Earth's Climate System

Air and Ocean Circulation

- In order to understand climate change, we have to understand how climate first works.

The Earth is unevenly heated….

- The Sun's radiation reaches Earth's surface at different intensities
- Water and land absorb energy at different rates
- Water absorbs <u>more</u> thermal energy than air

Thermal Energy Circulation

- Thermal Energy is transported from areas that receive a lot of radiation to areas that receive less radiation.

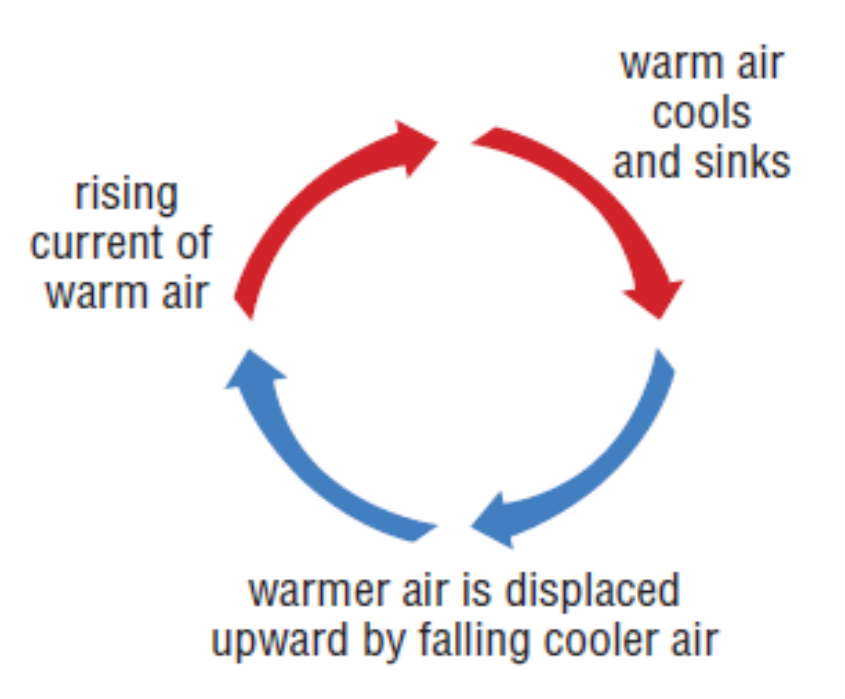
- This keeps polar regions warmer and tropical regions cooler than they would otherwise be

Uneven Heating Creates Currents

- Warm air is less dense than cold air which means that hot air rises; this creates currents
- http://www.youtube.com/watch?v=4cOMushj7w8

- Warm water is less dense than cold water which means that warm water rises; this creates currents
- http://www.youtube.com/watch?v=bN7E6FCuMbY

- A circular current in air and other fluids (water) caused by the rising of warm fluid as cold fluid sinks

