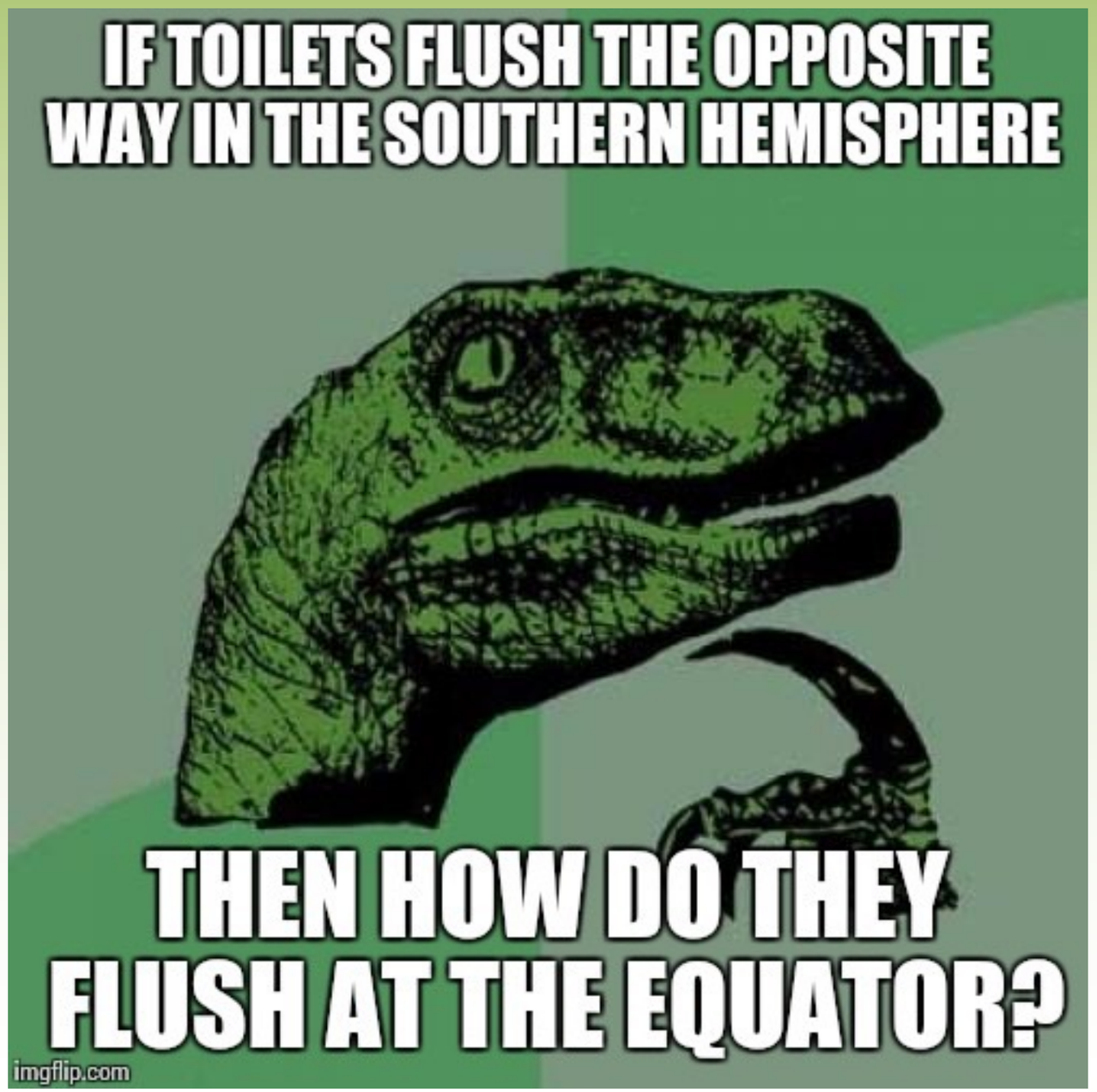
Agenda:

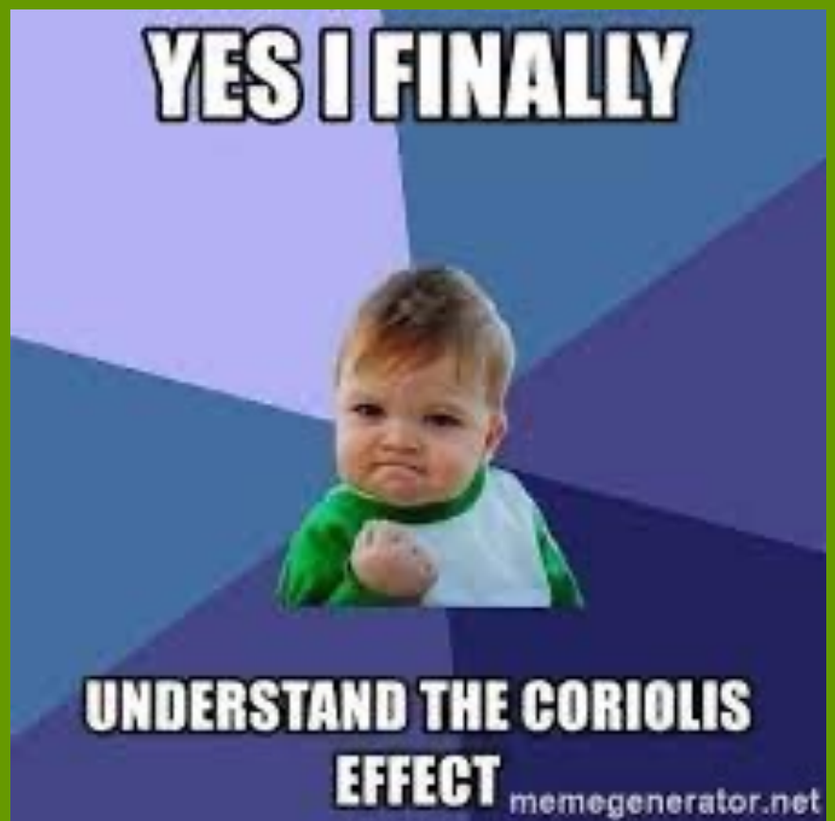
- Ch. 4 Notes
- Class time for HW and questions



Bell Work

1. Explain how convection currents function

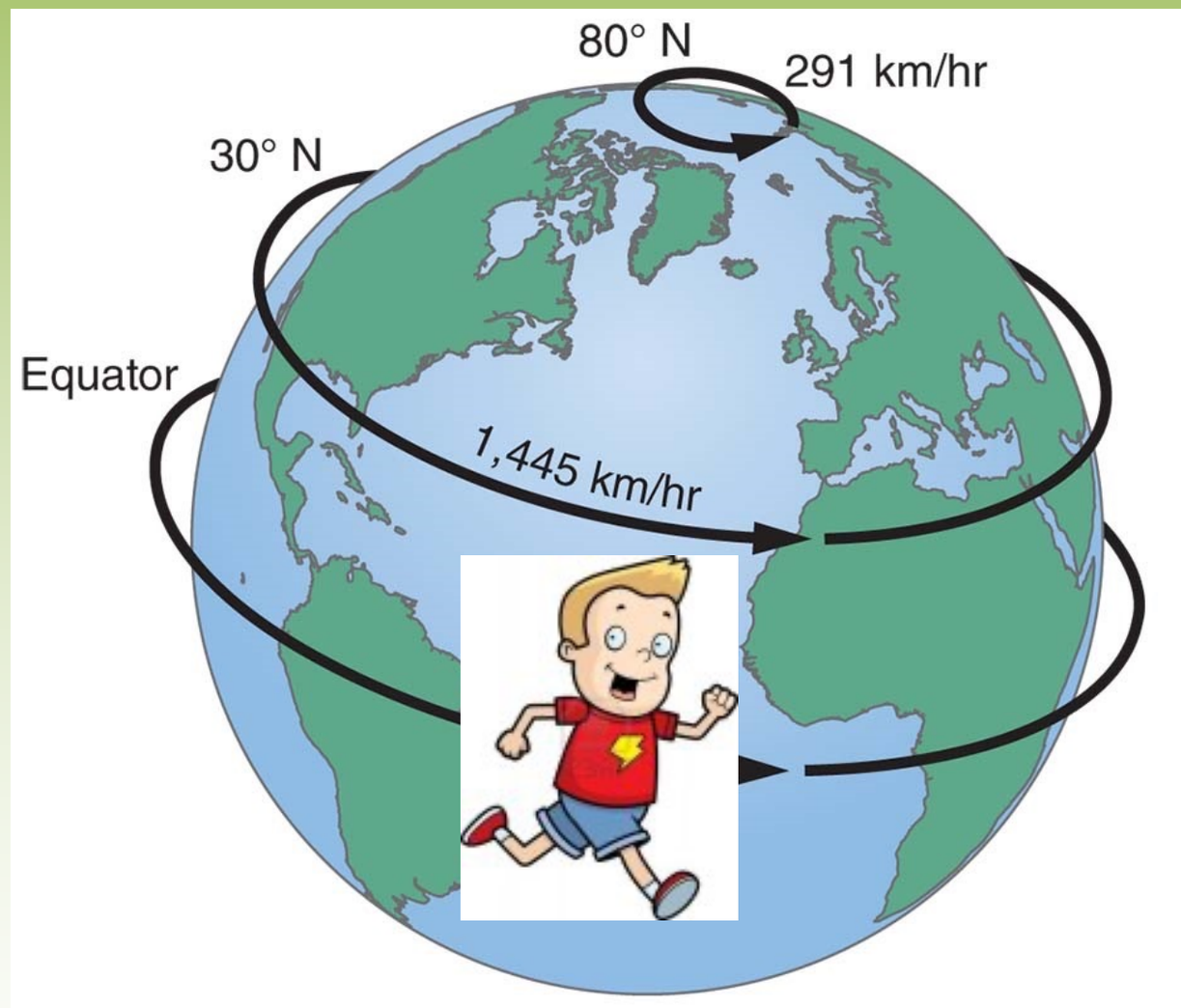
2. Describe the Coriolis effect



Earth's Rotation and the Coriolis Effect

- As Earth rotates, its *surface moves much faster at the equator than in mid-latitude and polar regions.*

- Imagine your-self standing still as the Earth rotates. Where would you be traveling the fastest over 24 hours (one full rotation of the Earth)?



