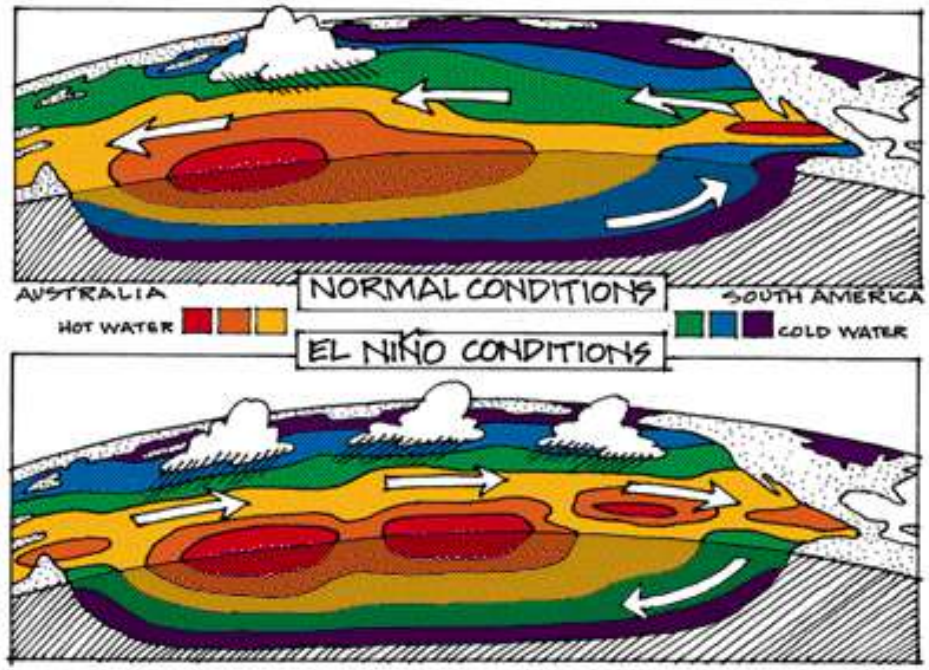
# Interactions Between the Atmosphere & Hydrosphere

## Weather & Climate




~occur every 3-7 years
~can last weeks or years!
~cooler/wetter conditions in SE US
~dry weather in southern Africa, Southeast Asia, Indonesia, Australia
~warm weather in Alaska, Canada & northern US

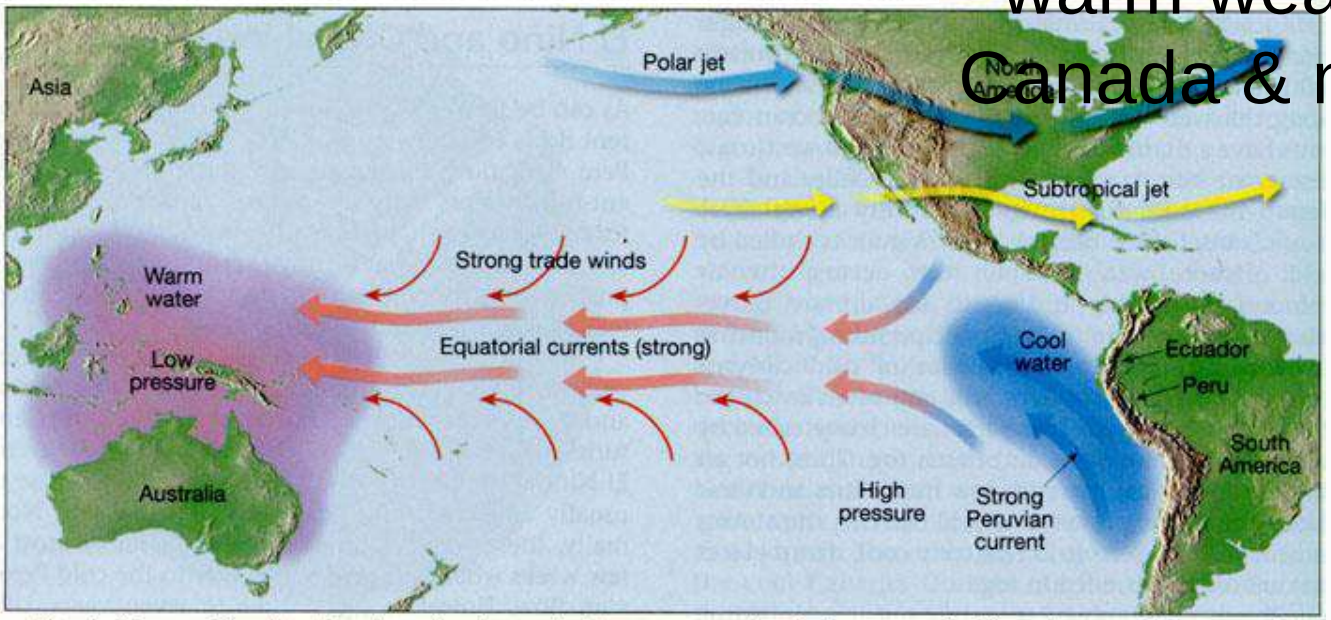



Fig.6 Normally, the trade winds and strong equatorial currents flow toward the west. At the same time, an intense Peruvian current causes upwelling of cold water along the west coast of South America.

# The Earth's Life-Support System Has Four Major Components (The 4 "Spheres")

- Atmosphere: The Air
- Hydrosphere: The Water
- Geosphere (Lithosphere): The Land/Rock
- Biosphere: The Life

