimes.com/video/world/americas/100000001448717/paraguays-fading-forest.html>

Papua New Guinea Rainforest

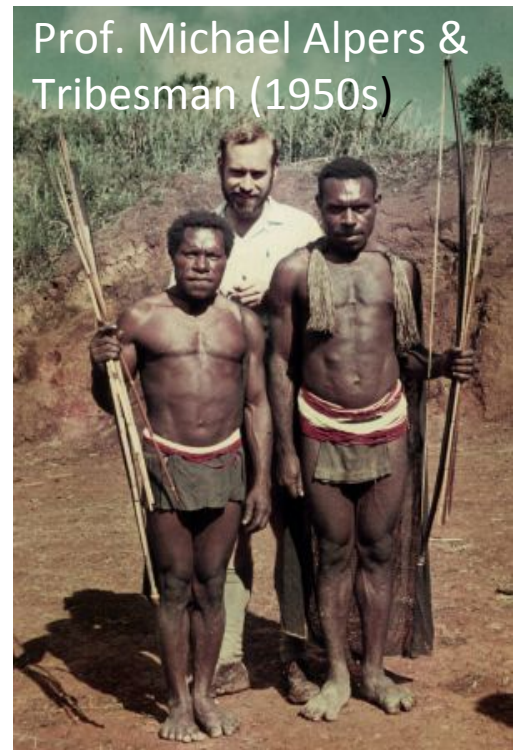


Healthy Cells



Prion-infected Cells

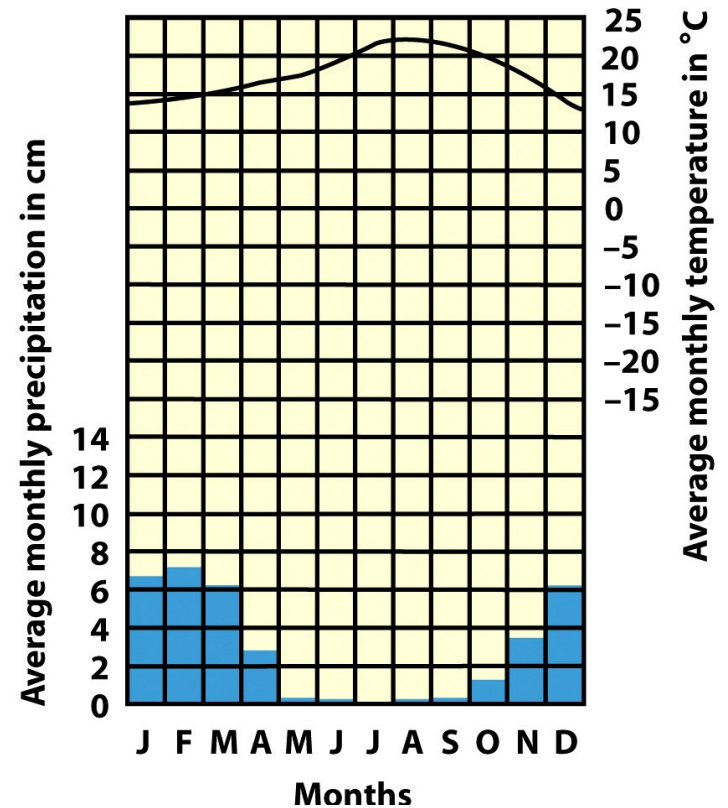
Immunostain
of Brain
Sections



Prof. Michael Alpers &
Tribesman (1950s)