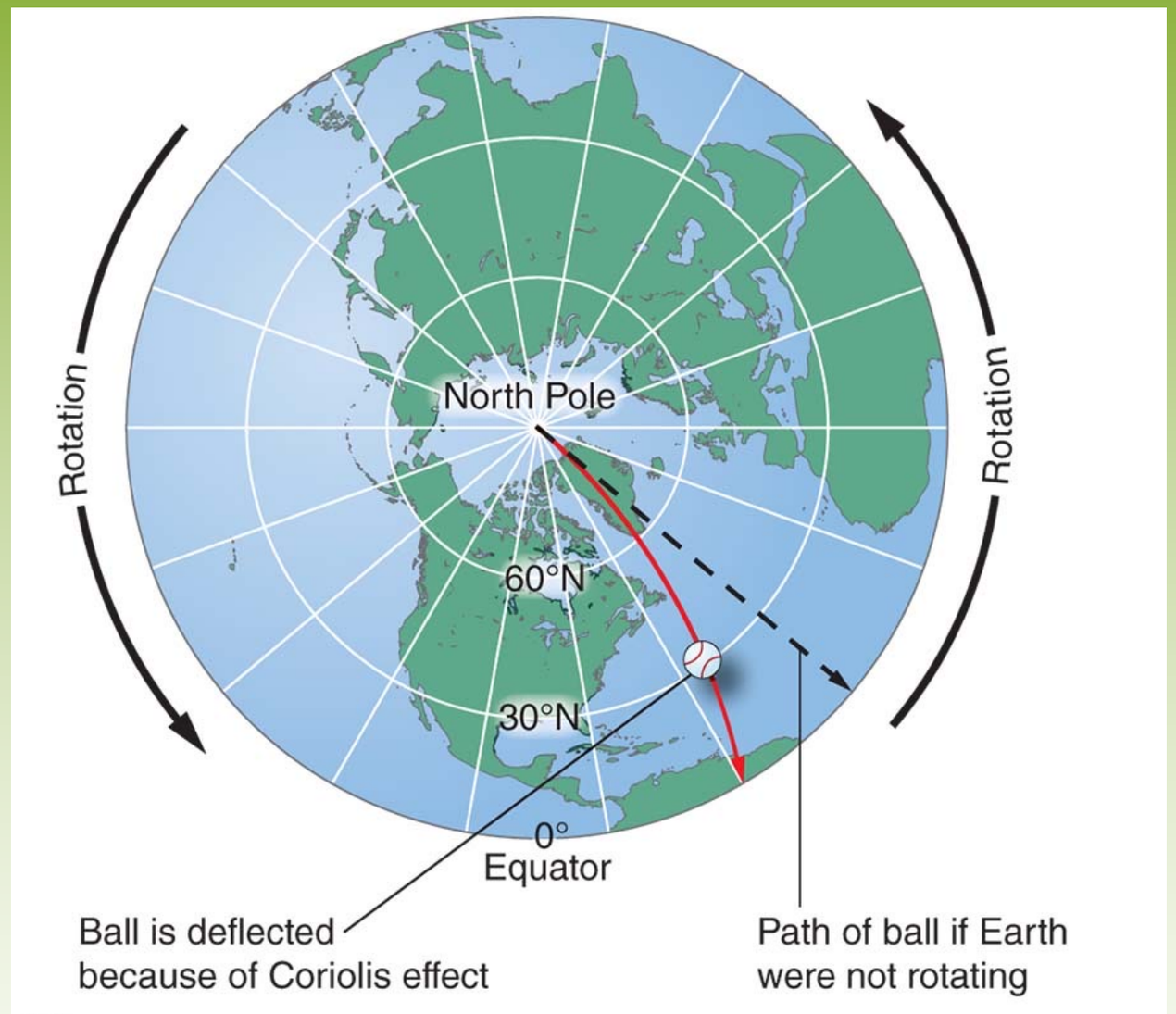
Earth's Rotation and the Coriolis Effect

- The faster rotation speeds closer to the equator cause a deflection of objects that are moving directly north or south.

- What direction does the Earth rotate? EAST FERGODSAKES!!!

- Imagine you throw a ball from the north pole, south toward the equator, which direction will it be deflected?

WEST FERGODSAKES!!!



The deflection of an object's path due to Earth's rotation is called the **Coriolos effect**

Earth's Rotation and the Coriolis Effect

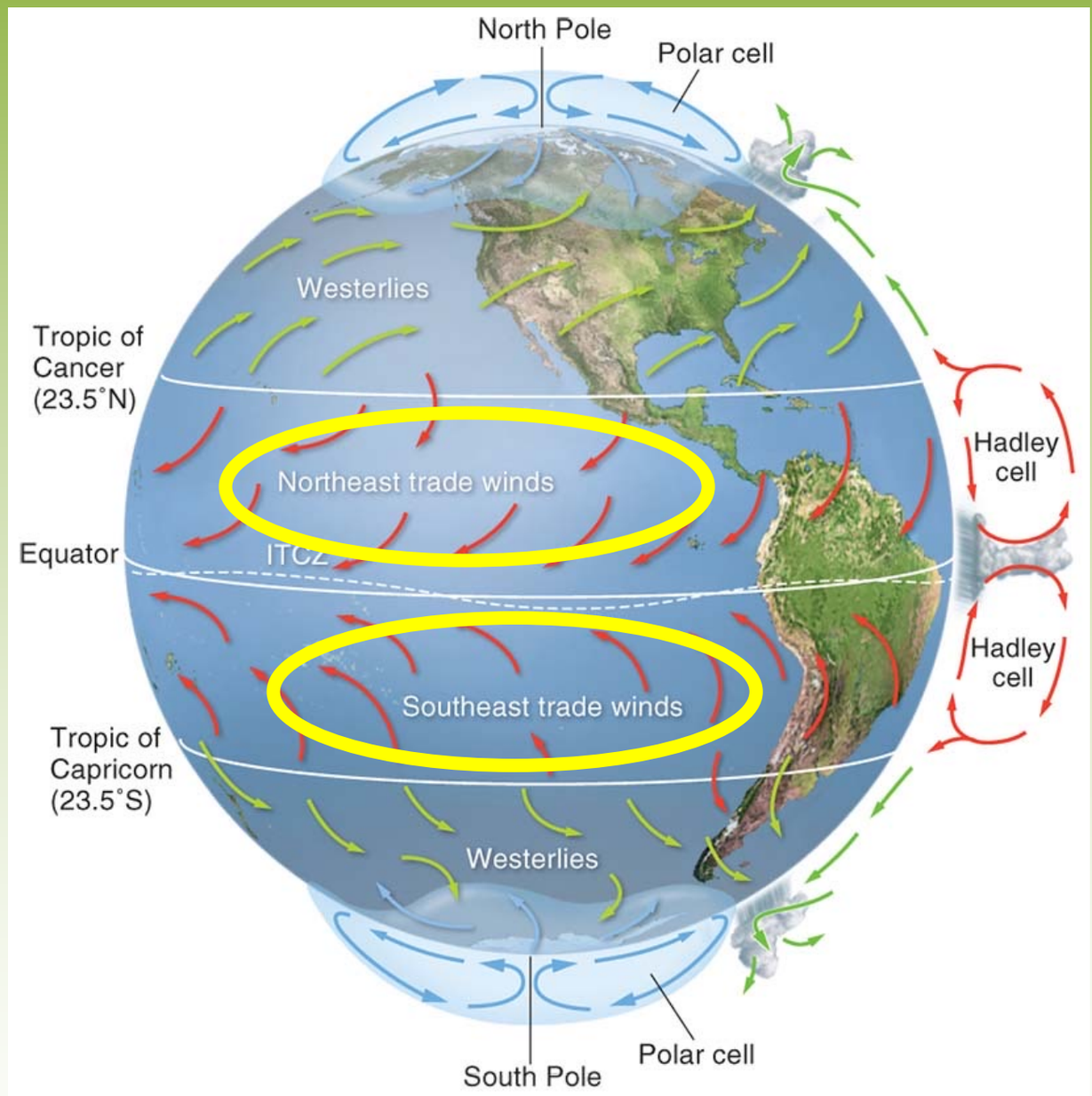
- The **prevailing winds** of the world are produced by a *combination of atmospheric convection currents and the Coriolis effect*.

- Where the air sinks at 30° latitude, the earth is rotating at 1,445 km per hour and as the air travels along the Earth's surface toward the equator, *Earth's speed of rotation increases* to 1,670 km per hour

- As a result the *air movement toward the equator is deflected to the west*

- Due to this deflection the Hadley cell north of the equator producing prevailing winds that come from the northeast (**northeast trade winds**)

- Hadley cells south of the equator produces prevailing winds that come from the southeast (**southeast trade winds**)



Earth's Rotation and the Coriolis Effect

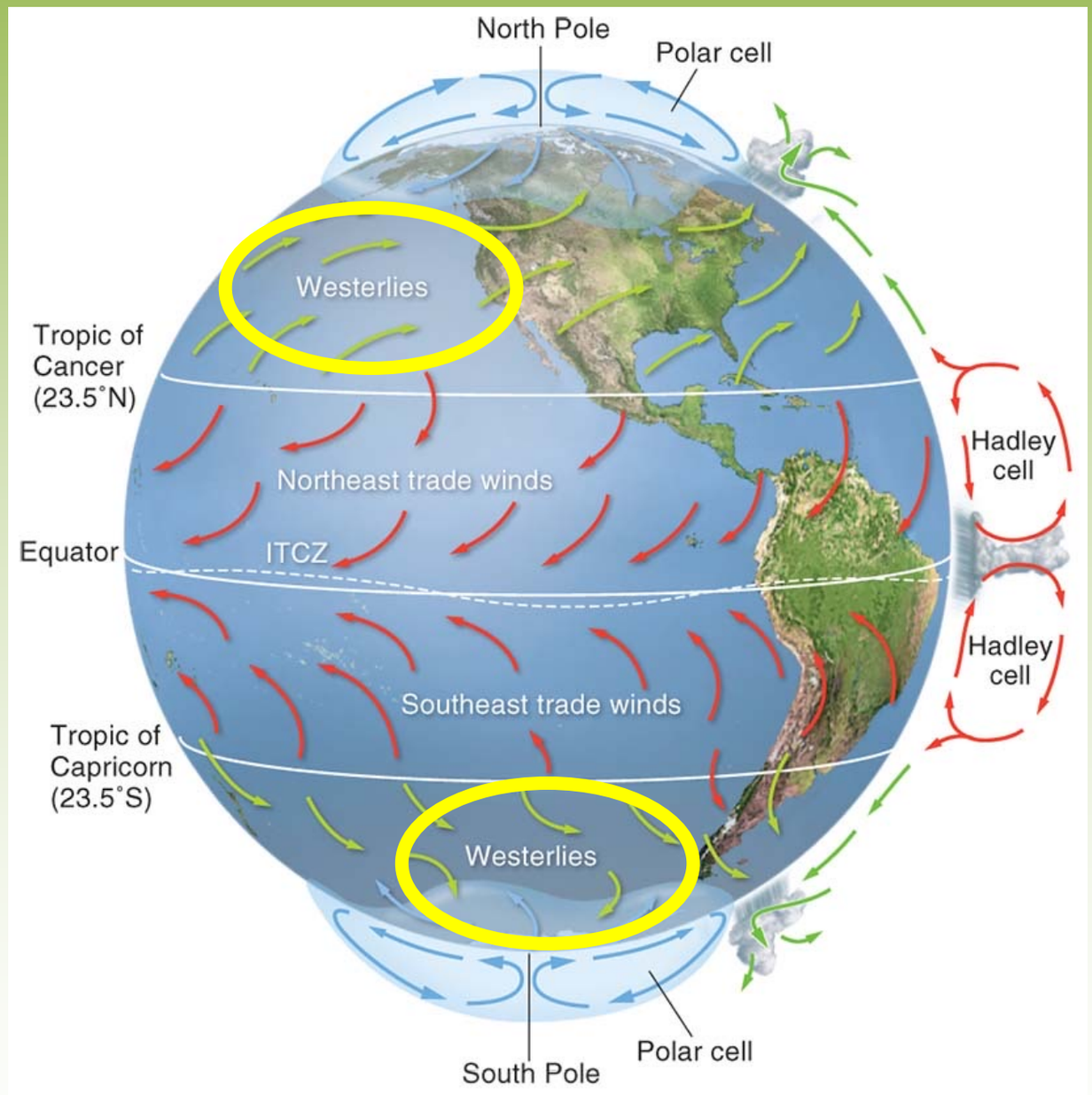
- Between 30° and 60° *winds are variable* due to the mixing air currents from the Hadley cells and the polar cells