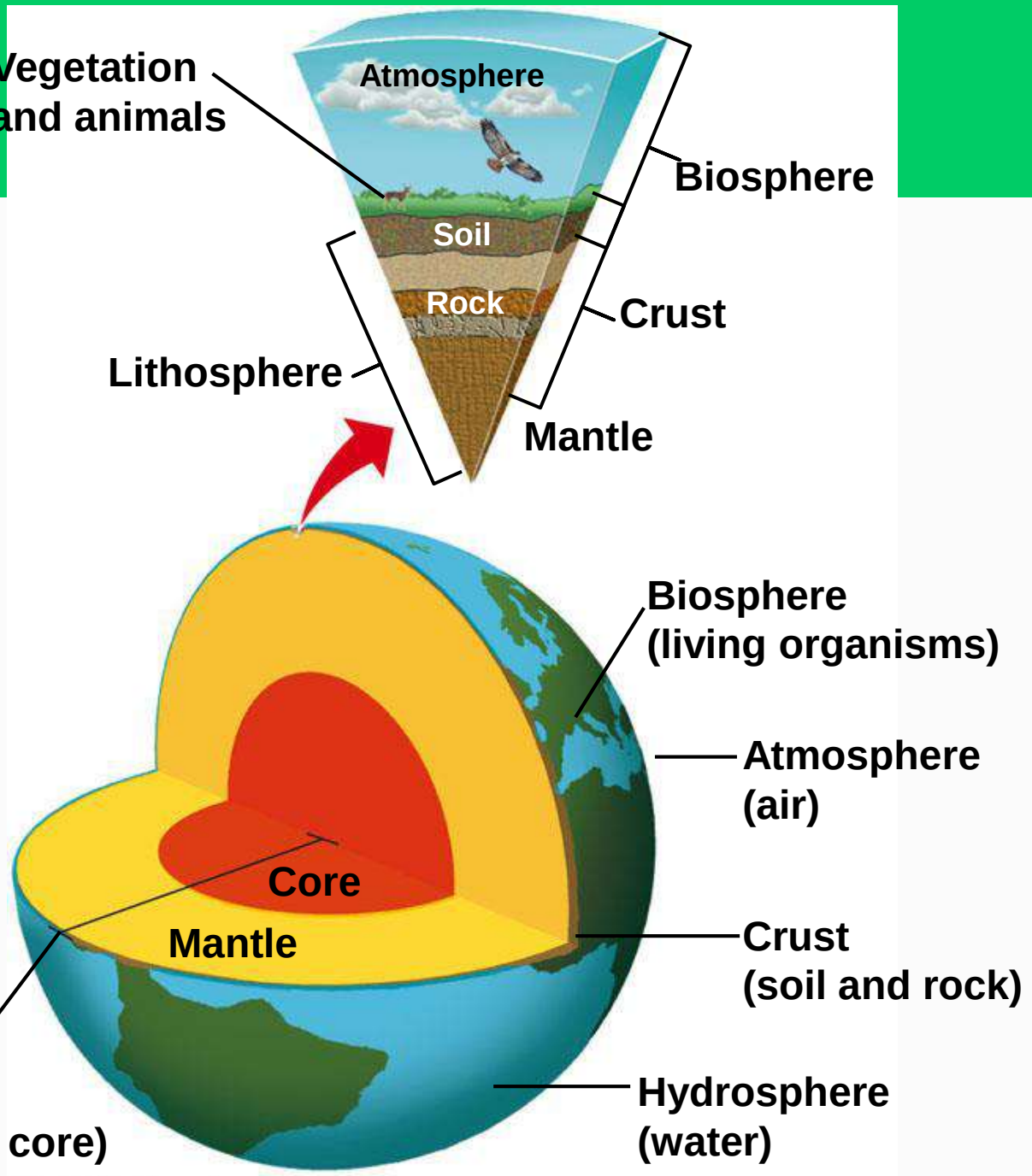




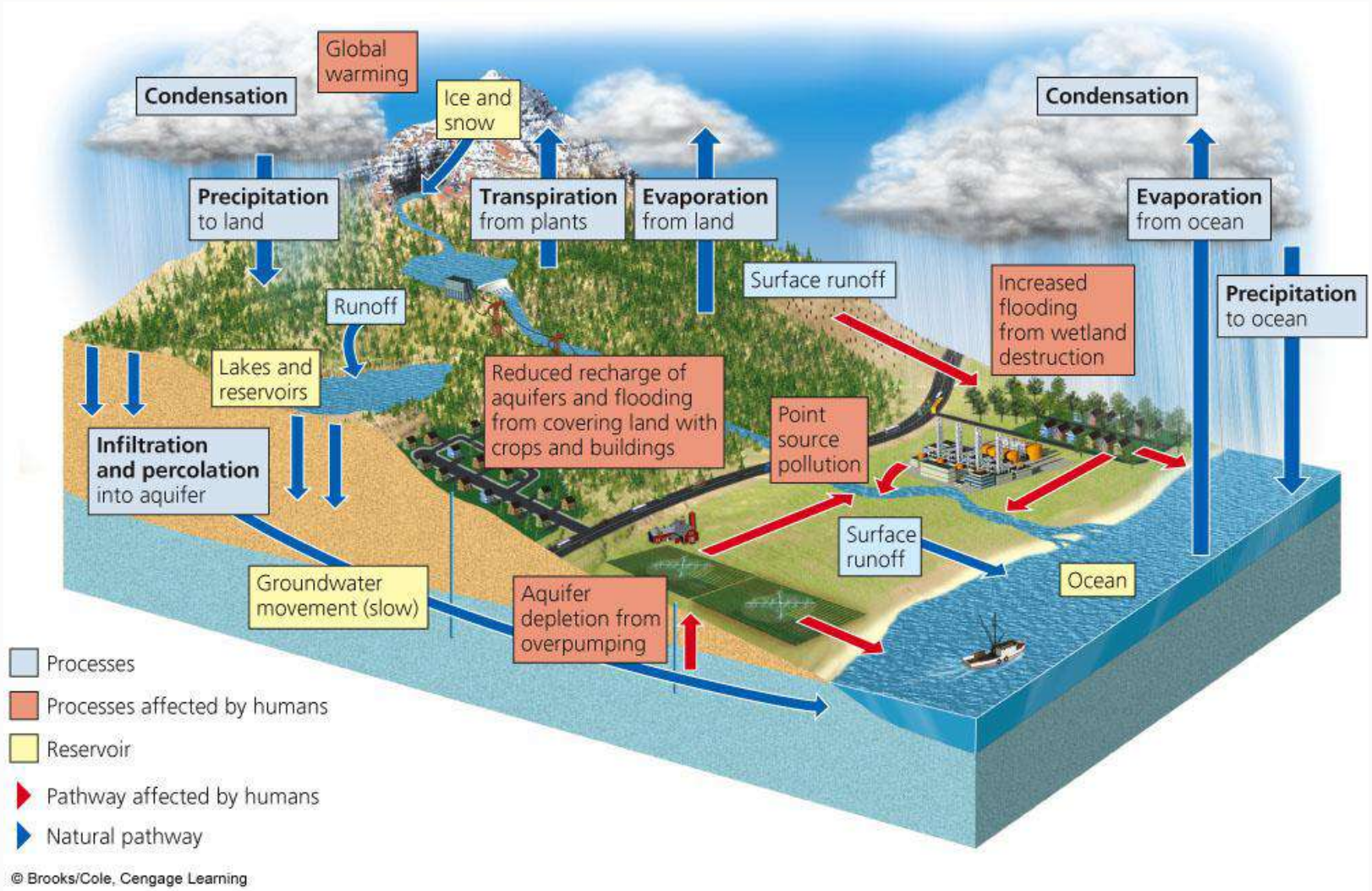

Fig. 3-6, p. 55

# Water Cycles Review

- Natural renewal of water quality: three major processes
  - Evaporation – fueled by the sun
  - Precipitation – fueled by gravity
  - Transpiration – fueled by the sun

- Alteration of the hydrologic cycle by humans
  - Withdrawal of large amounts of freshwater at rates faster than nature can replace it
  - Clearing vegetation
  - Increased flooding when wetlands are drained

# Hydrologic Cycle Including Harmful Impacts of Human Activities



# Science Focus: Water's Unique Properties

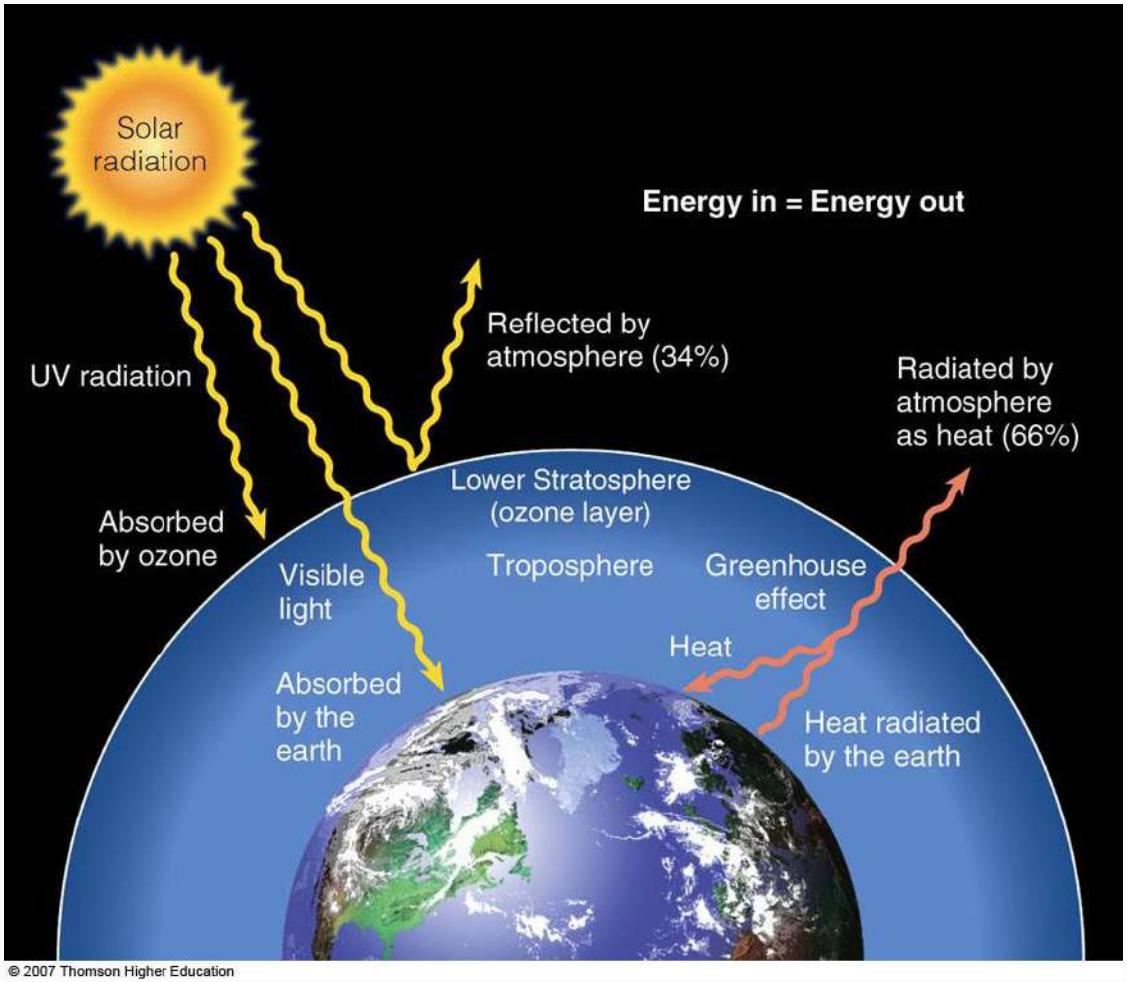
- Properties of water due to **hydrogen bonds** between water molecules:
  - Exists as a liquid over a large range of temperature
  - Changes temperature slowly
  - High boiling point: 100˚C
  - Adhesion and cohesion
  - Expands as it freezes
  - Solvent
  - Filters out harmful UV

# Layers of the Atmosphere

- Atmosphere
  - Membrane of air around the
  - planet
- Troposphere
  - Weather occurs here

- Stratosphere
  - Lower portion contains ozone to filter out most of the sun’s harmful UV radiation
- Mesosphere
  - Where meteors burn up
- Thermosphere (Ionosphere)
  - Where the aurora borealis occurs

# What Happens to Solar Energy Reaching the Earth?





- Solar energy flowing through the biosphere warms the atmosphere, evaporates and recycles water, generates winds and supports plant growth.