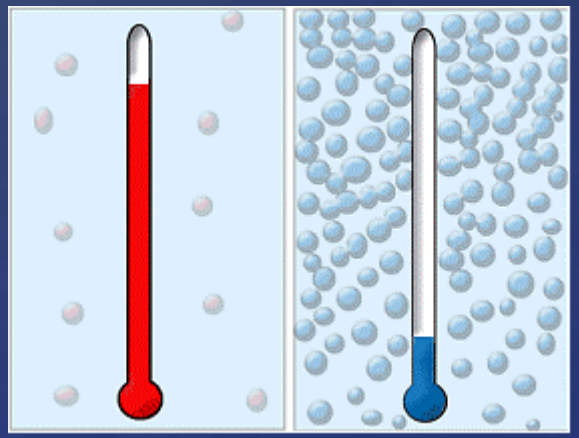


Convection Currents

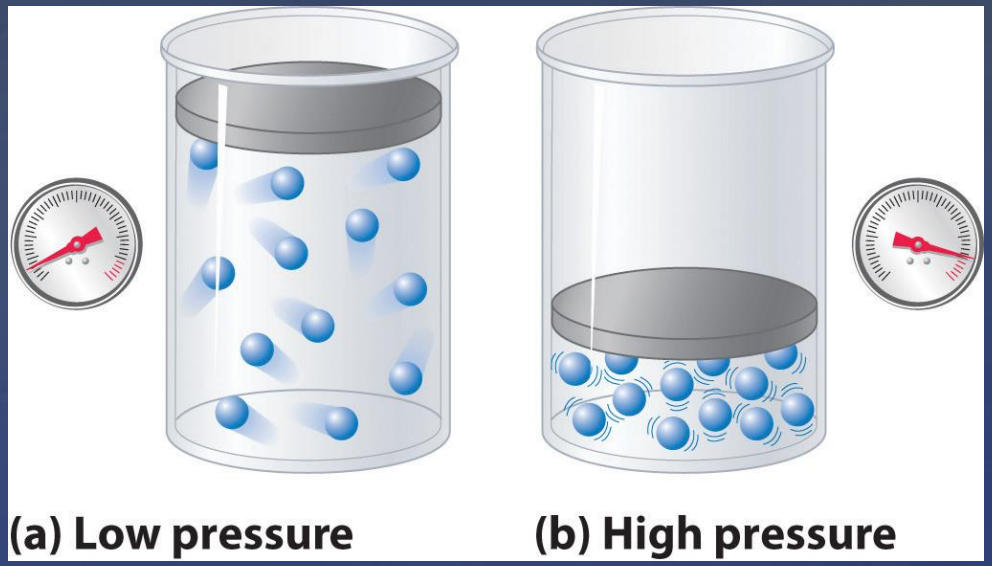
- As warm air rises, it creates an area of low pressure below it