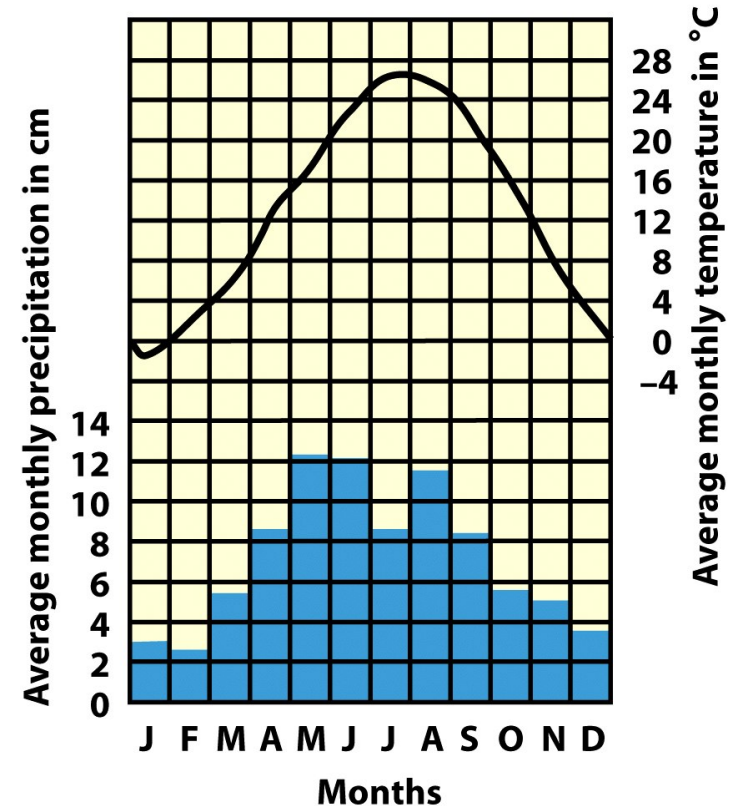
- Kuru (Laughing Sickness or The Shakes) or Creutzfeldt Jakob Disease (CJD) – prions
- Transmitted by cannibalism on island
- Incubation period for disease 5-40 years
- Similar to Mad Cow Disease – prions
- Prions are weird because they are proteins and can be completely benign for years and then cause the disease.

Chaparral or Mediterranean



1. Mild moist winters and hot dry summers.
2. Vegetation is small-leafed shrubs and small trees
3. Found in Santa Monica Mountains of USA and areas around Mediterranean Sea, southern Australia, central Chile, southwestern South Africa.
4. Little organic matter and nutrient-poor soil.
5. Annual precipitation low, precipitation occurs in winter months.