Figure 3-8

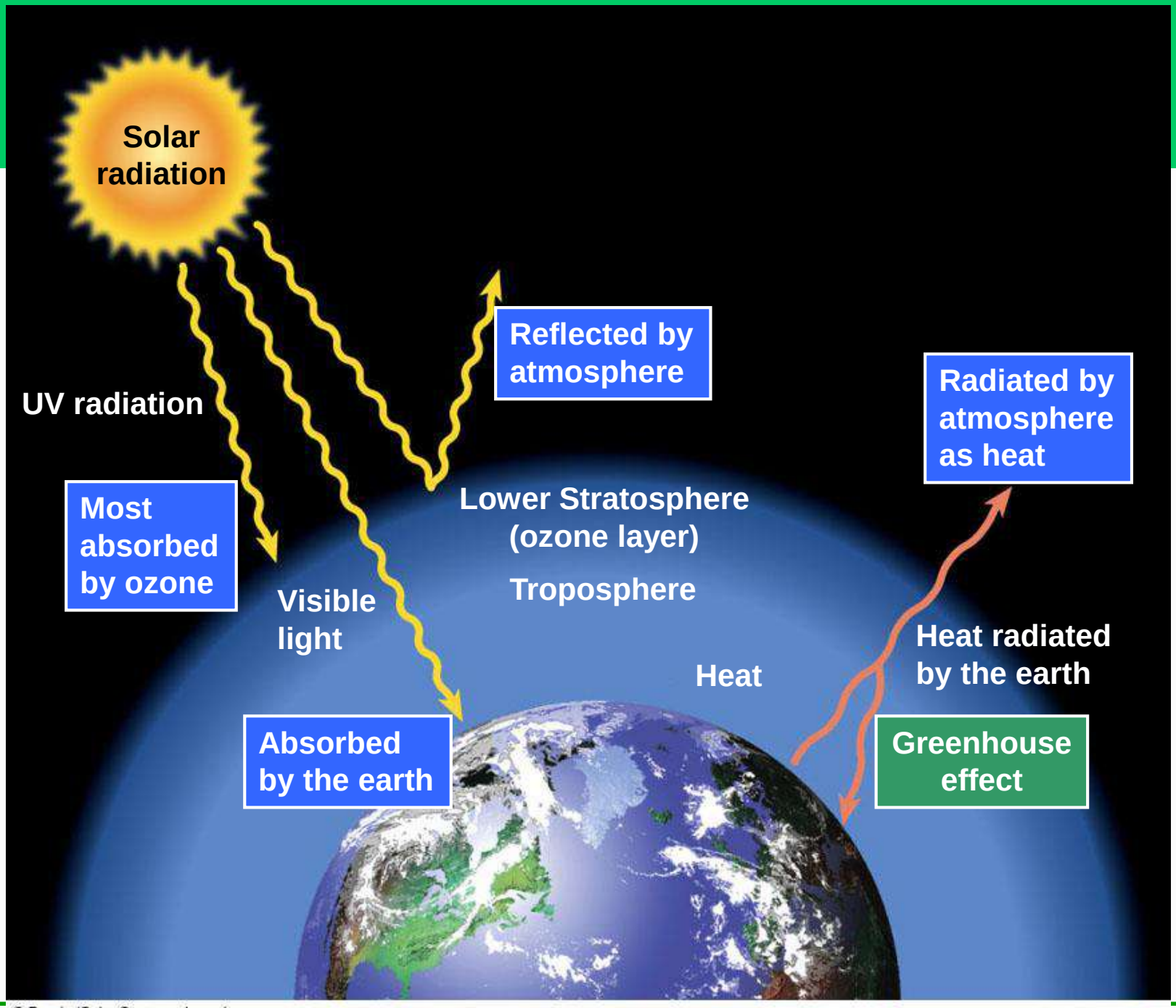





Fig. 3-8, p. 56

# Greenhouse Gases Warm the Lower Atmosphere

GLOBAL WARMING (& Greenhouse Effect) has NOTHING to do with the OZONE LAYER!!

- **Greenhouse gases**
  - $H_2O$
  - $CO_2$
  - $CH_4$
  - $N_2O$
    - Nitrogen and Oxygen (99% of atmosphere **<u>are NOT</u>** greenhouse gases)
- **Greenhouse effect = GOOD!!**

- Human-enhanced **global warming "global climate change" (BAD)**

# STOP

# Questions for you!!
# Write down your responses!

1. What is weather?
2. Name some characteristics of weather.
3. What is climate?
4. What causes the seasons?
5. What causes wind?
6. What causes ocean currents?
7. How can mountains, lakes, or oceans affect the local climate of an area?

# Get with a partner and check yourself!

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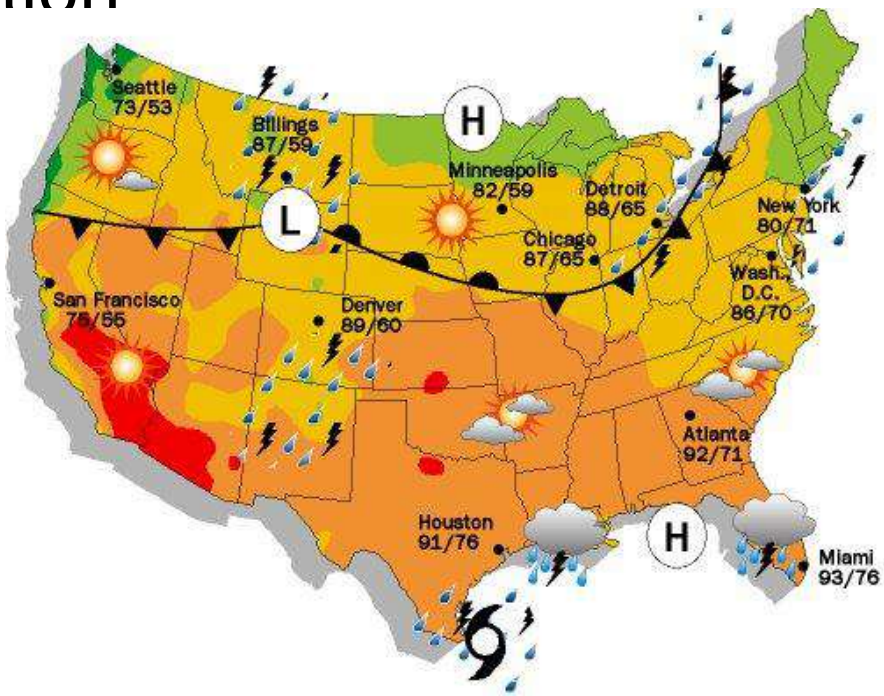
# 1. What is weather?

- Weather is a local area's short term conditions (we're talking hours or days at a time).

# 2. Name some characteristics of weather.

- Temperature
- Precipitation
- Humidity
- Wind speed & direction
- Cloud cover
- Pressure
- Other physical conditions of the lower atmosphere (TROPOSPHERE)



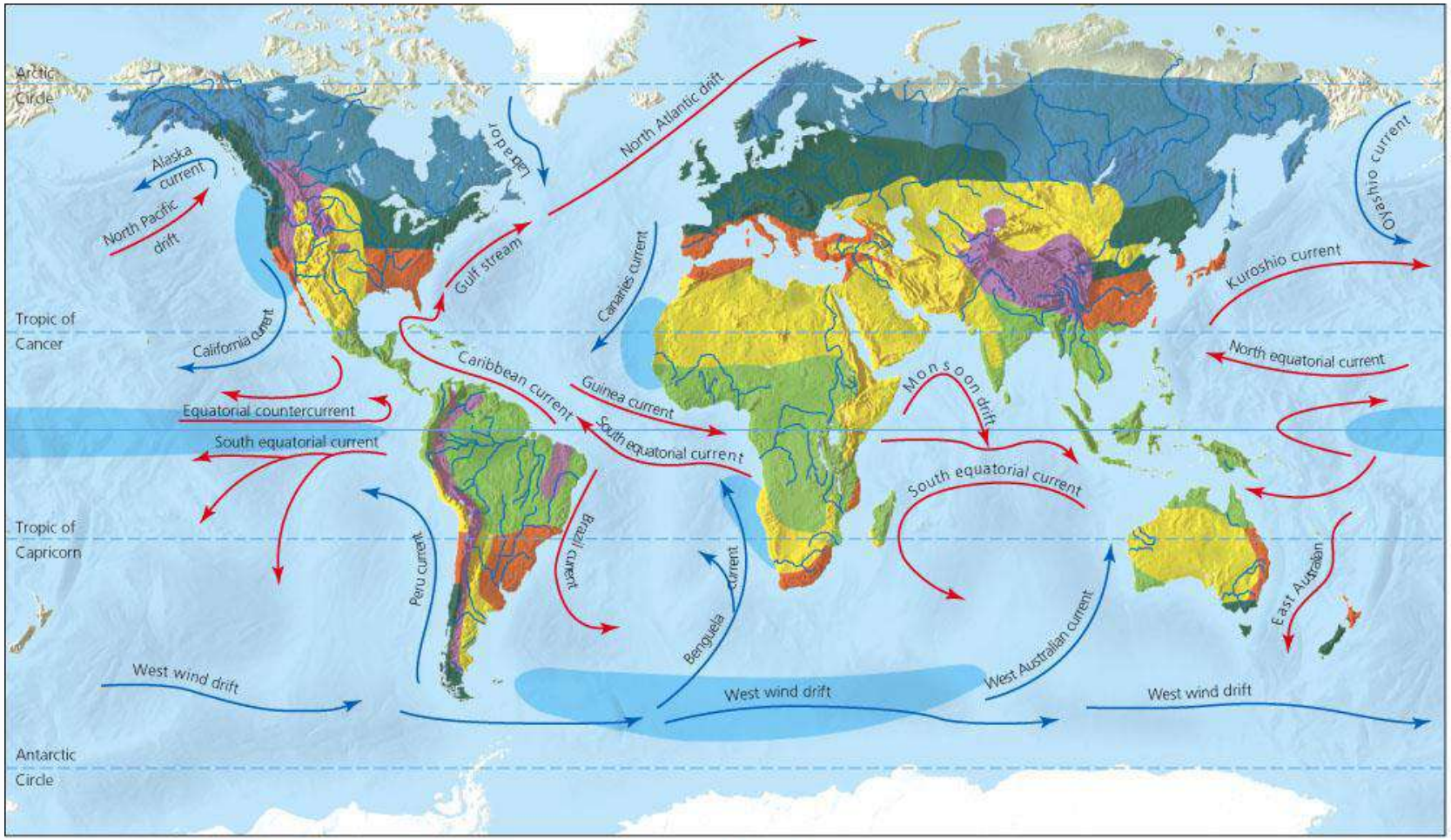
# 3. What is climate?