- As cool air falls, it creates an area of high pressure

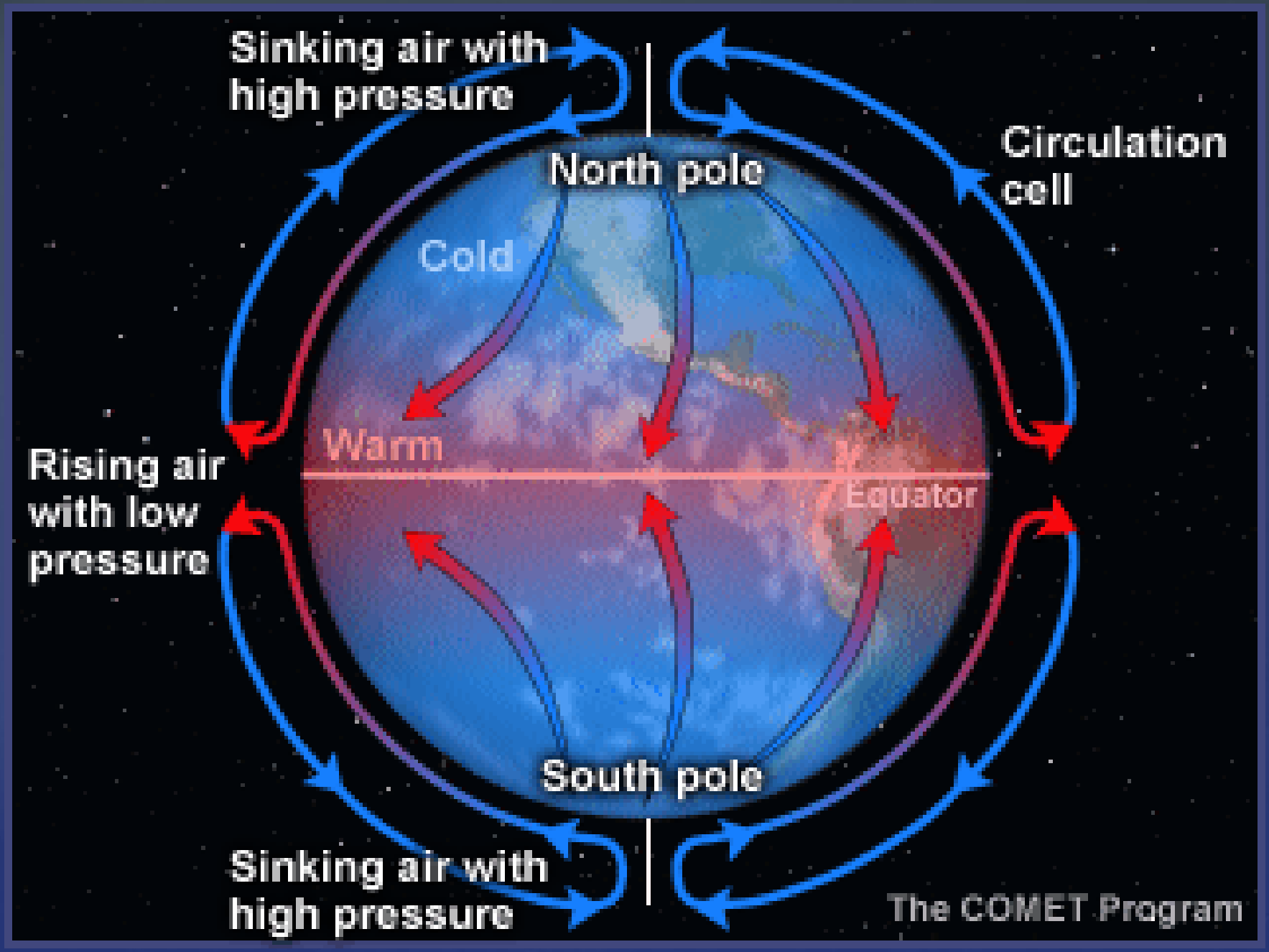
Energy Transfer in the Atmosphere



- Air flows from areas of high pressure to areas of low pressure – this makes air currents or wind



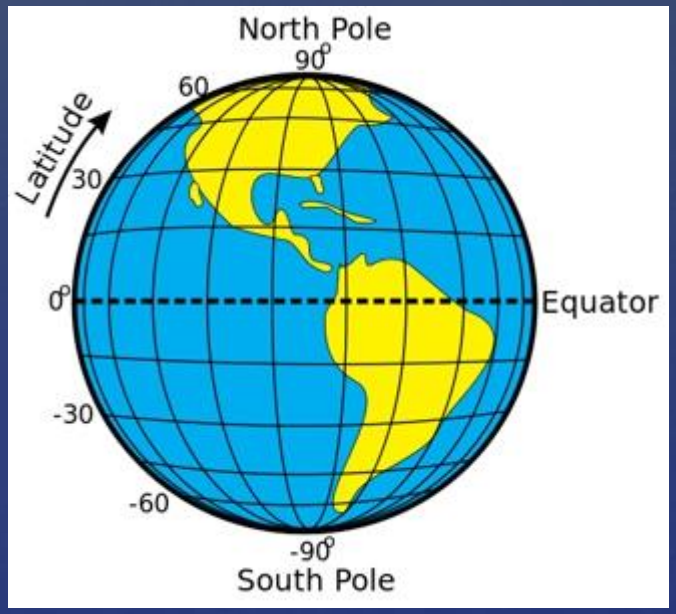
Energy Transfer in the Atmosphere


Sinking air with high pressure
North pole
Circulation cell
Cold
Warm
Rising air with low pressure
Equator
South pole
Sinking air with high pressure
The COMET Program