- The Earth is *rotating faster at 30° than 60°* which deflects air movement to the east

- In the *northern hemisphere* the prevailing winds are from the *southwest*

- In the *southern hemisphere* the prevailing winds are from the *northwest*

- In both cases, these winds are called **<u>westerlies</u>**



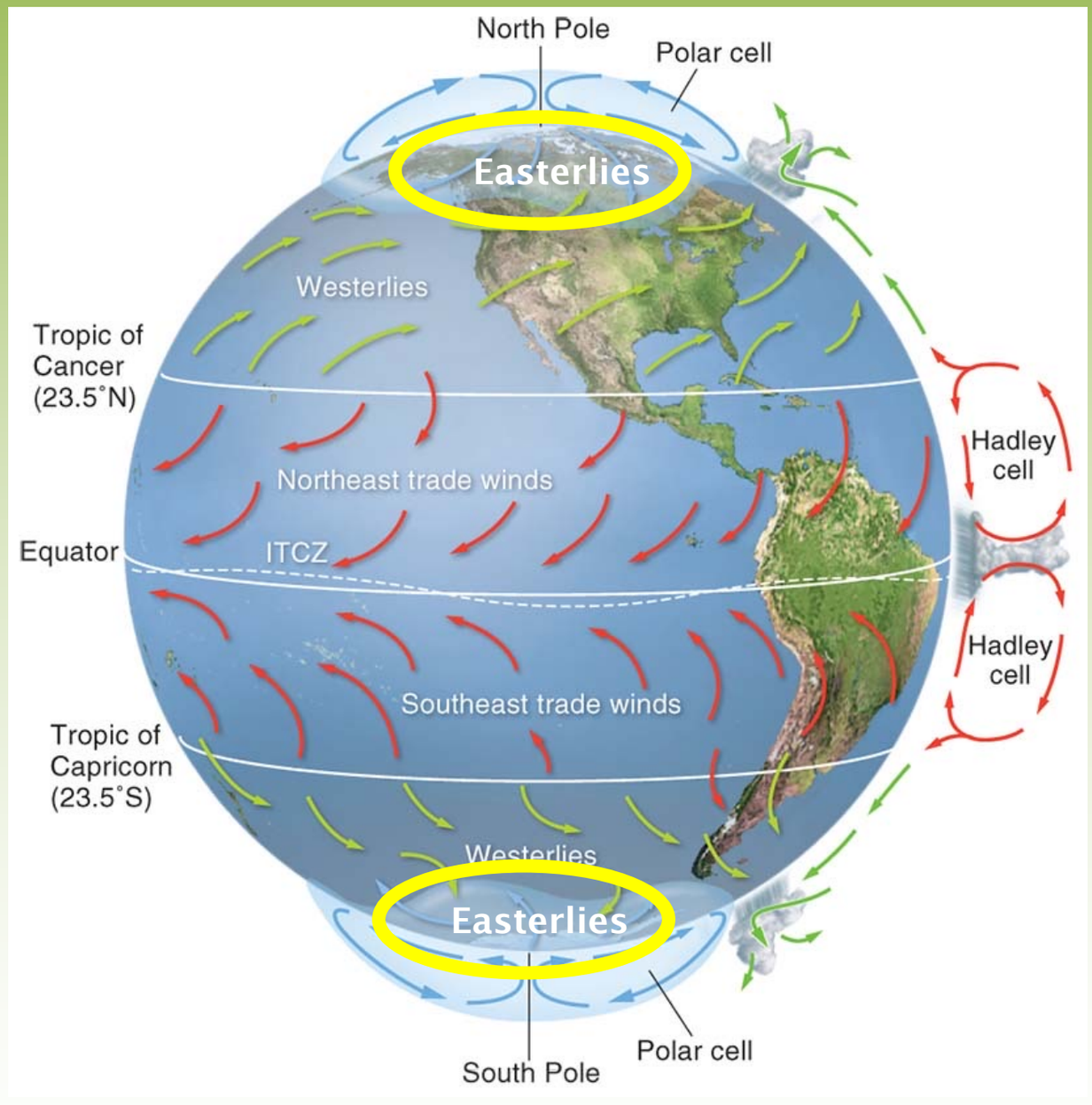
Earth's Rotation and the Coriolis Effect

- Polar cells *move air away from the poles* toward the 60° latitude at the Earth's surface

- Earth is *rotating faster at 60° than at 90°* so the air movement is *deflected to the west*

- Due to this polar winds come out of the *northeast in the northern hemisphere* and out of the *southeast in the southern hemisphere*