- Climate is an areas general pattern of atmospheric weather conditions measured over long periods of time (decades to thousands of years)
  - Two most important factors are:
    - Temperature & Precipitation

"Climate is what we expect, weather is what we get"

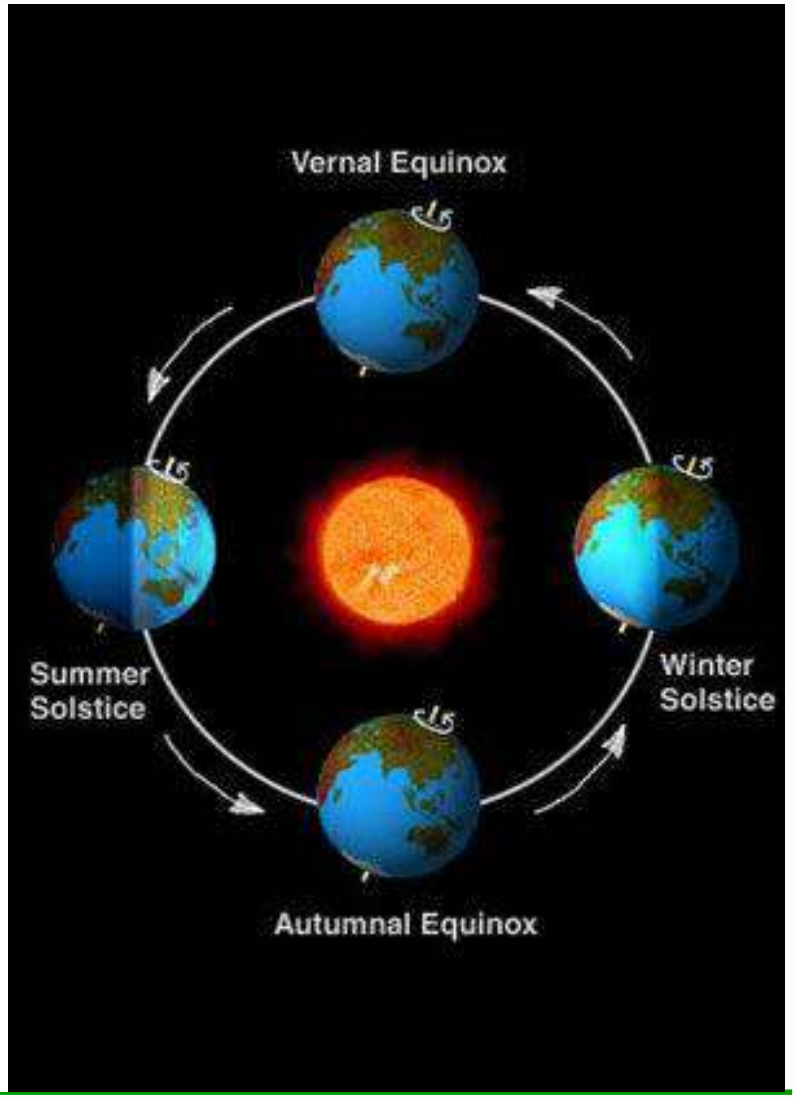
– *Mark Twain*

# Natural Capital: Generalized Map of the Earth's Current Climate Zones



# What causes the seasons?

- Seasons are caused by the variation in the intensity of solar radiation due to the **tilt** of the earth.
  - In summer we (Northern Hemisphere) are tilted toward the sun
  - In winter we are tilted away



# Animation: Seasonal variation

http://www.myboe.org/portal/default/Resources/Viewer/ResourceViewer?action=2&resid=114306

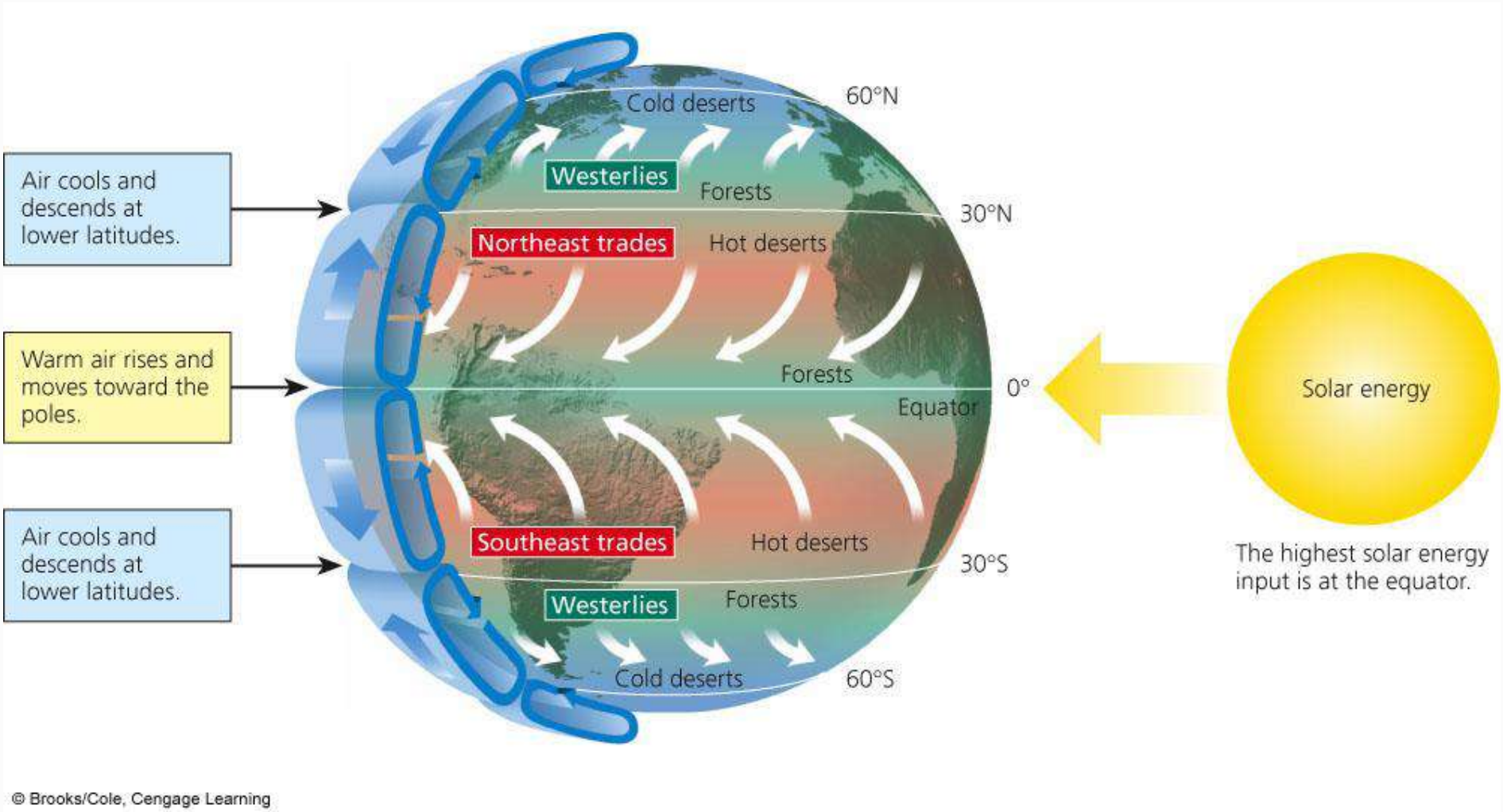
https://www.youtube.com/watch?v=WLRA87TKXLM

# 5. What causes wind?

- A combination of two major factors
  1. Uneven heating of the earth's surface by the sun
  2. Rotation of the earth on its axis
     - The equator spins FASTER than the poles so heated air masses are deflected to the west or east this causes the major prevailing winds, which cause most surface winds.
     - Observe Coriolis effect

       http://www.classzone.com/books/earth_science/terc/content/visualizations/es1904/es1904page01.cfm