Prevailing Winds

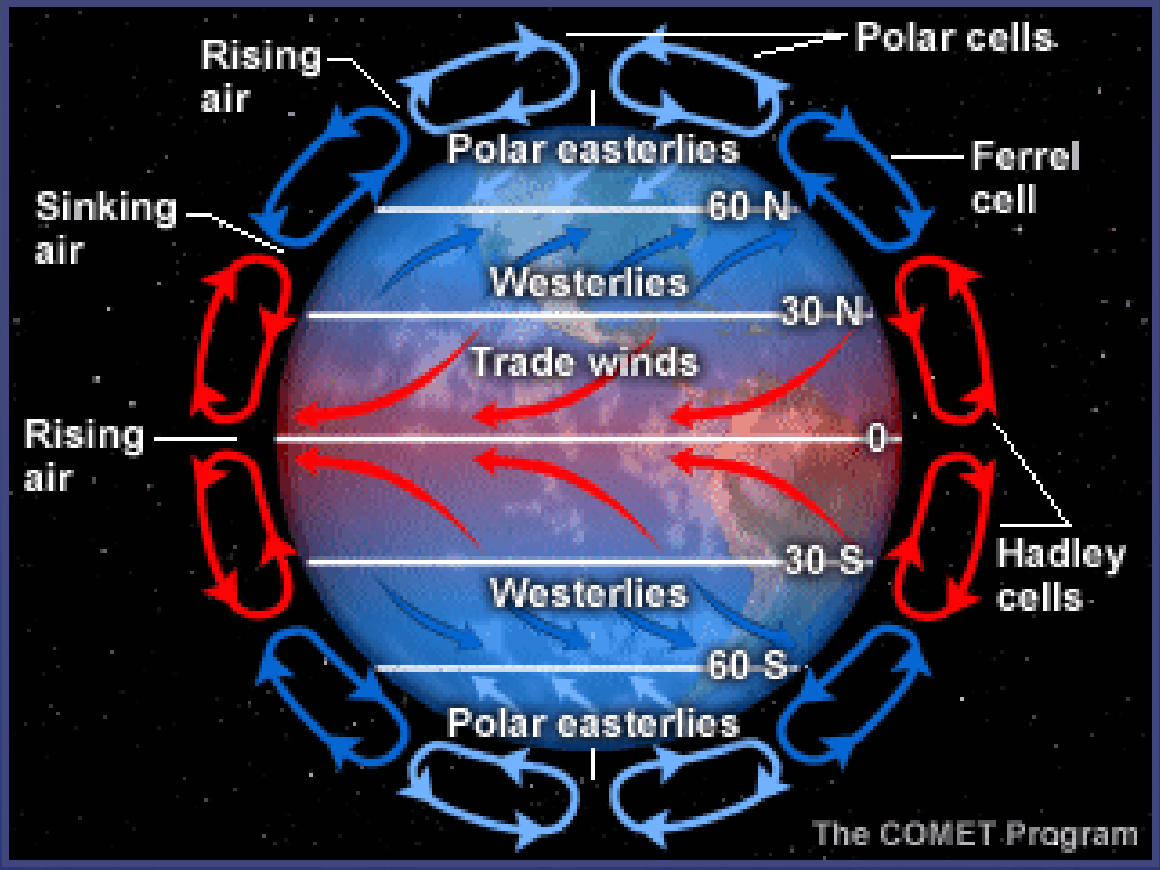
The Earth has permanent bands of high and low pressure