- These winds are called the **<u>easterlies</u>**

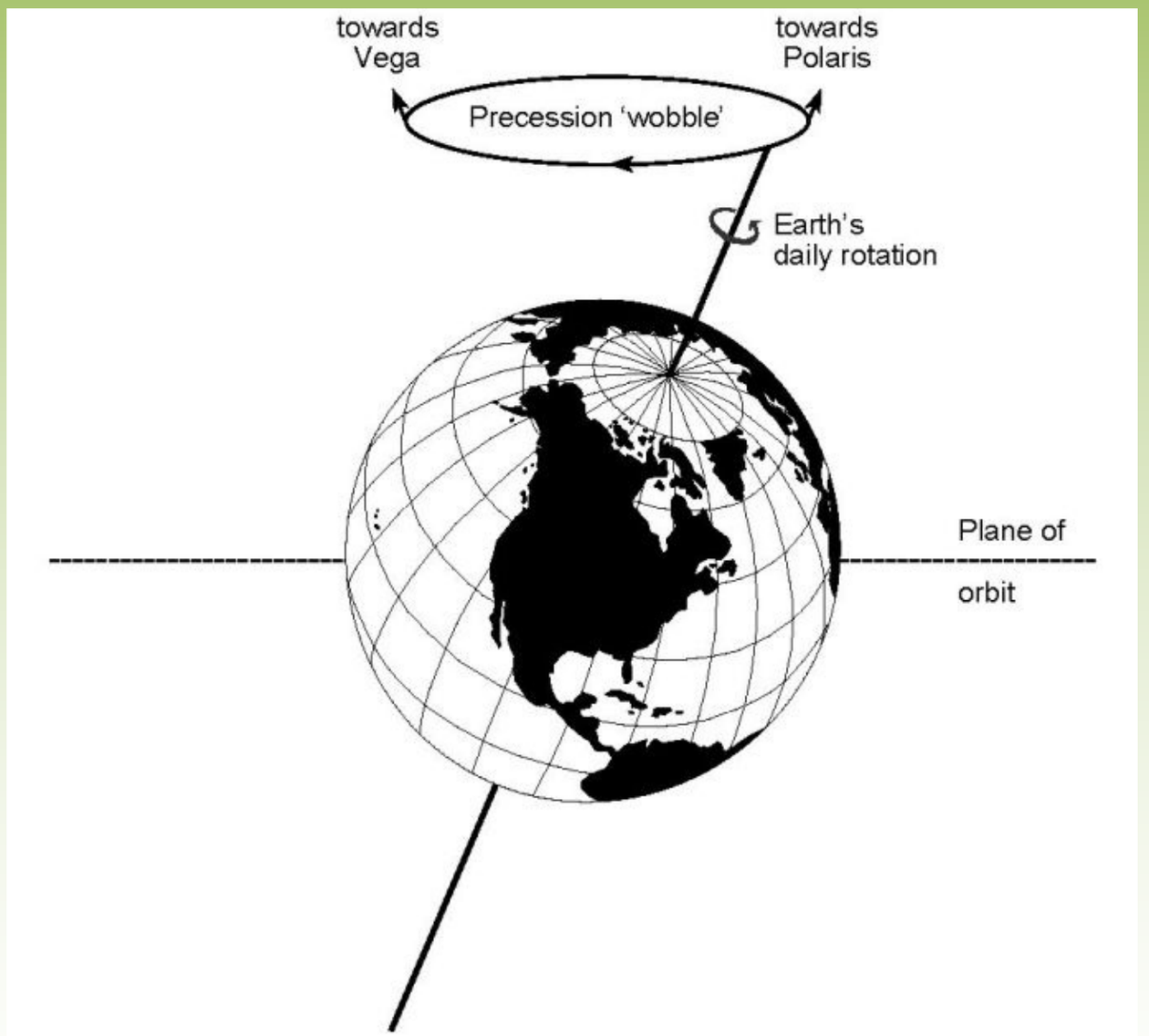


Earth's Tilt and the Seasons

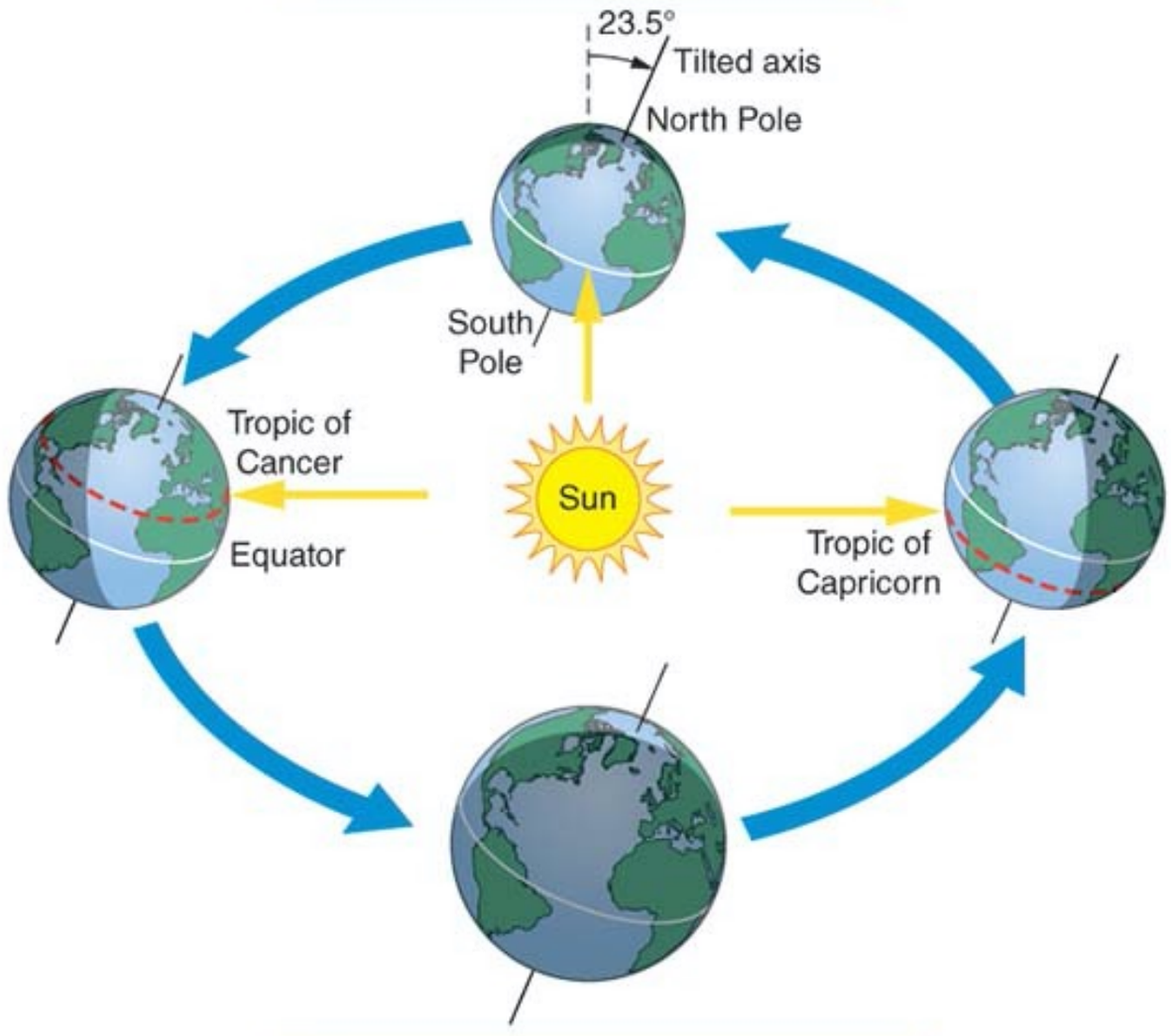
- The latitude receiving the most direct sunlight *shifts over the course of the year* (ITCZ)

- The Earth's axis of rotation is tilted 23.5 °

- When the *Northern Hemisphere* is tilted toward the Sun, the *Southern Hemisphere* is tilted away from the Sun, and vice versa



1 March equinox
The Sun is directly overhead at the equator and all regions of Earth receive 12 hours of daylight and 12 hours of darkness. Spring begins in the Northern Hemisphere. Fall begins in the Southern Hemisphere.



2 June solstice
The Northern Hemisphere is maximally tilted toward the Sun and experiences the longest day of the year. Summer begins in the Northern Hemisphere. Winter begins in the Southern Hemisphere.

4 December solstice
The Northern Hemisphere is maximally tilted away from the Sun and experiences the shortest day of the year. Winter begins in the Northern Hemisphere. Summer begins in the Southern Hemisphere.

3 September equinox
The Sun is directly overhead at the equator and all regions of Earth receive 12 hours of daylight and 12 hours of darkness. Fall begins in the Northern Hemisphere. Spring begins in the Southern Hemisphere.

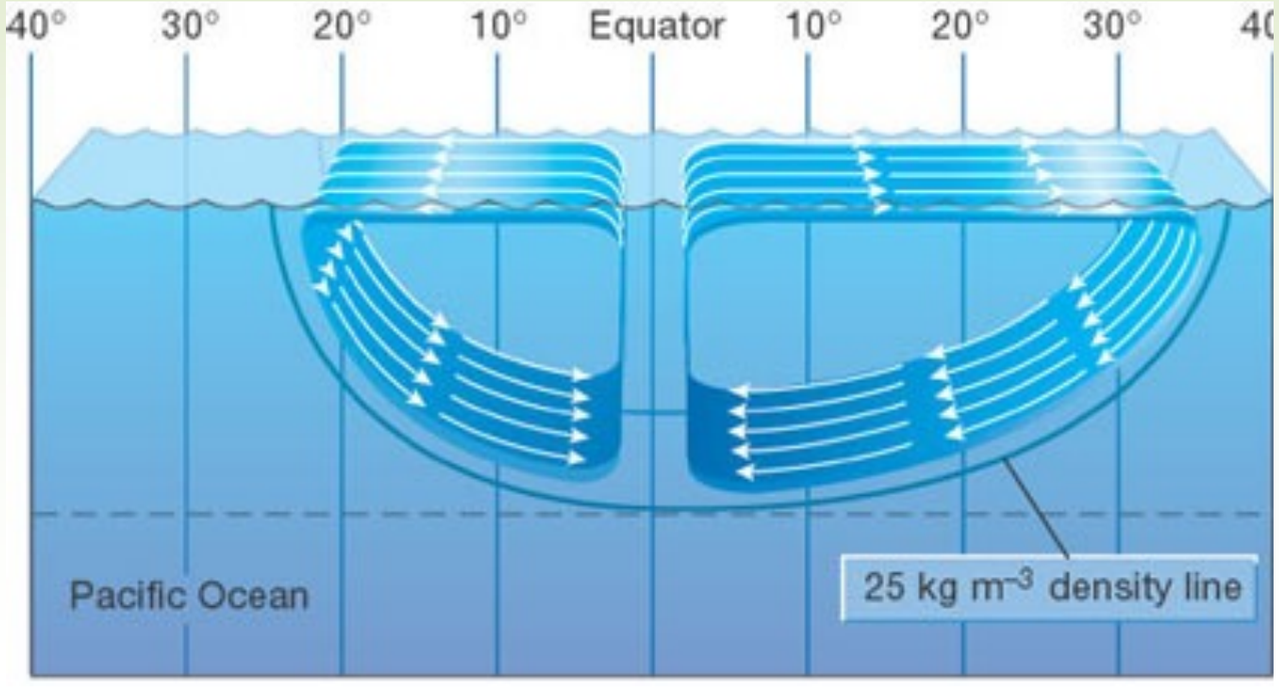
Ocean Currents

- Ocean currents are driven by a combination of *temperature*, *gravity*, *prevailing winds*, the *Coriolis effect*, and the *locations of continents*.

- Warm water, like warm air, expands and rises.

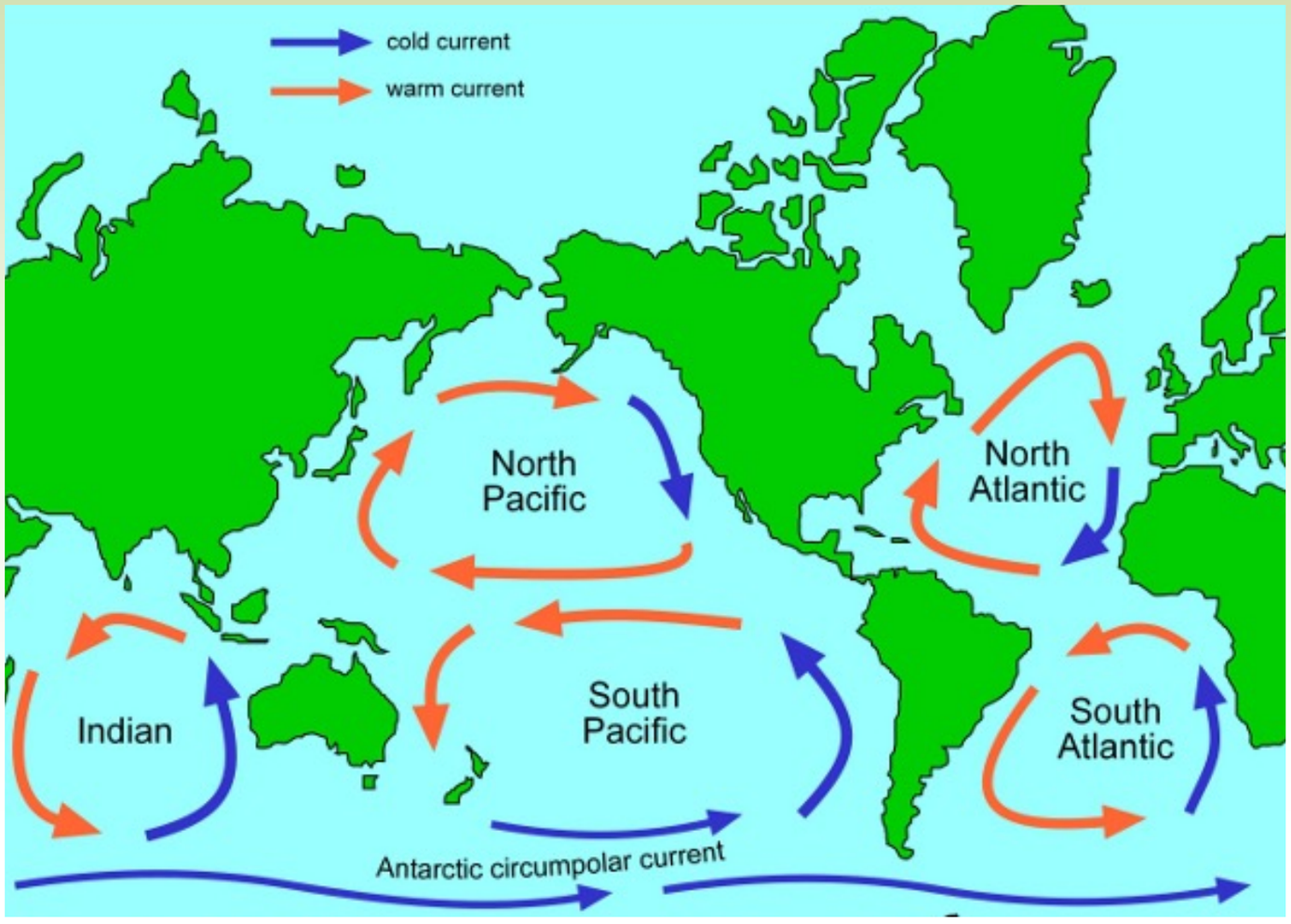
- Warm water rises at the tropics making the *water level 8cm higher in elevation* than mid-latitude waters

- Slight slope is sufficient for gravity to make water flow *away* from the equator