Temperate Grassland – Dances with Wolves

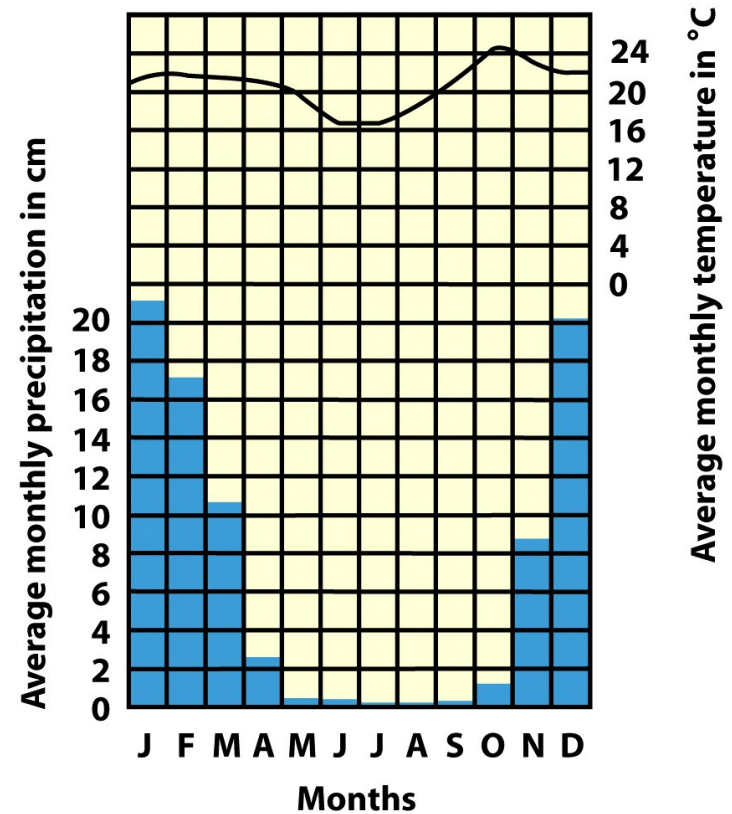


1. Cold winters and hot summers – large annual temperature difference.
2. Vegetation is grasses, trees grow sparsely except near rivers and streams.
3. Great Plains of USA.
4. Periodic wildfires help maintain grasses as dominant vegetation.
5. Soil has high of organic matter from all the decomposing grass.
6. Annual precipitation ranges from 25 – 75 cm.

Grassland



Savanna

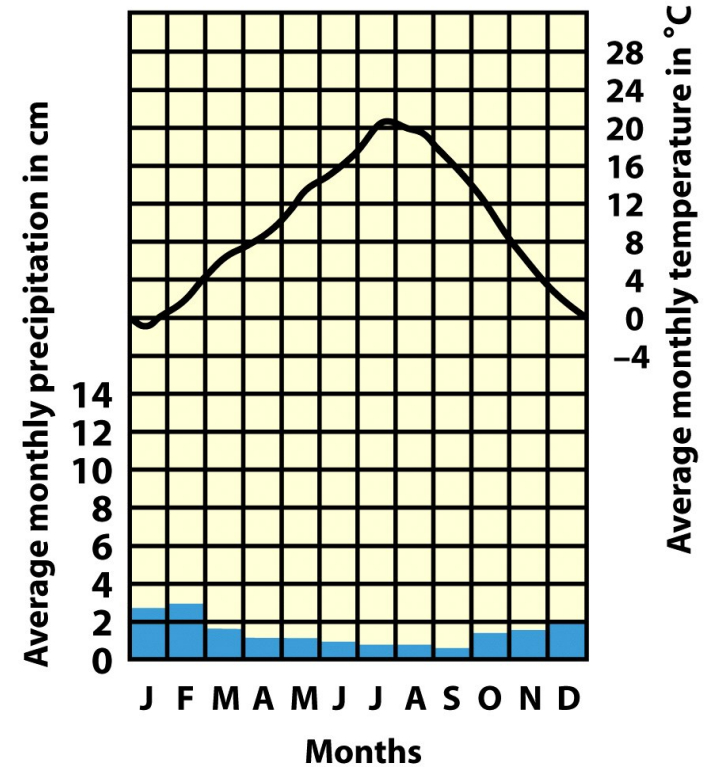


1. Tropical grassland with widely scattered trees.
2. Temperatures constant throughout year.
3. African savanna is best known, although savanna also found in South America, western India, and northern Australia.
4. Nutrient-poor soil because it is heavily leached during rainy seasons.
5. Annual precipitation ranges from 85 – 150 cm and this is the overriding climatic factor.
6. Precipitation occurs during rainy season followed by prolonged dry periods.

Video Botswana savannah and the Okavango River Delta:

http://video.nationalgeographic.com/video/botswana_okavangodelta

Desert



1. Biome in which the lack of precipitation limits plant growth.
2. Temperatures relatively constant throughout year, but large daily temperature changes because low water vapor content of air = cold nights and hot days.
3. Deserts found in both temperate and tropical regions.
4. Soil is low in organic material but often high in mineral content, particularly salts.
5. Sparse plant cover.
6. Precipitation generally less than 25 cm per year.