# Global Air Circulation



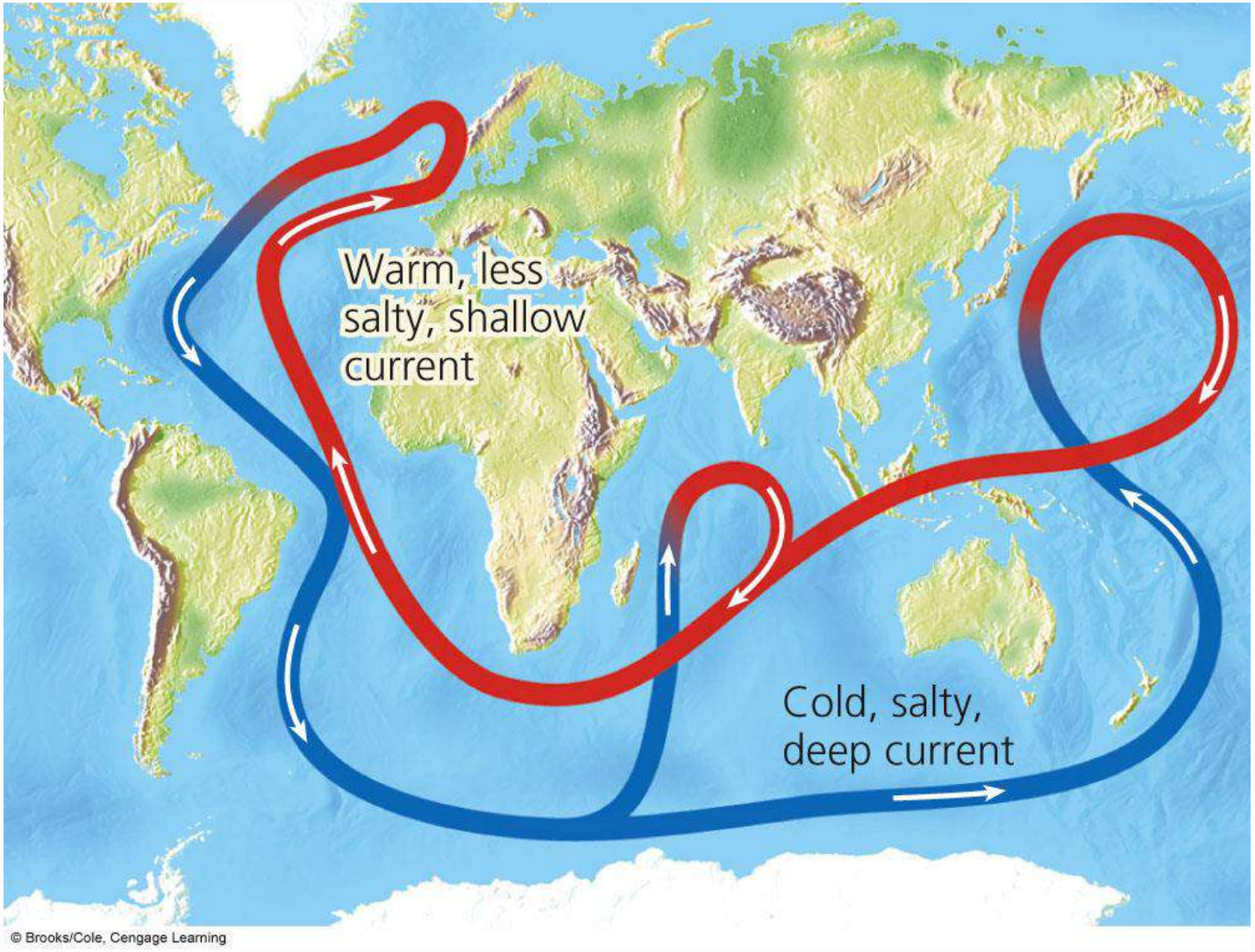
# 6. What causes ocean currents?

- The currents are driven by:
  - Prevailing winds
  - The earth's rotation
  - Redistribution of heat from the sun

The EAC from "Nemo"

https://www.youtube.com/watch?v=I-N_7cgwHmQ

# Connected Deep and Shallow Ocean Currents



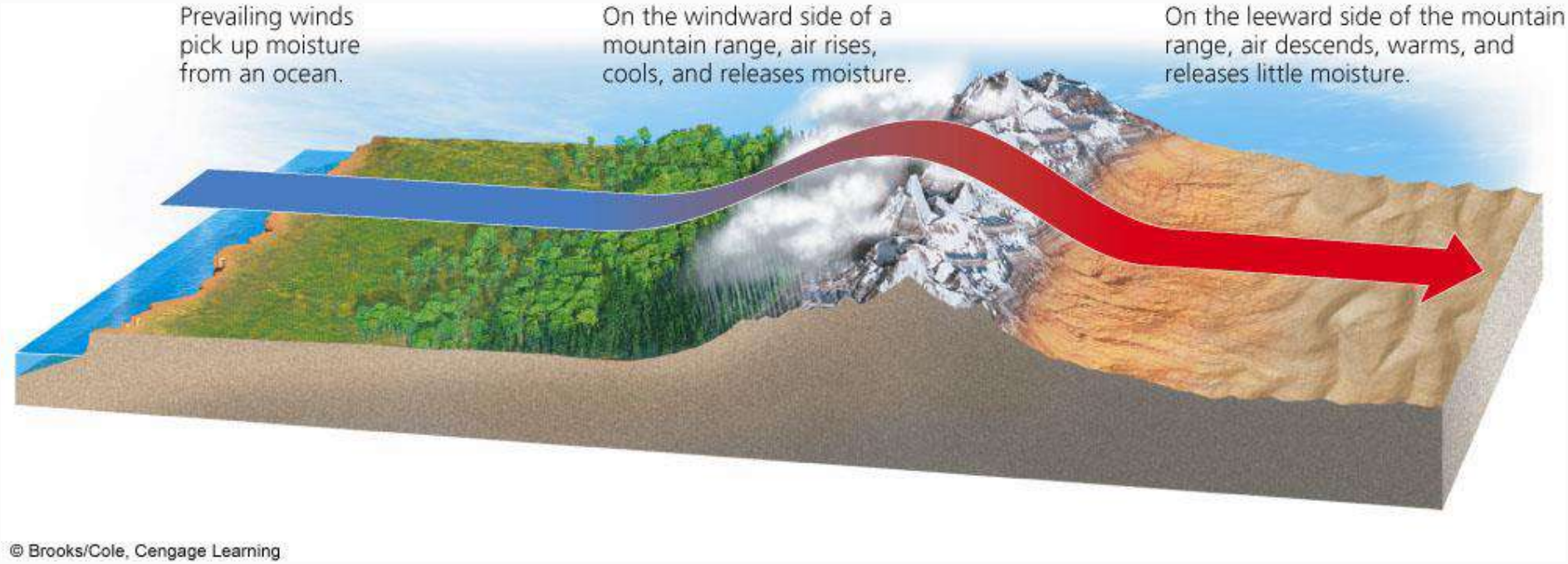
# Does the Coriolis effect really make toilets flush "backward in Australia"

- If they did, it would be because of the Coriolis effect – but toilets are far too small and flush too quickly to be influenced by this force.
- Really… it depends on the shape of the bowl (angles of water entry and exit)
  - MYTH – BUSTED!

# 7. How can mountains, lakes, or oceans affect the local climate of an area?

- Surface features affect local climate
  - Mountains
    - Windward: rainy (Seattle)
    - Leeward: dry (Death Valley)
      - Rain Shadow Effect
  - Lakes
    - Snow
      - Lake Effect Snow
      - https://www.youtube.com/watch?v=6YjuEI0RplA
  - Oceans
    - Sea Breezes & Moderate climates
  - Even cities can create a “microclimate”