Gyres

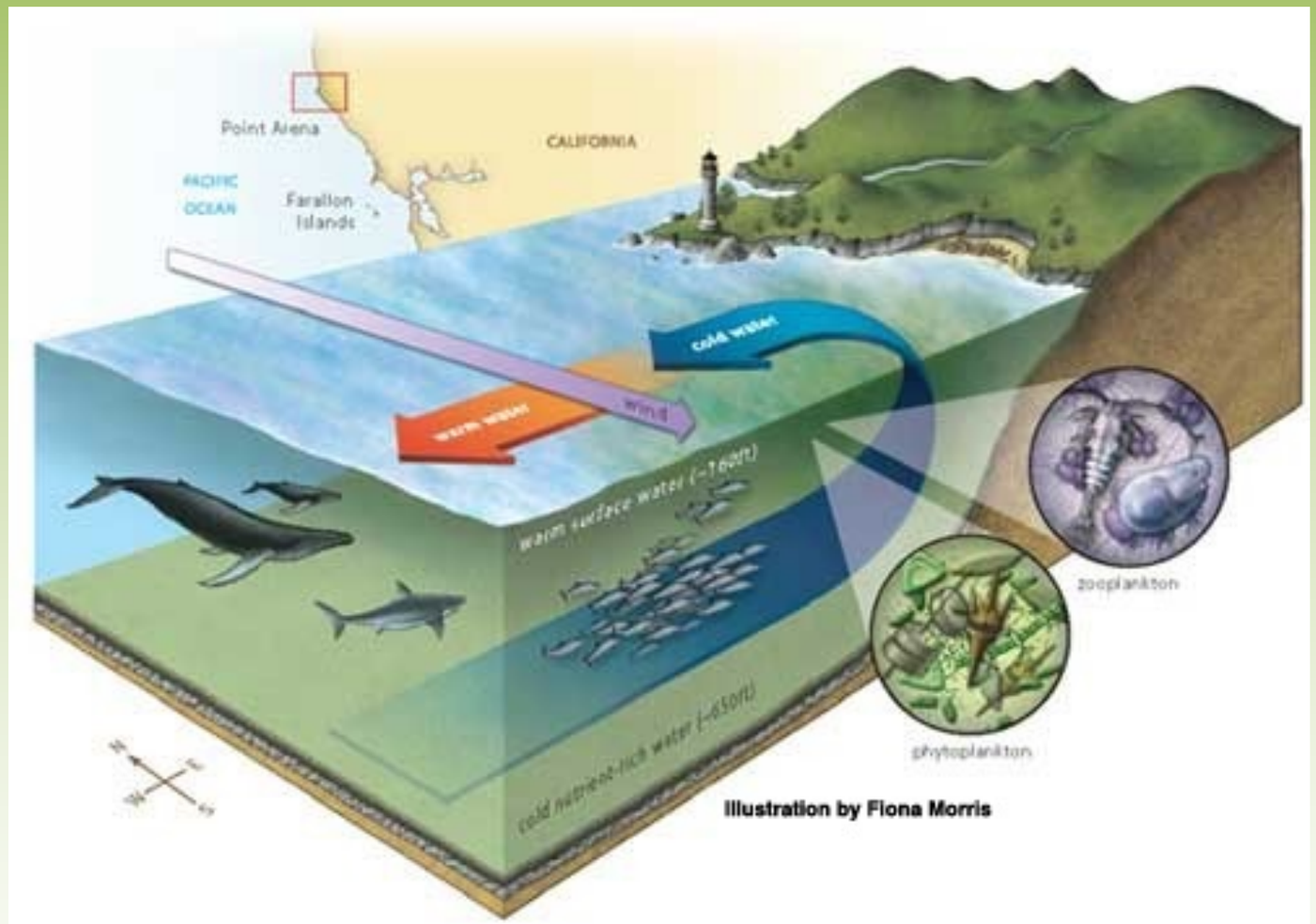
- Water movement is driven by the *trade winds* and the *westerlies*
- *Clockwise* circulation pattern in the *Northern* hemisphere and *counterclockwise* in the *Southern* hemisphere
- **<u>Gyres</u>**- the large-scale patterns of water circulation.
- Gyres *redistribute heat* in the ocean much like a convection current does in the air



Upwelling

- **<u>Upwelling</u>**- as the surface currents separate from one another, *deeper waters rise and replace the water* that has moved away.

- This upward movement of water brings *nutrients* from the ocean bottom that supports the large populations of *producers*, which in turn support large populations of *fish*.



Upwelling

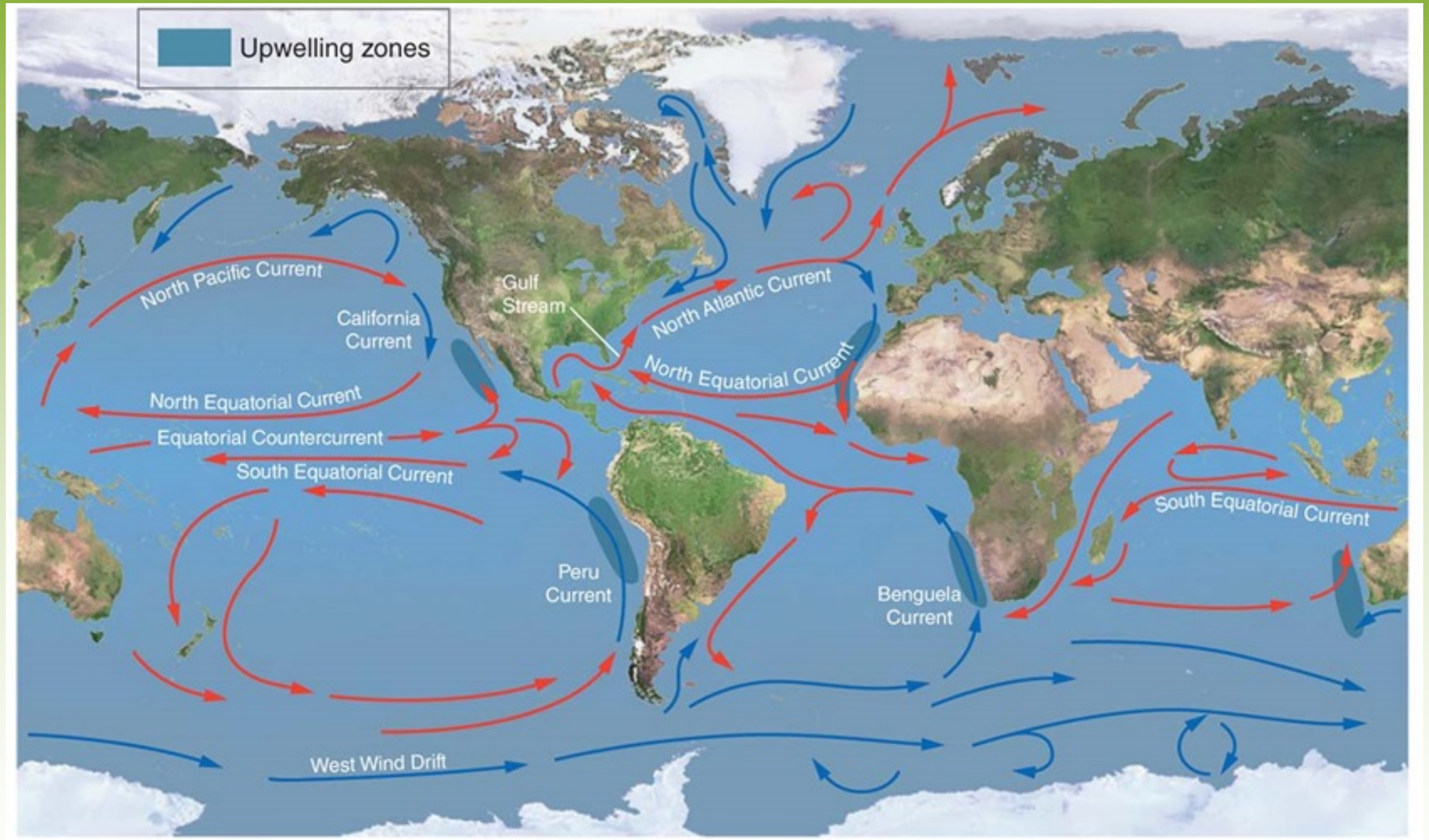


Figure 4.11
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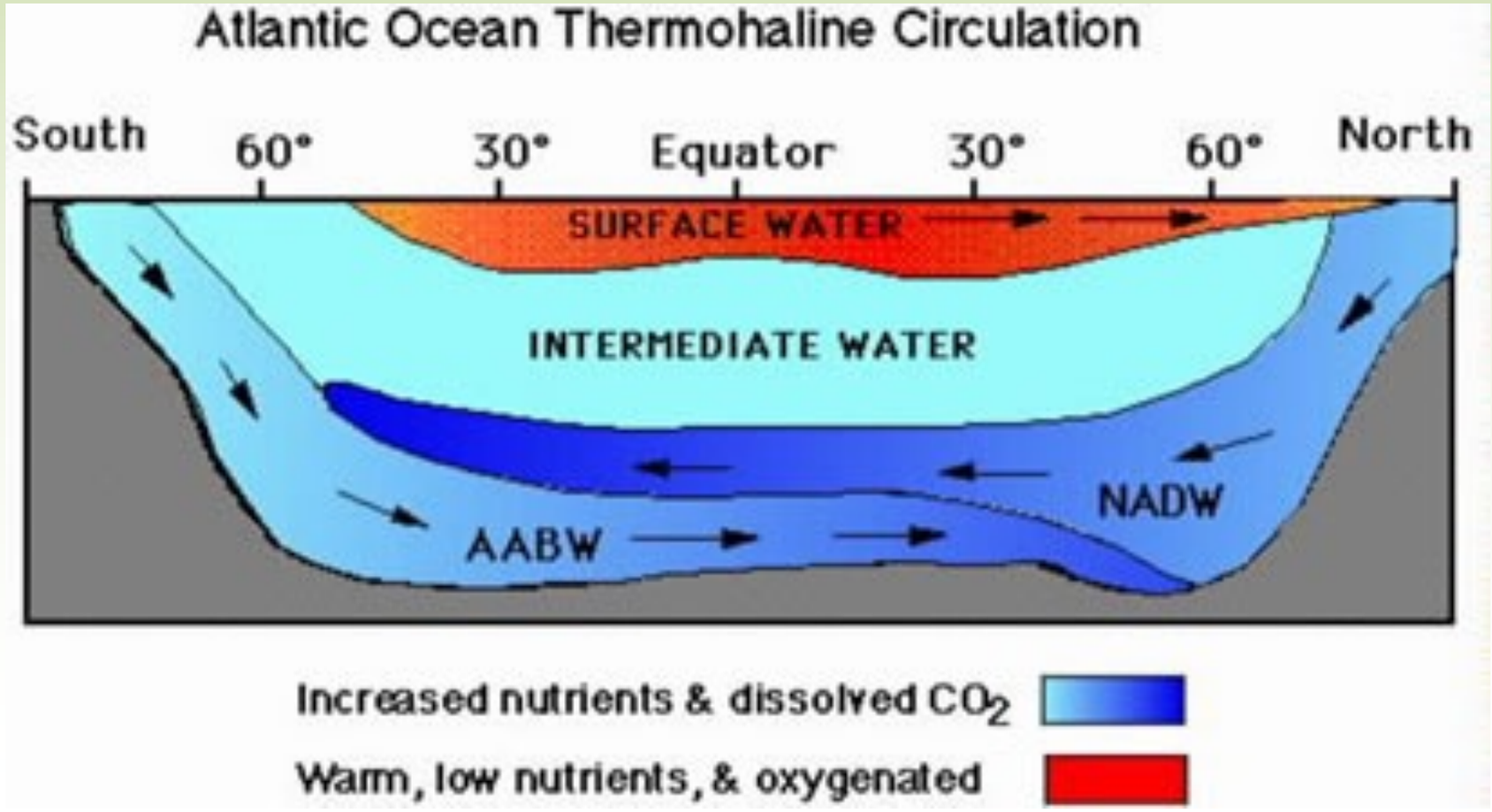
Thermohaline Circulation

- **<u>Thermohaline circulation</u>**- another oceanic circulation that drives the mixing of surface water and deep water.