Desert

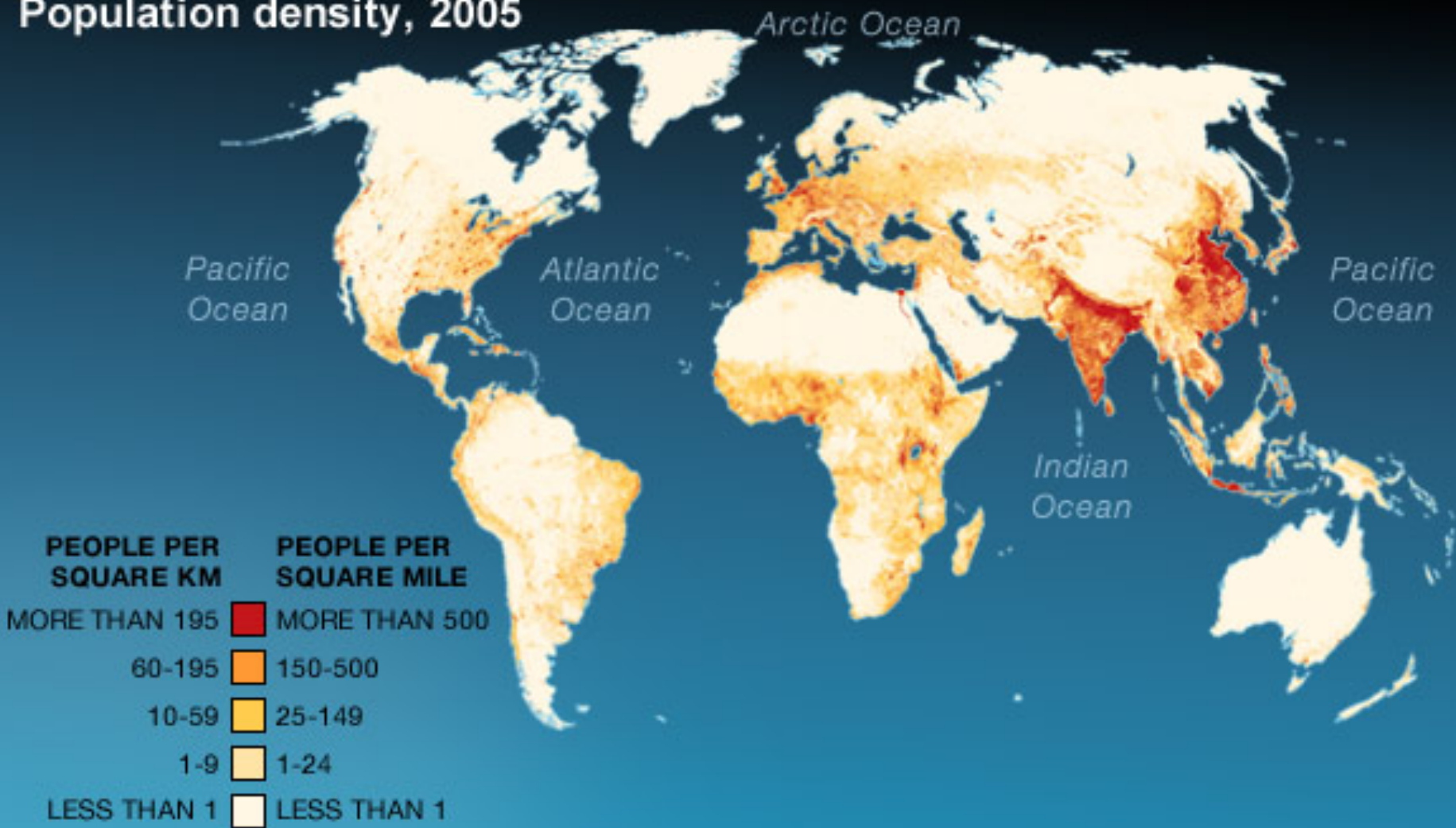


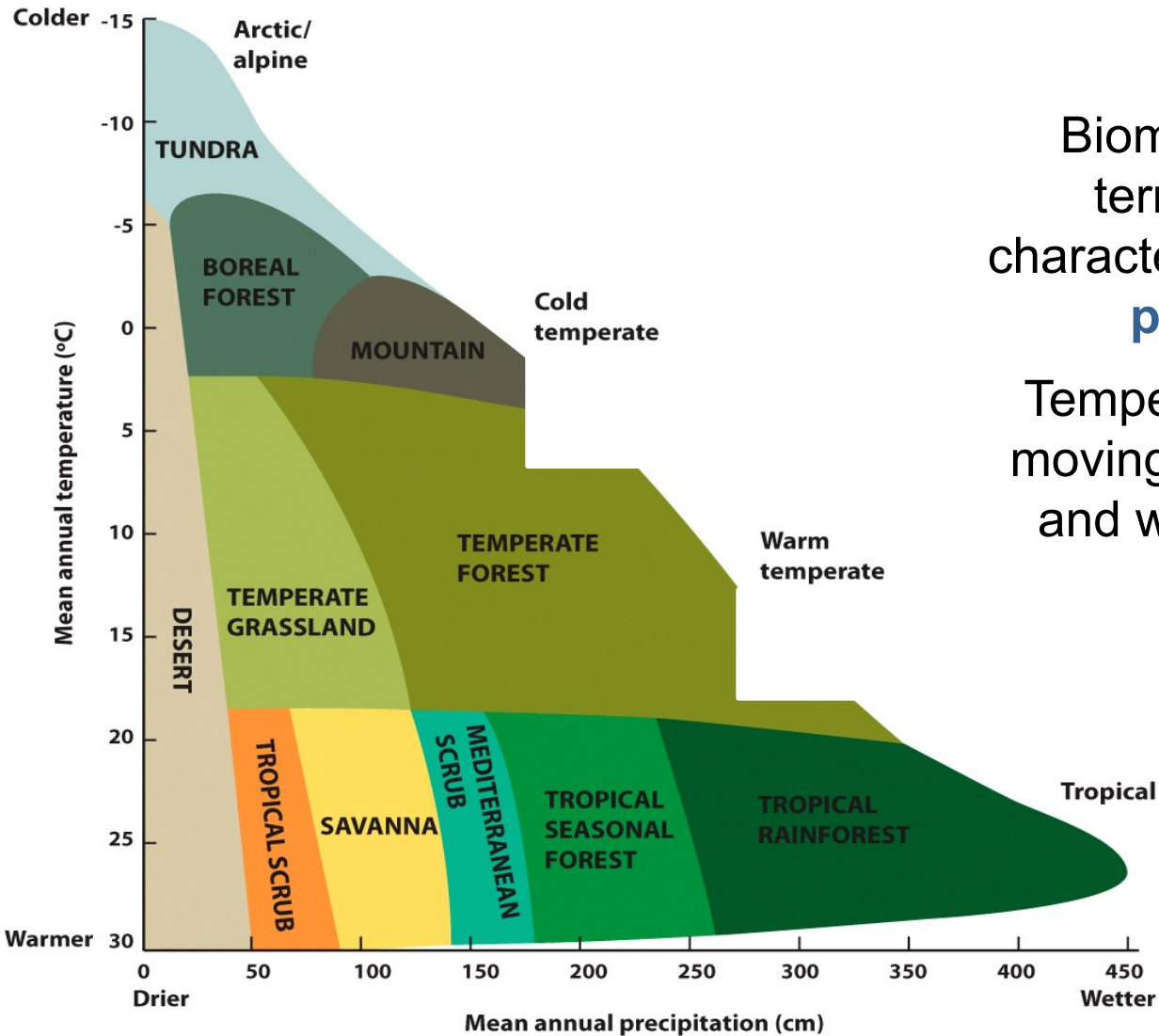
Video Sahara Desert, northern Chad:

http://video.nationalgeographic.com/video/chad_gueltaarchei

“Urban biome”

Population density, 2005





Biomes are specific types of terrestrial ecosystems with characteristic **temperature** and **precipitation** conditions.

Temperature decreases when moving away from the equator and with increased elevation.