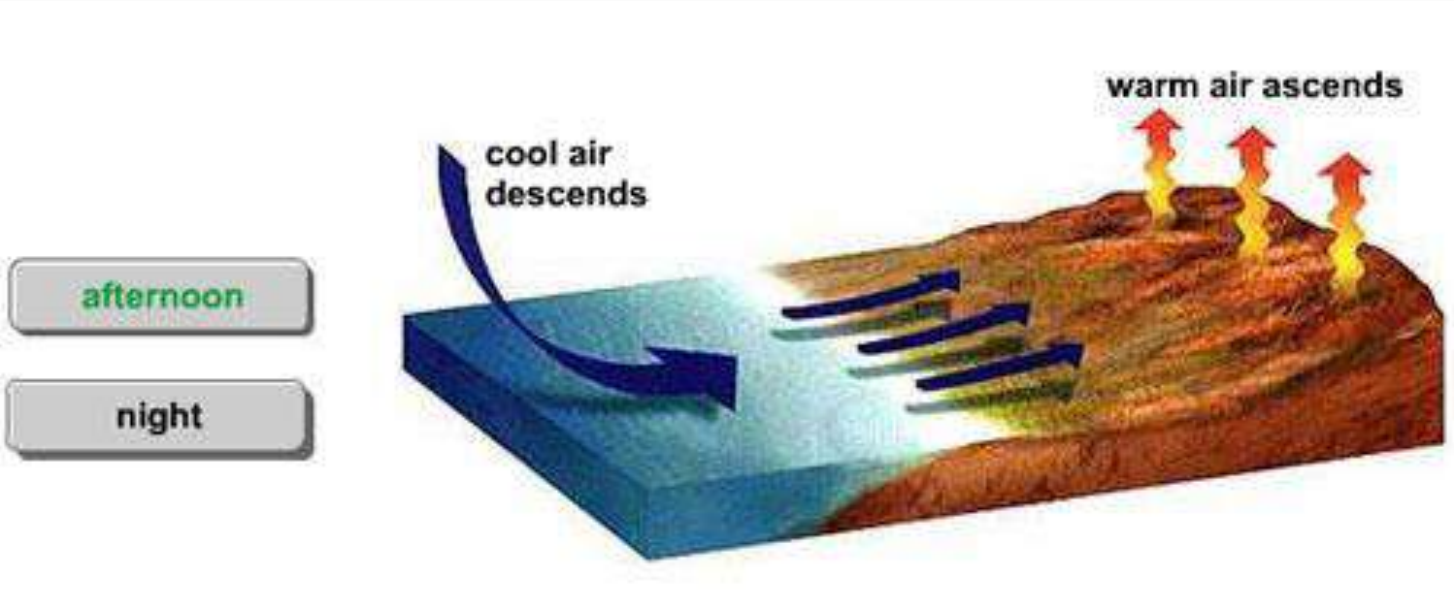
# Rain Shadow Effect





http://www.mrphome.net/mrp/rainshadow.swf

# Animation: Coastal breezes




https://www.youtube.com/watch?v=gM0d3fGew-0

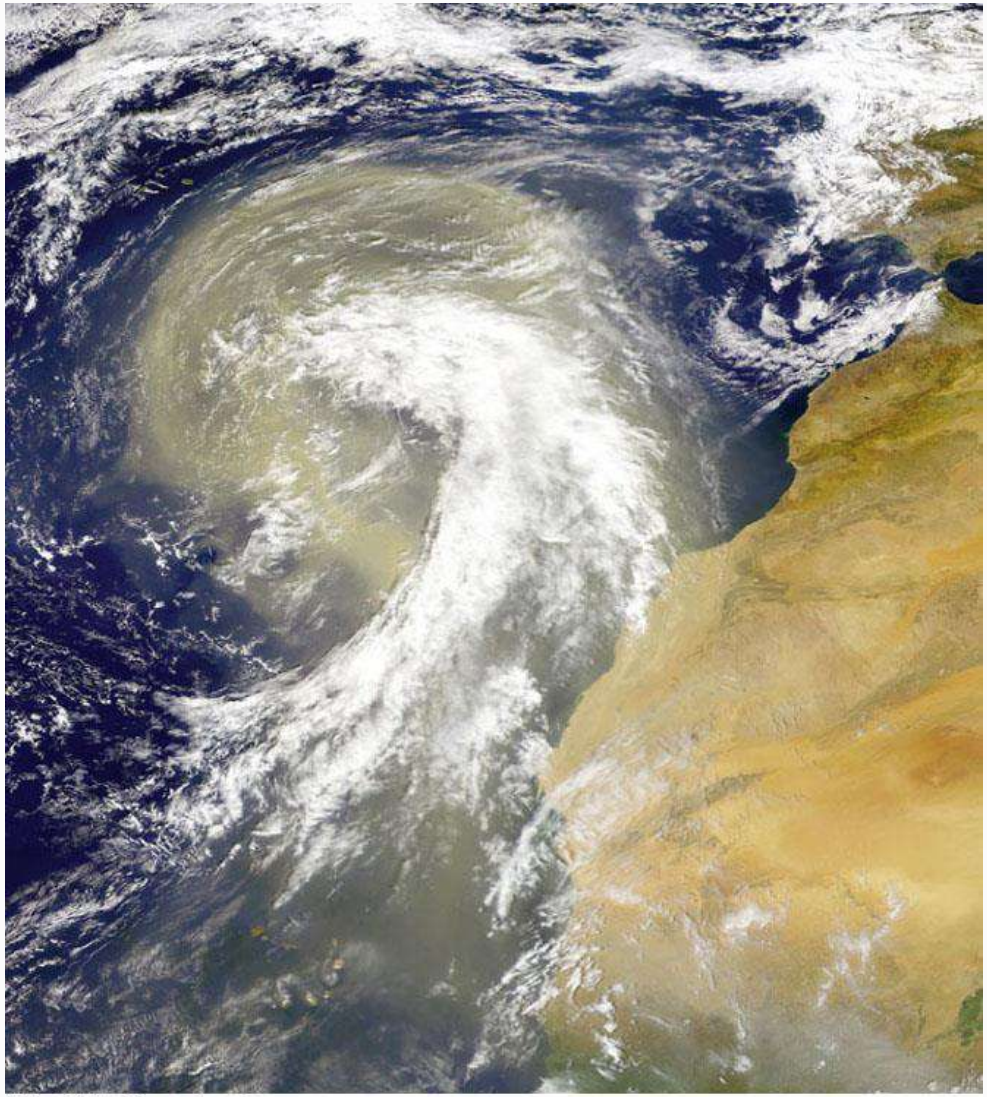
# Interaction Between Climate (Atmosphere & Hydrosphere) & The Biosphere

## Chapter 7: How does Climate Effect Terrestrial Biodiversity

# Core Case Study: Connections between Wind, Climate, and Biomes

- *Everything we do affects some other part of the biosphere!!*
- Wind
  - Indirect form of solar energy
- Circulates
  - Heat
  - Moisture
  - Plant nutrients
  - Soil particles
  - Long-lived air pollutants

# Dust Blown from West Africa to the Amazonian Rain Forests



# There is a link between air circulation, ocean currents, and biomes

## REVIEW

- **Air circulation** in the lower atmosphere due to
  - Uneven heating of the earth's surface by the sun
  - Rotation of the earth on its axis
  - Properties of air, water, and land
- **Currents**
  - Prevailing winds
  - Earth's rotation
  - Redistribution of heat from the sun