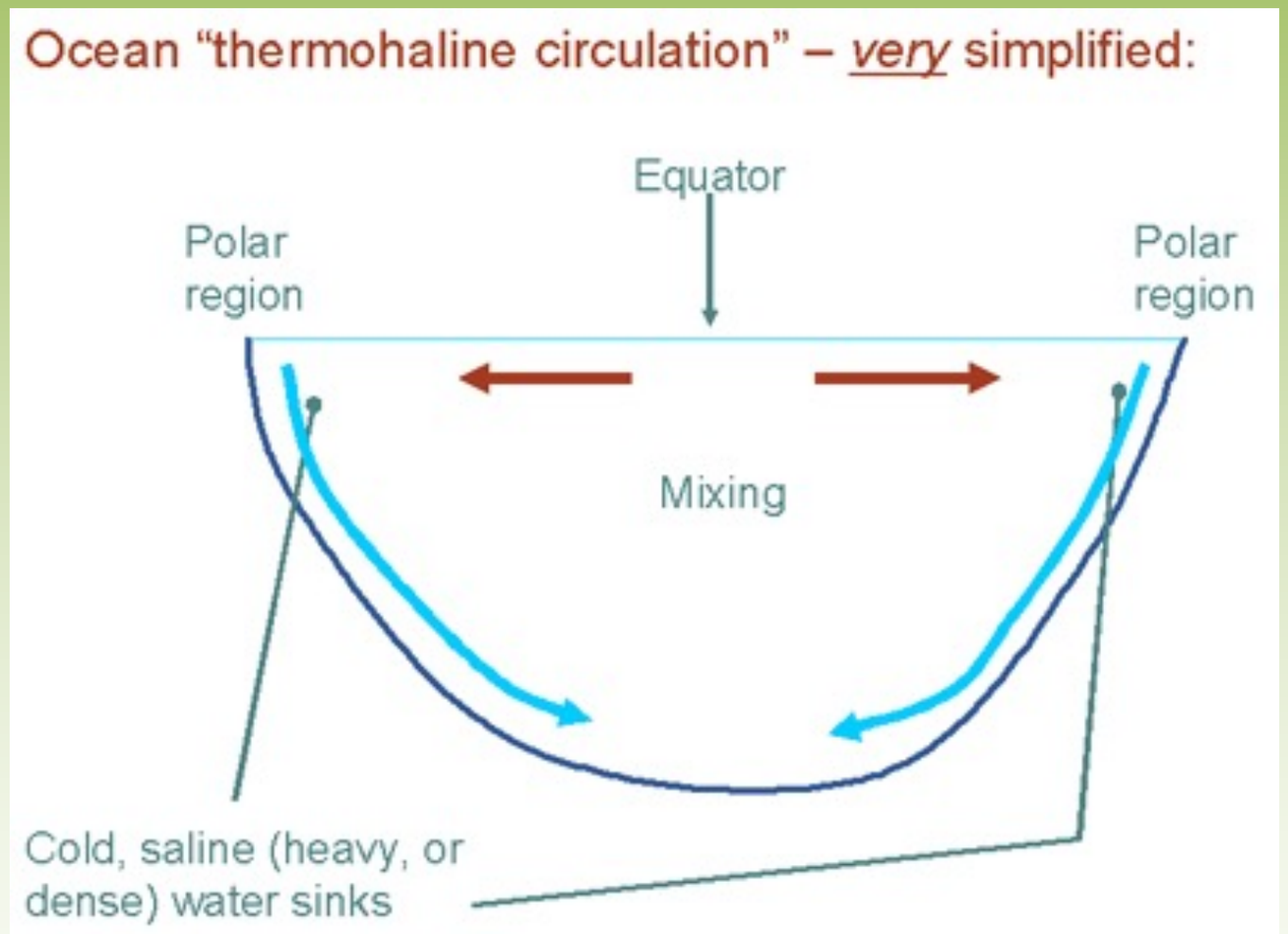
- Scientists believe this process is *crucial* for moving *heat and nutrients* around the globe.

- Thermohaline circulation appears to be driven by *surface waters that contain unusually large amounts of salt.*

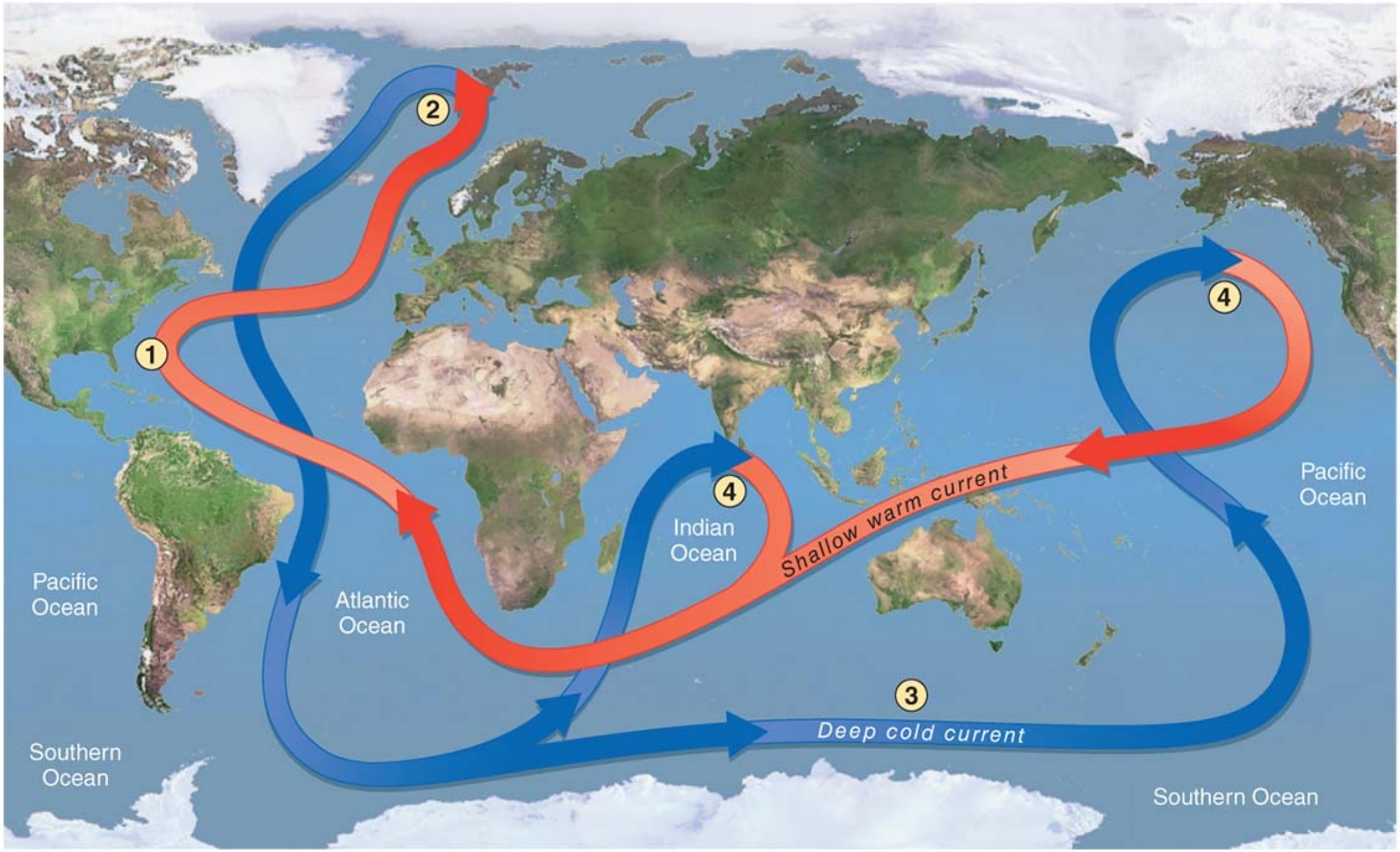


Thermohaline Circulation

- *Warm currents* flow the gulf of Mexico to the very cold N. Atlantic
- Some of the water freezes or evaporates and this *increases the salinity* of the water
- Cold salty water is dense so it *sinks*
- *Sinking of cold* water at high latitudes and *rising of warm* water from the equator drive a deep cold current that slowly moves past Antarctica and northward to the Pacific Ocean where it returns to the surface and flows back to the Gulf of Mexico
- Can take *hundreds of years* to complete



(1) Warm water flows from the Gulf of Mexico to the North Atlantic, where some of it freezes and evaporates.	(2) The remaining water, now saltier and denser, sinks to the ocean bottom.	(3) The cold water travels along the ocean floor, connecting the world's oceans.	(4) The cold, deep water eventually rises to the surface and circulates back to the North Atlantic.