- at the equator, 30° latitude, 60° latitude, and poles



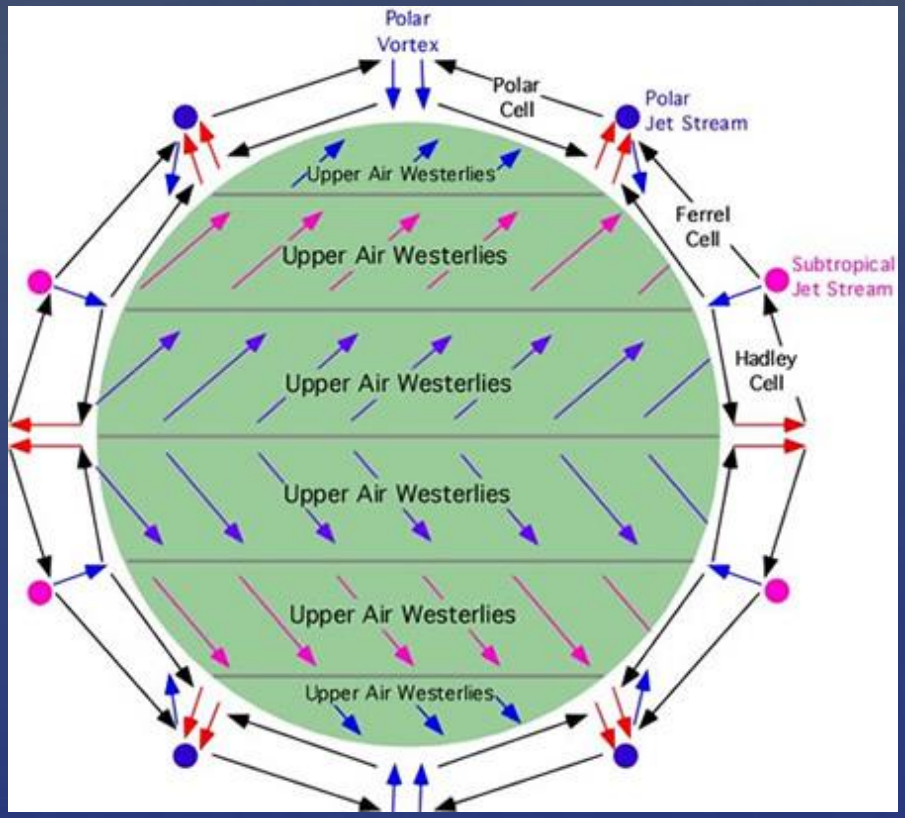
Prevailing Winds

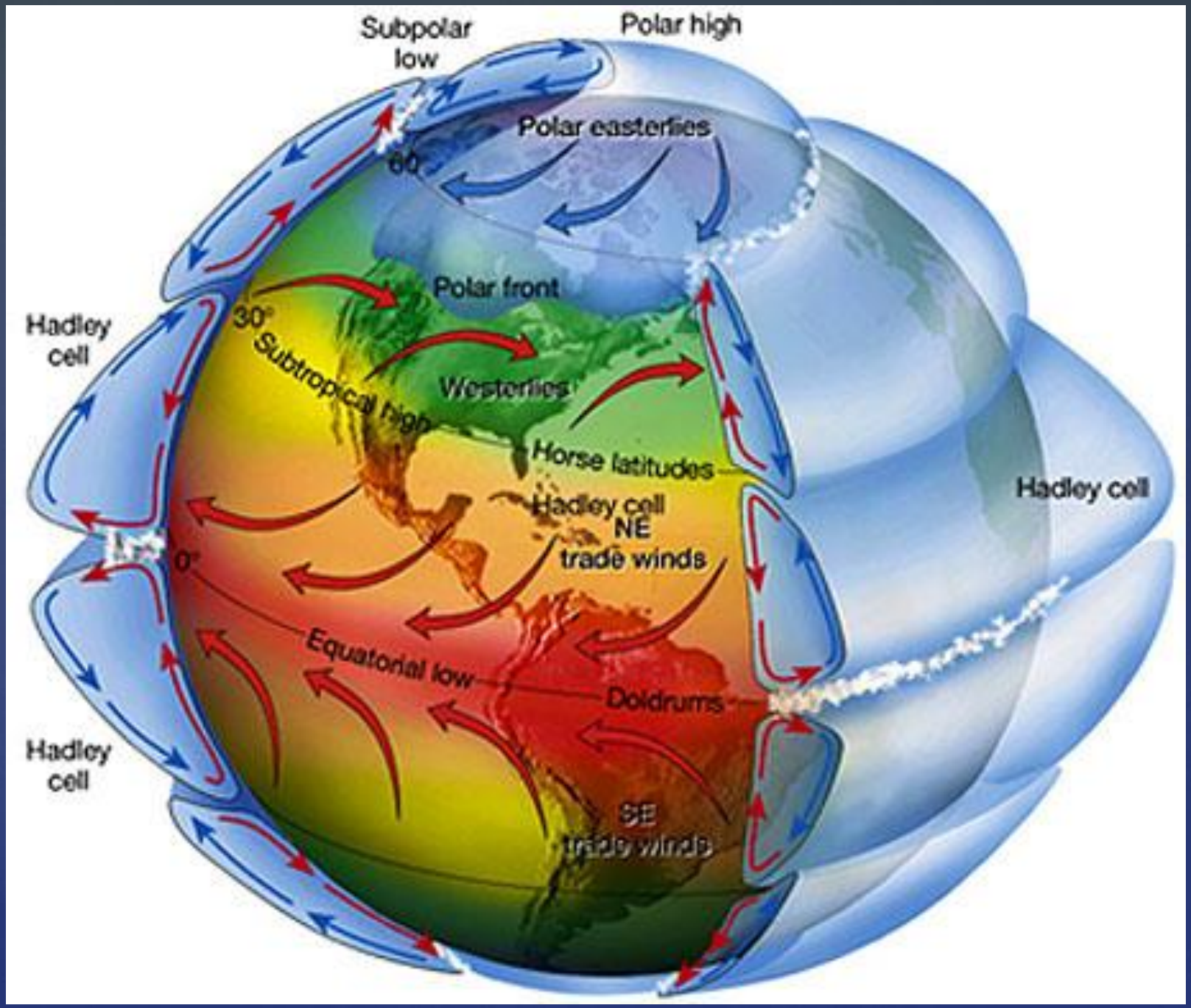
- High and Low pressure, along with the rotation of the Earth causes winds that curve around the globe in the same direction almost all the time