# Energy Transfer by Convection in the Atmosphere

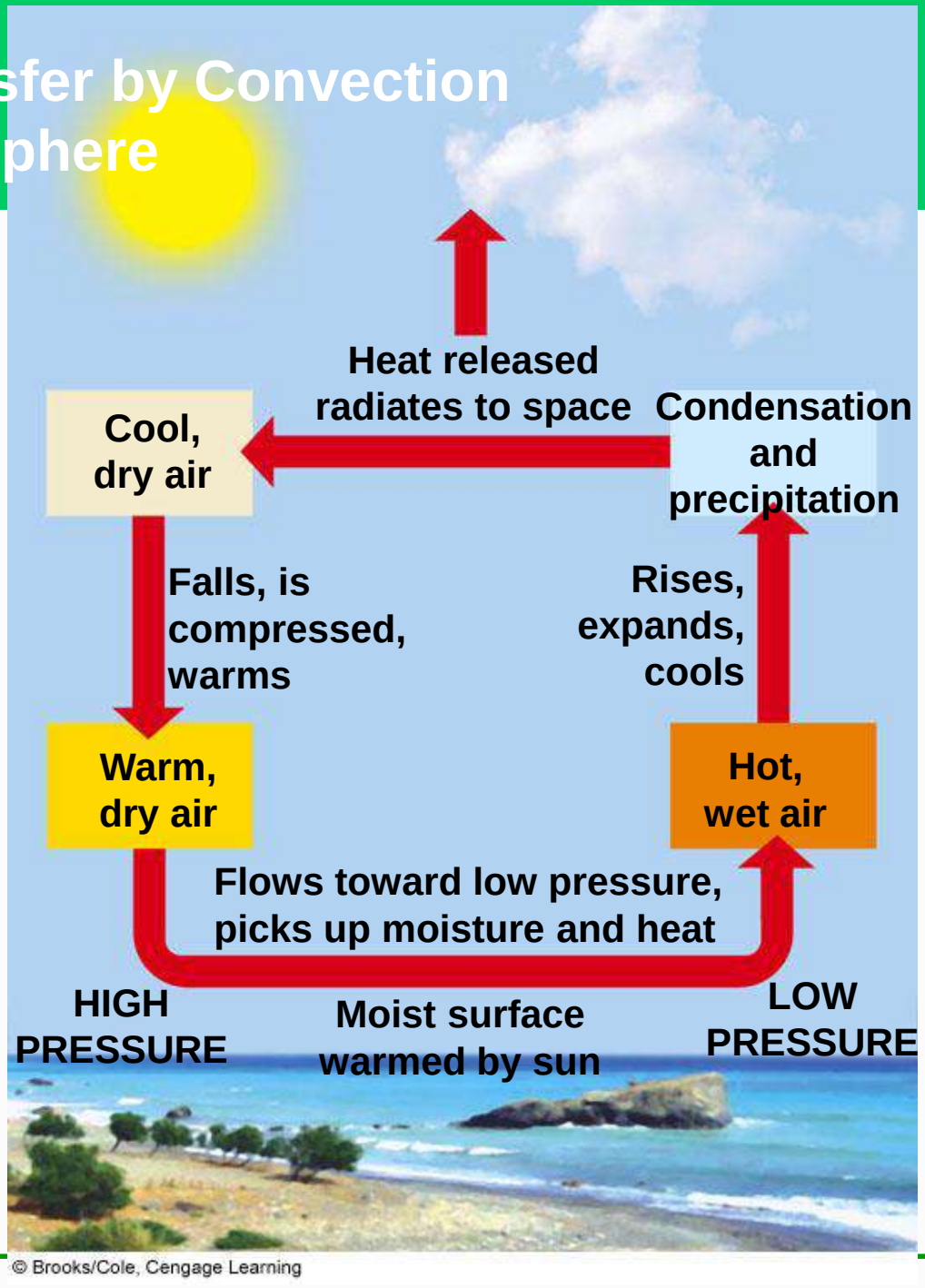
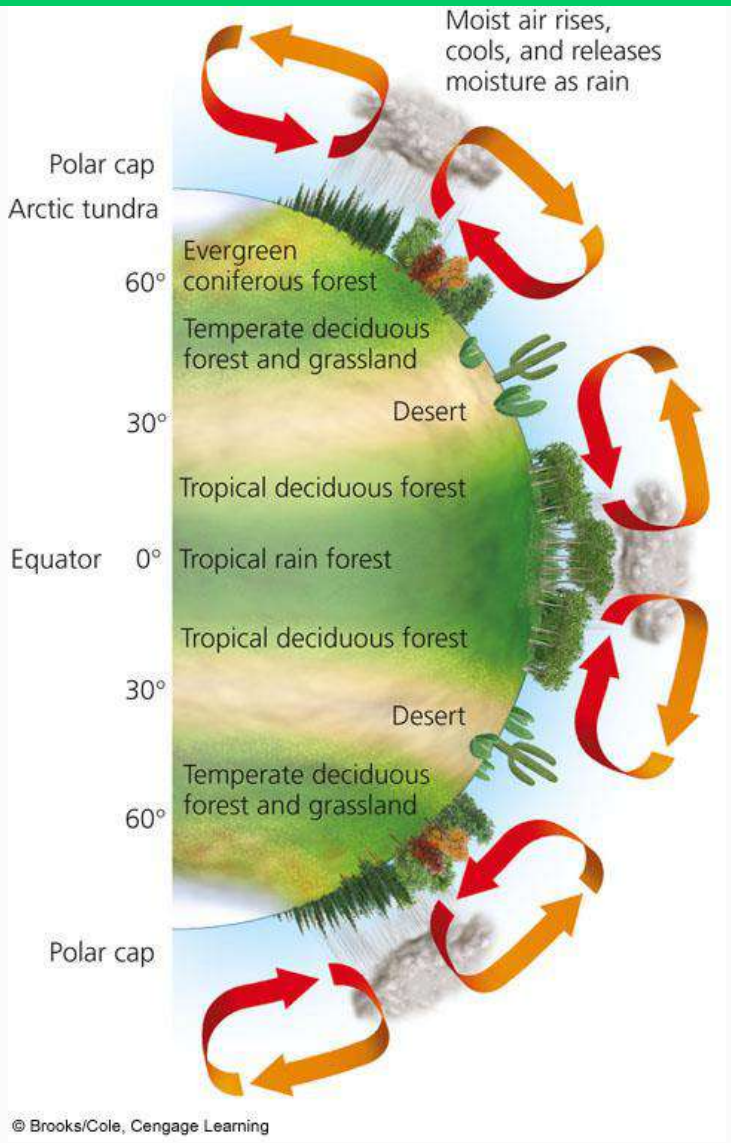
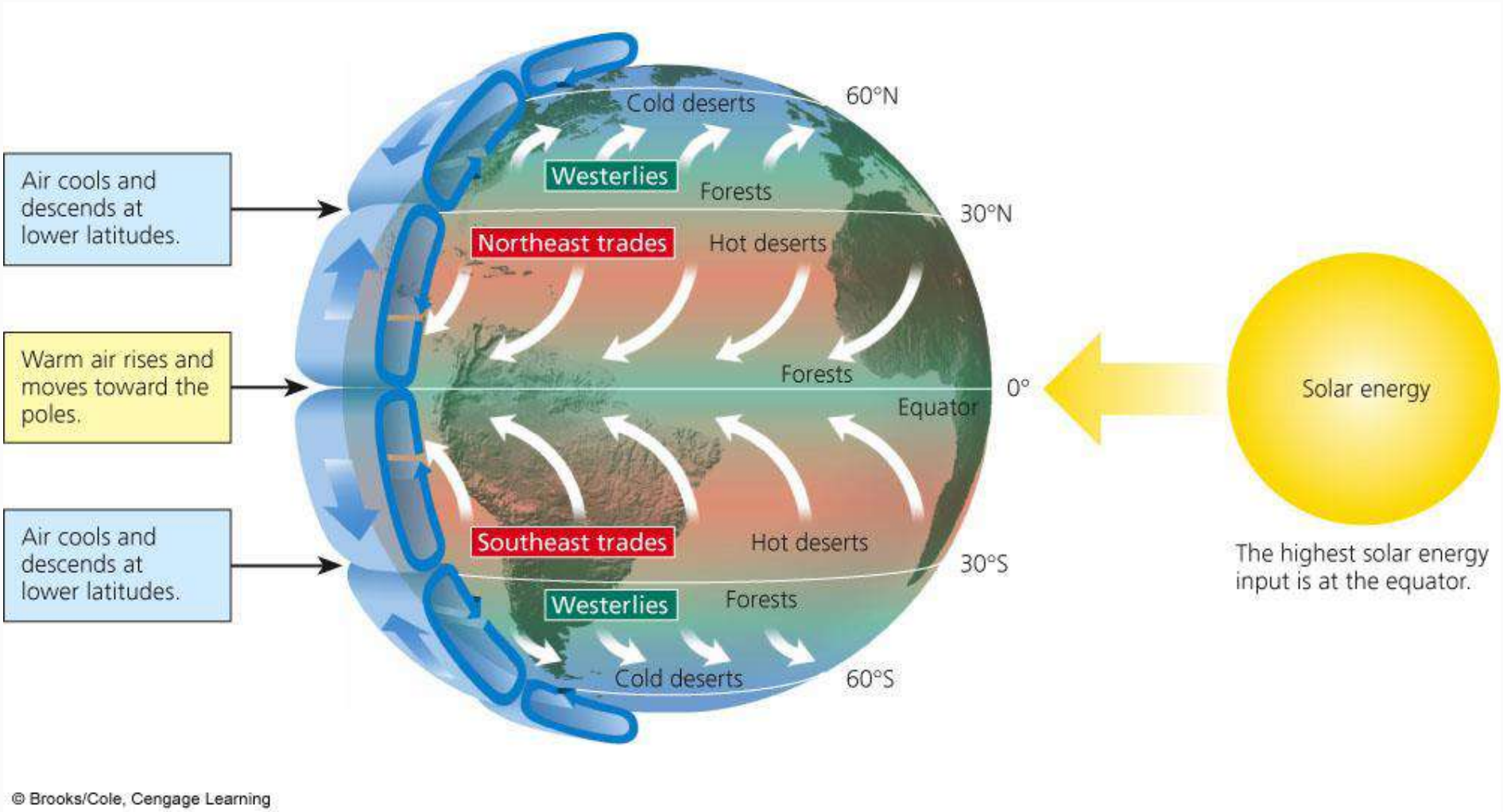