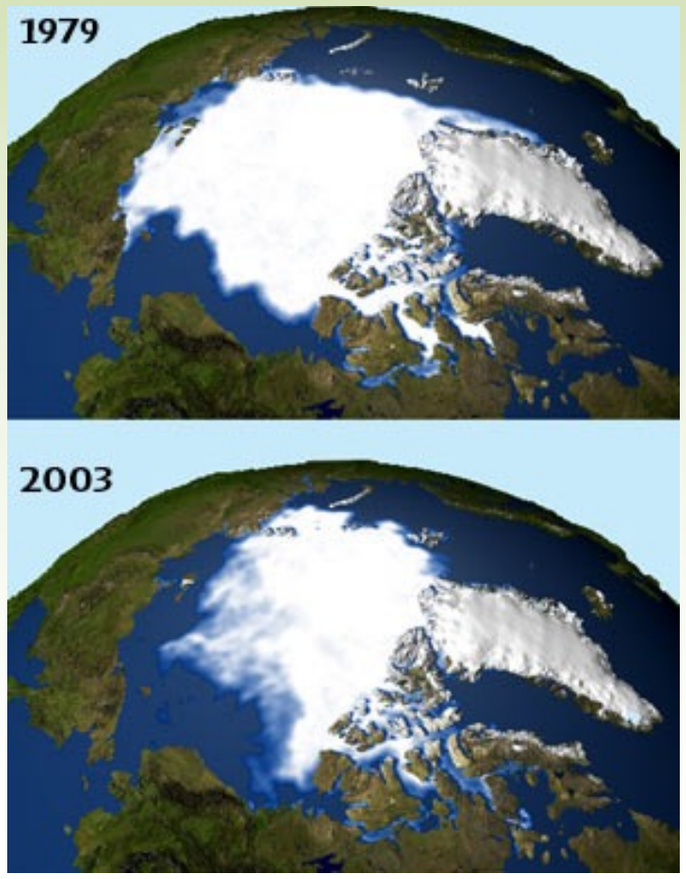
Heat Transport

- Ocean currents can affect the *temperature of nearby landmasses*.

- For example, England's average winter temperature is approximately 20 ° C (36°F) warmer than Newfoundland, Canada, which is located at a *similar latitude* but *receives cold ocean currents* from the North Atlantic

- Global warming concern is that the northern polar ice cap melting will *accelerate*, which could *dilute the salt* in the waters of the North Atlantic, making it *less likely to sink*

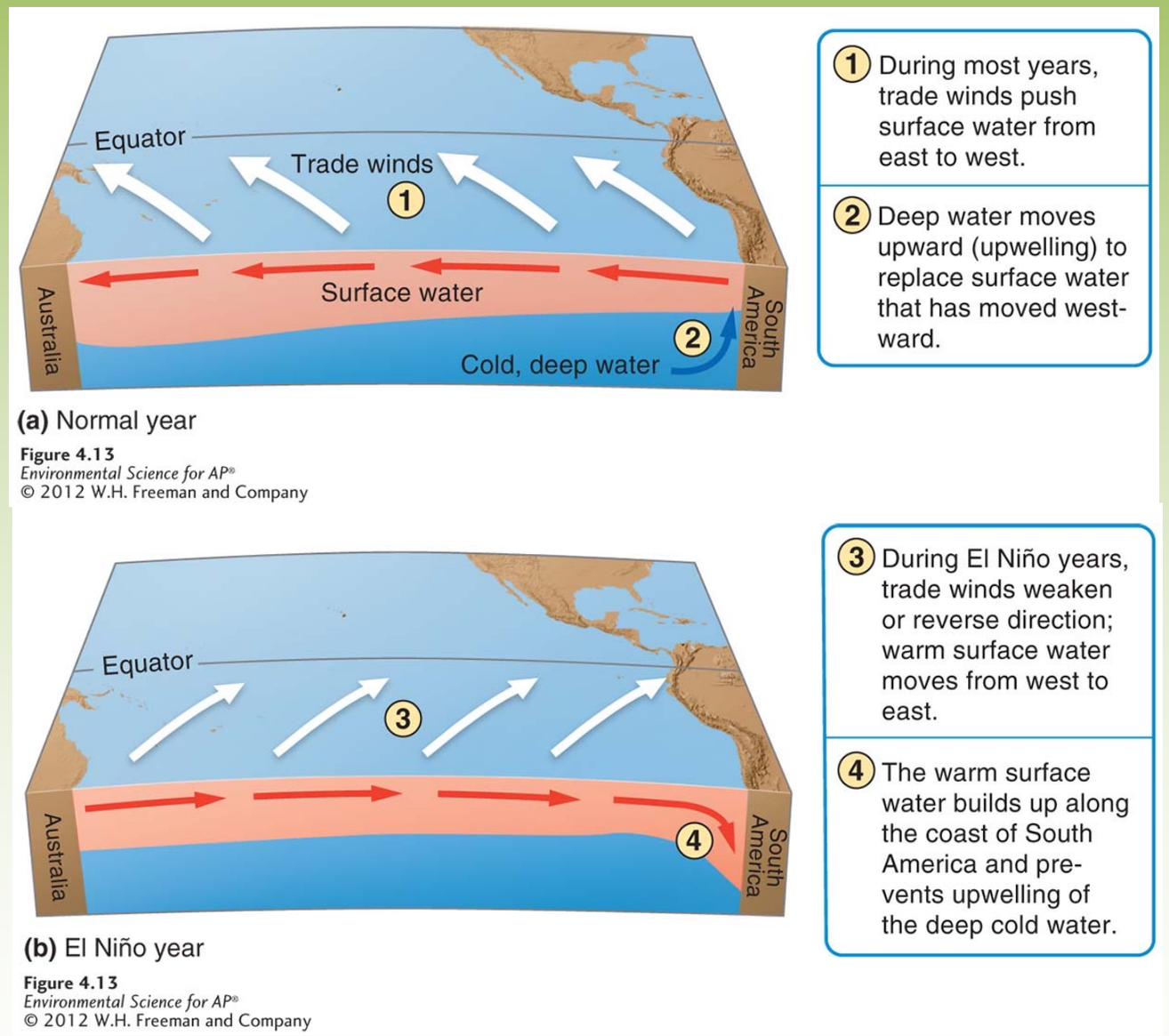
- Could potentially *shut down thermocline circulation* and stop the transport of warm water to western Europe, making it a much colder place



El Nino-Southern Oscillation

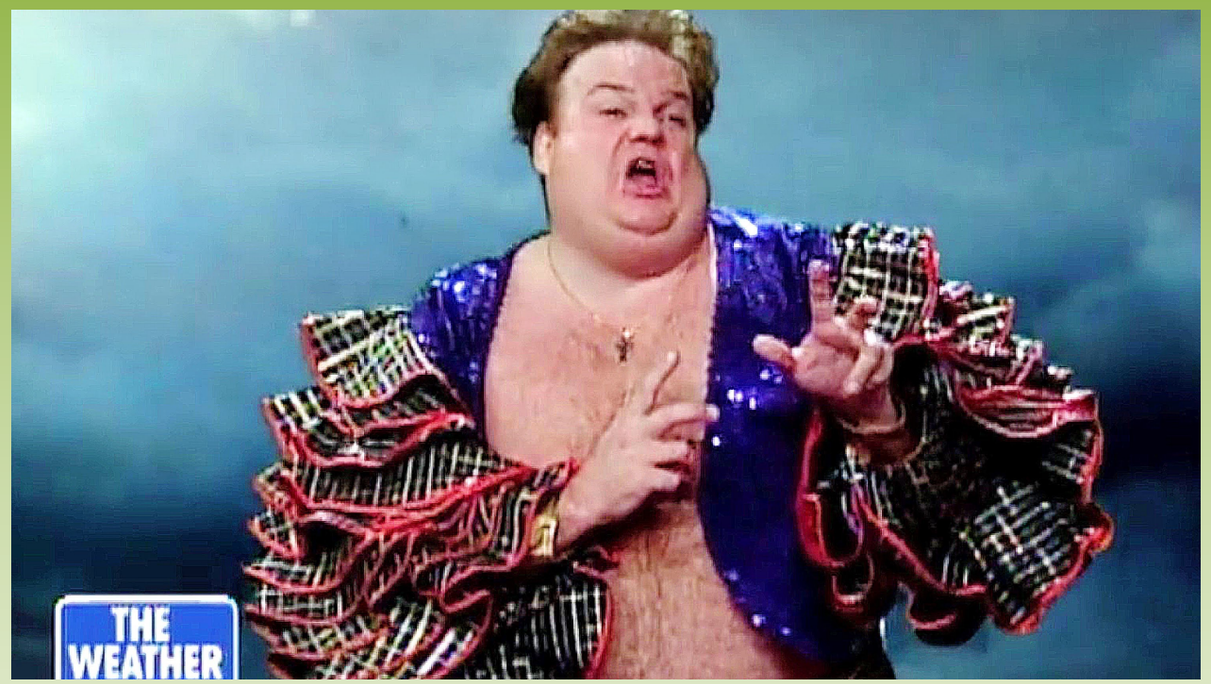
- Every *3 to 7 years*, the interaction of the Earth's atmosphere and ocean cause surface currents in the tropical Pacific Ocean to *reverse direction*.

- Trade winds near South America weaken, which allows *warm equatorial water* from the western Pacific to move eastward toward the west coast of South America



El Nino-Southern Oscillation

- Movement of warm water *suppresses upwelling* off the coast of Peru and *decreases productivity there which declines fish populations*



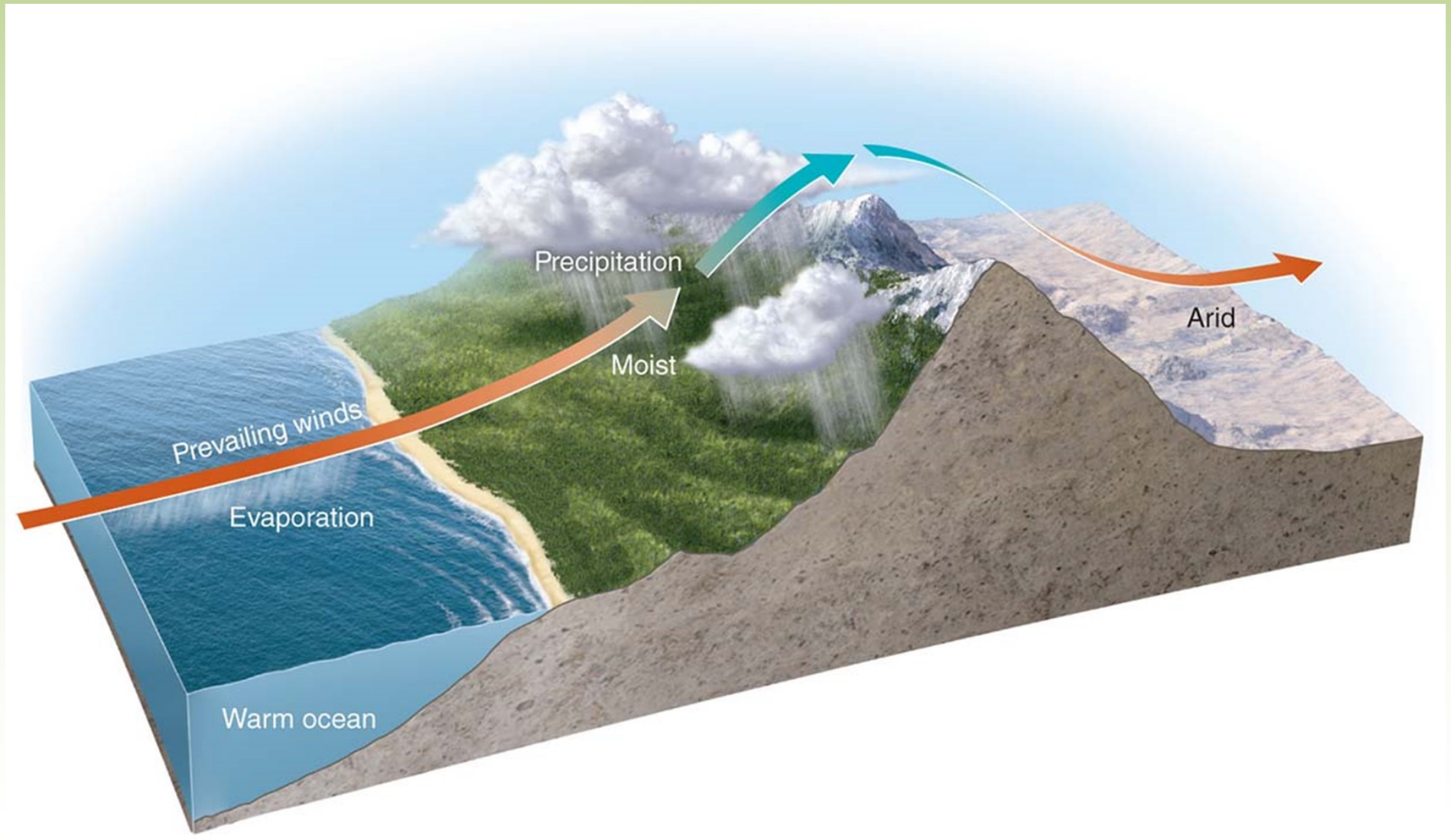
- Phenomenon is called ***El Niño*** and can last *weeks to years*