Fig. 7-4, p. 143

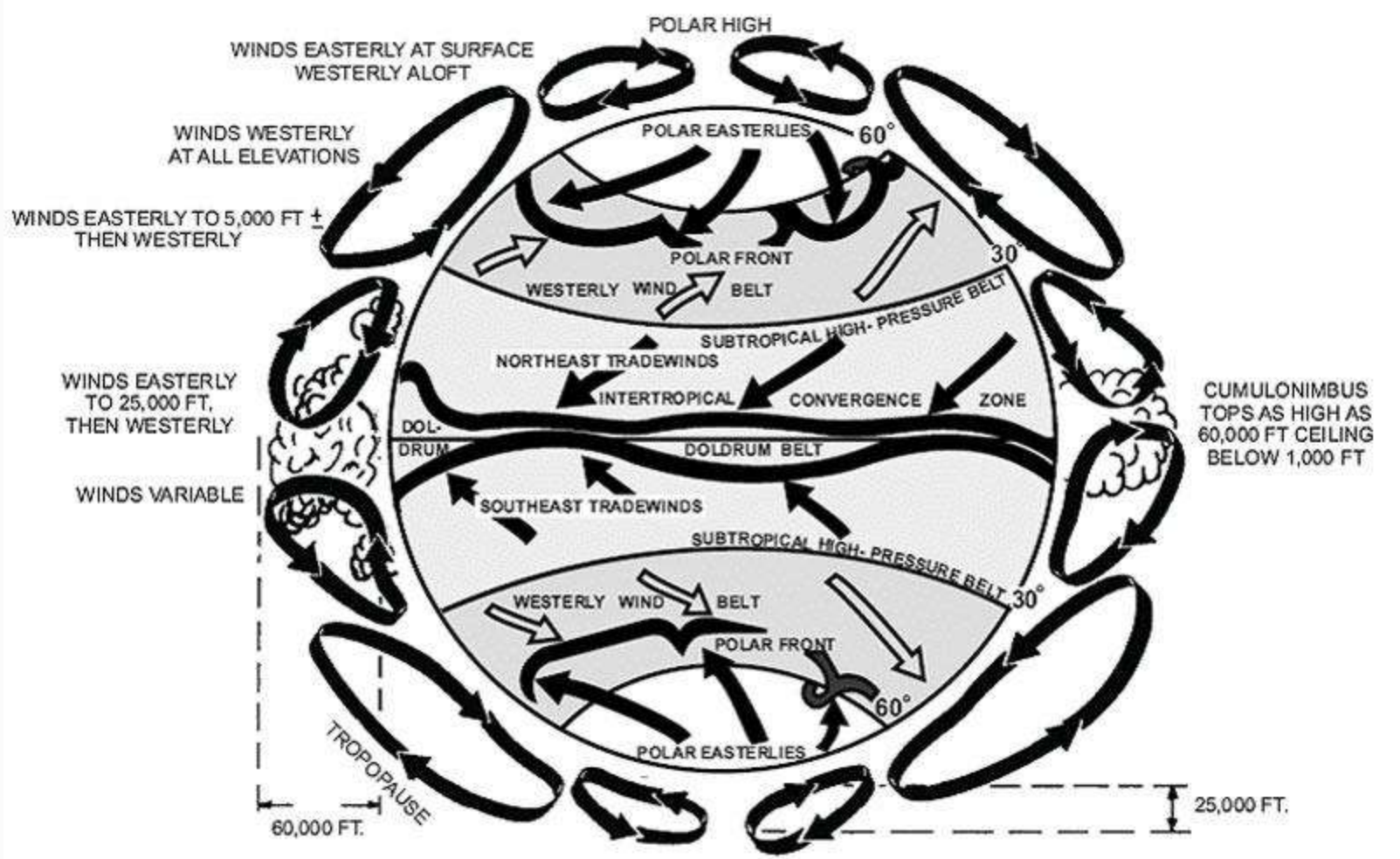
# Global Air Circulation, Ocean Currents, and Biomes



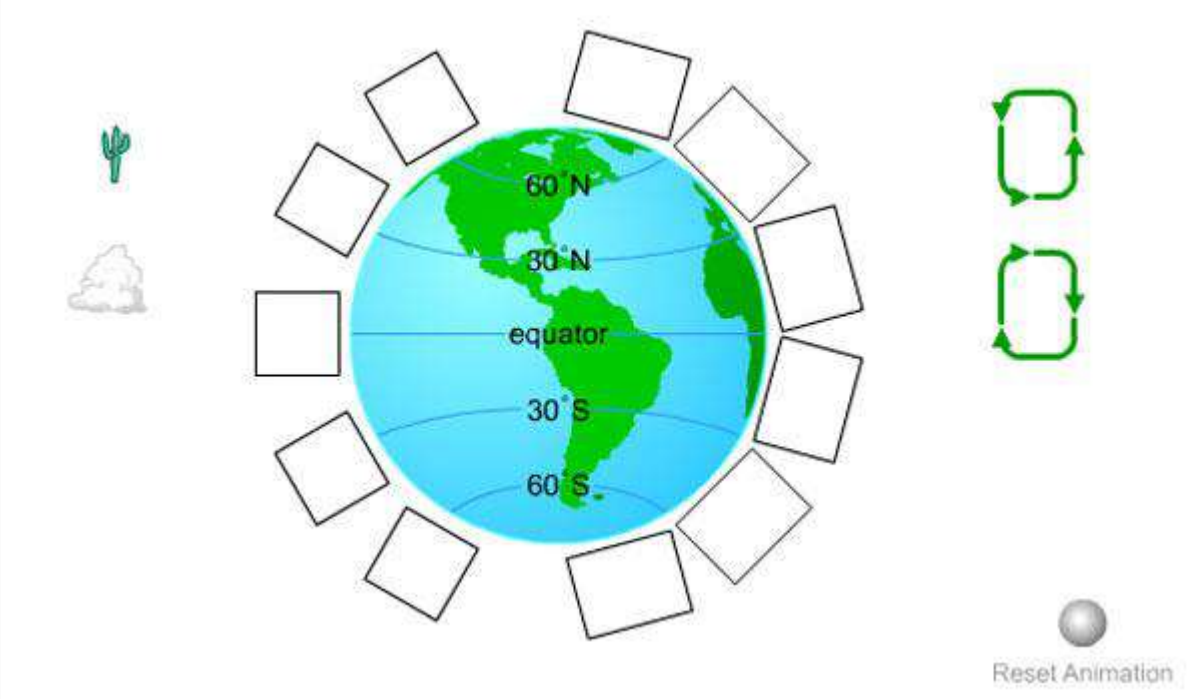
# Global Air Circulation



# Interaction of Convection Cells, Prevailing Winds and Ocean Currents

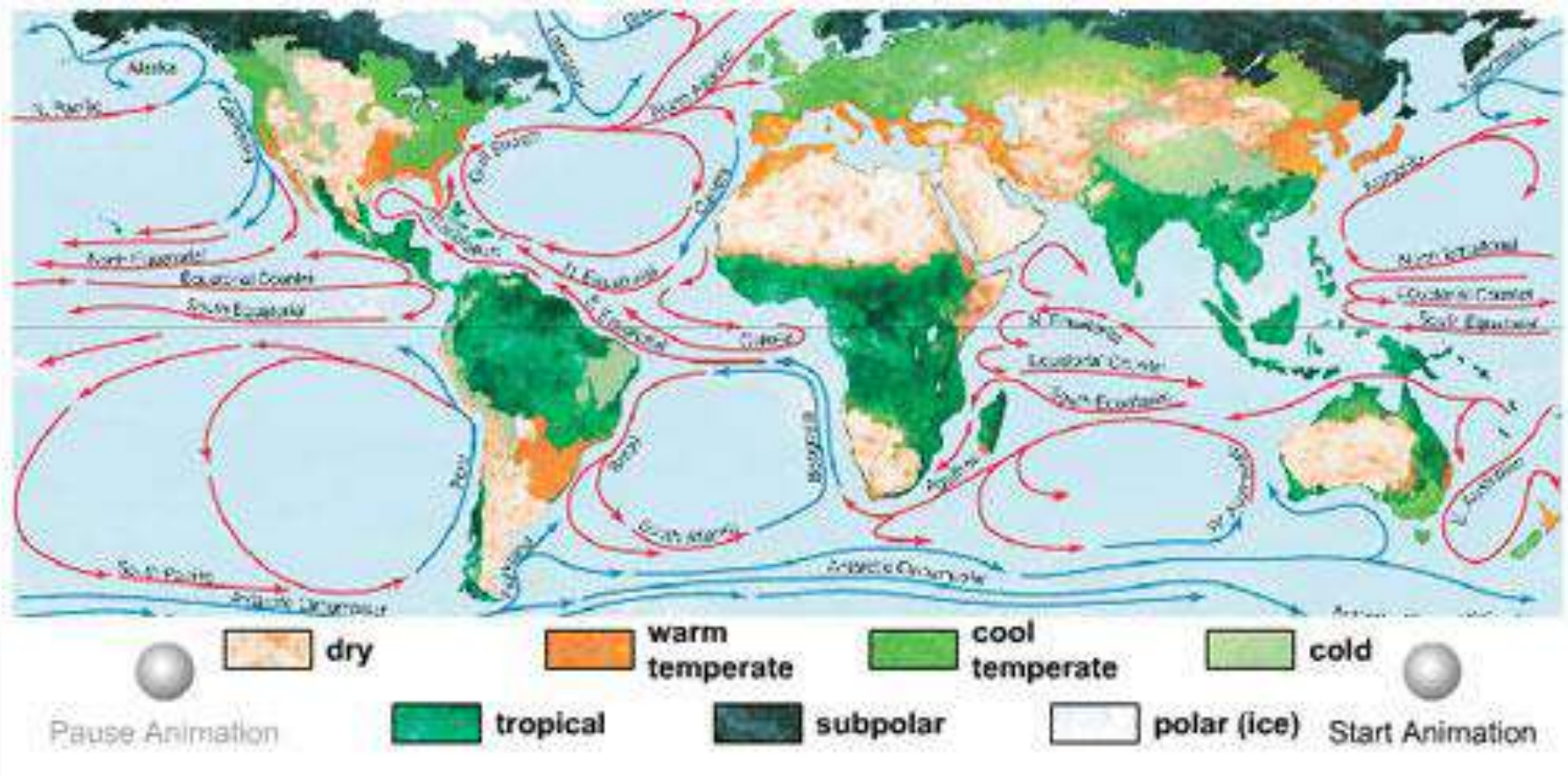


# Animation: Air circulation




https://smartsite.ucdavis.edu/access/content/user/00002950/bis10v/media/ch31/global_circ_v2.html

# Active Figure: Climate and ocean currents map




http://www.kevinflint.org/ppt/chap5/Animations/climate_currents_v2.html