- *Periodic changes in winds and ocean currents* are collectively called the **El Niño-Southern Oscillation (ENSO)**

Global impact of ENSO includes *cooler and wetter conditions in the southeastern US* and *unusually dry weather in southern Africa and Southeast Asia*

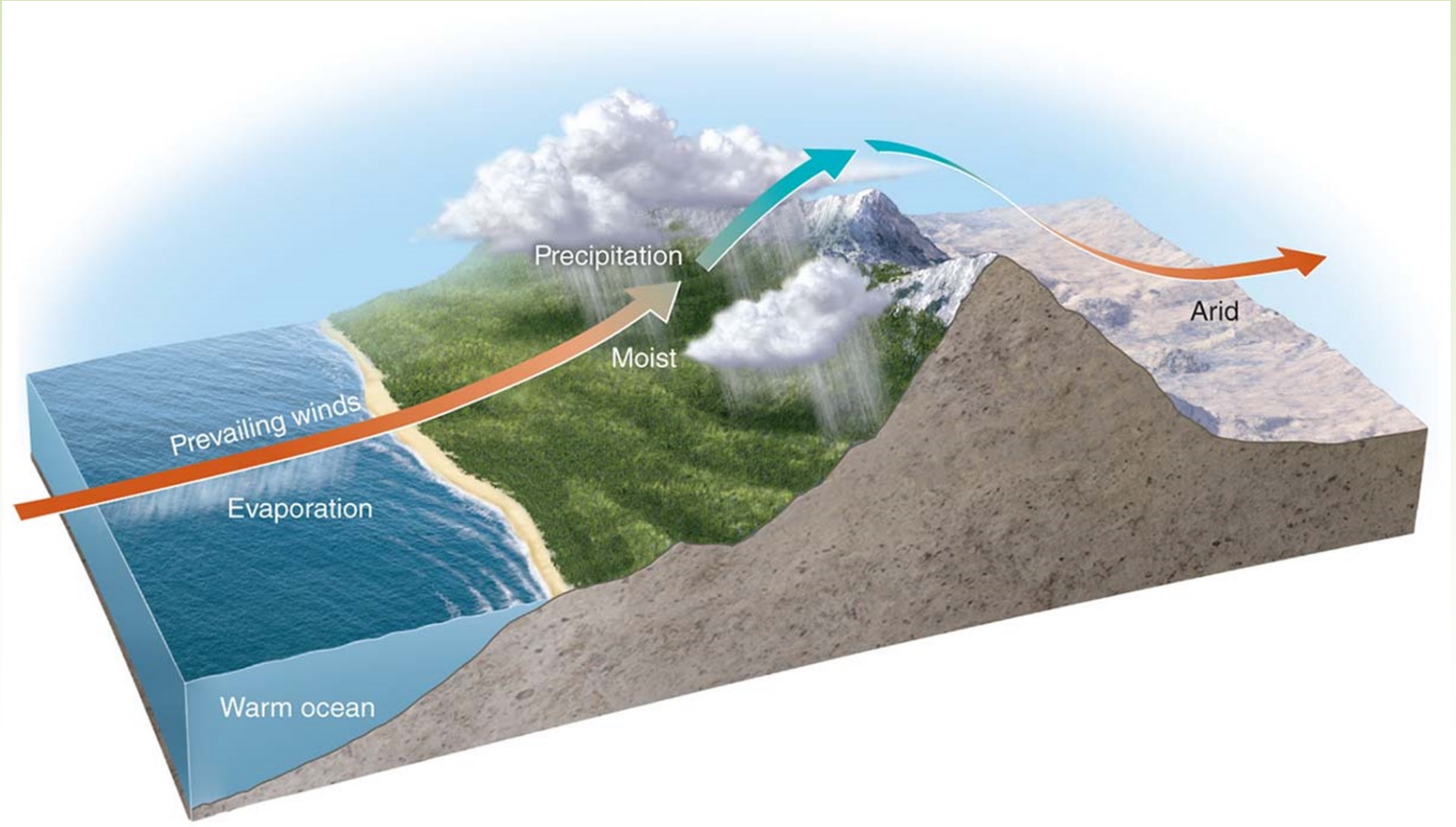
Rain Shadows

- When air moving inland from the ocean that contains a *large amount of water vapor* meets the *windward side* of a mountain range (the side facing the wind), it *rises* and begins to experience *adiabatic cooling*.
- Because water vapor condenses as air cools, clouds form and precipitation falls.



Rain Shadows

- The presence of the mountain range causes *large amounts of precipitation* to fall on its *windward side*.
- The cold, dry air then travels to the other side of the mountain range (the *leeward side*), where it *descends* and experiences *higher pressures*, which cause *adiabatic heating*.
- This air is now *warm and dry* and process *arid conditions* on the *leeward si*de forming the region called a **rain shadow**.



Variations in Climate Determine the Dominant Plant Growth Forms of Terrestrial Biomes

- **<u>Biomes-</u>** The presence of *similar plant growth* forms in areas possessing *similar temperature and precipitation* patterns.

- Categorized by particular combinations of average *annual temperatures* and *annual precipitation*

- Notice that within each temperature range we can observe a *wide range* of precipitation

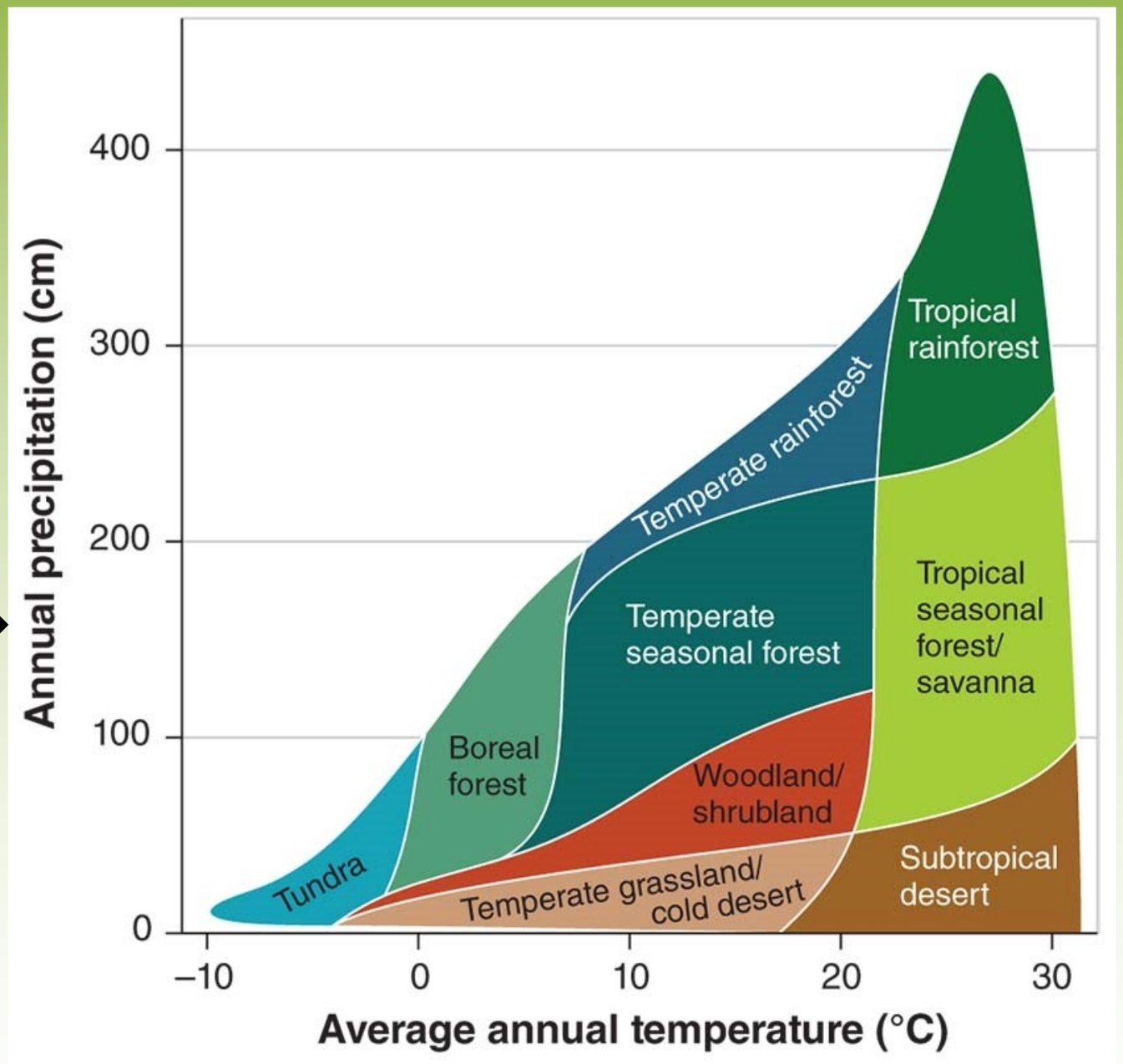


Figure 4.16
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