Prevailing Winds

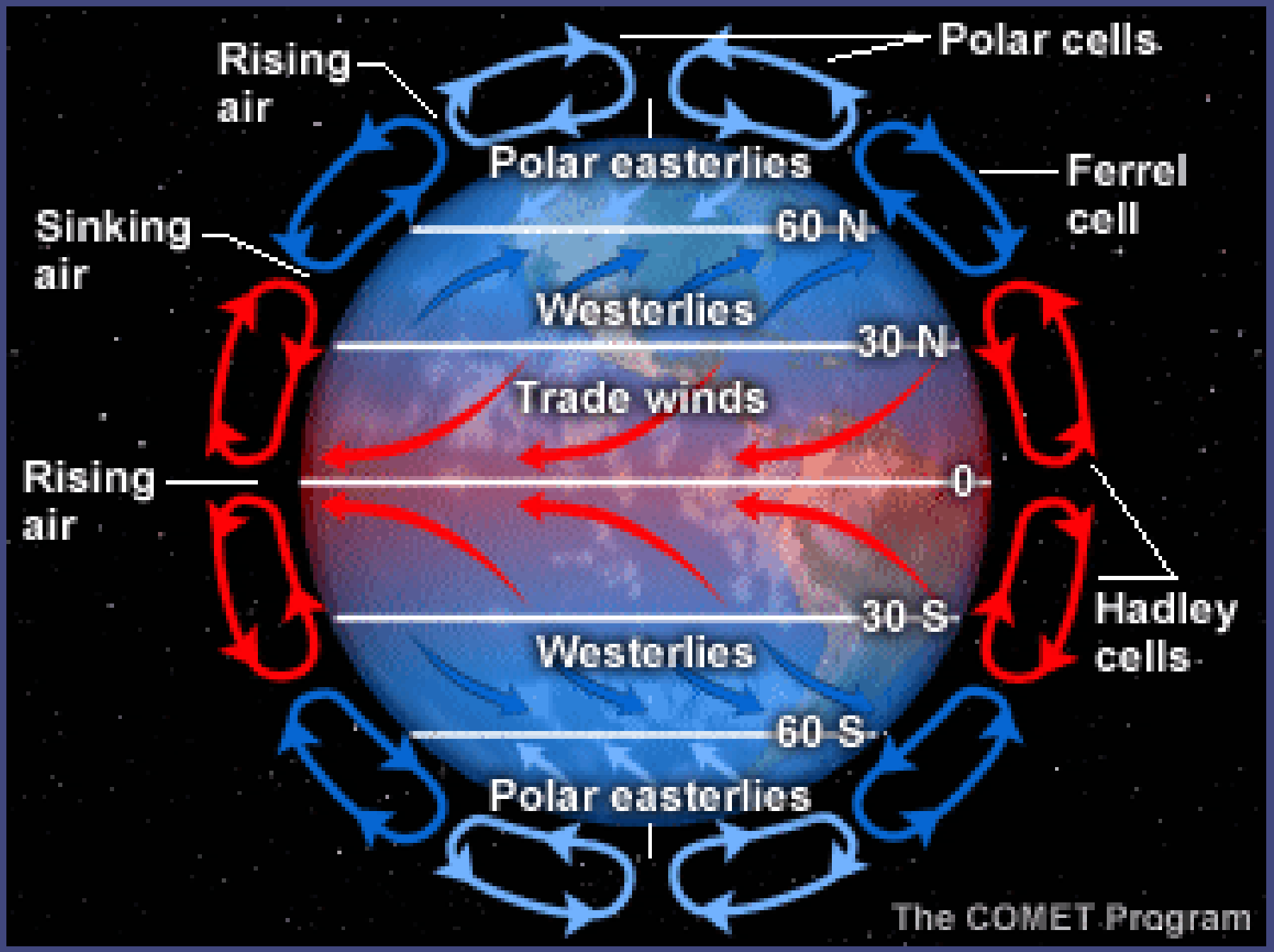
- Prevailing winds push warm air (as well as warm ocean water) from equator to the poles




Subpolar low
Polar high
Polar easterlies
60°
Polar front
Hadley cell
30°
Subtropical high
Westerlies
Horse latitudes
Hadley cell
NE trade winds
Hadley cell
0°
Equatorial low
Doldrums
Hadley cell
SE trade winds

- http://www.youtube.com/watch?v=mPsLanVS1Q8 National Geographic – Coriolis Effect

- http://www.youtube.com/watch?v=7DVL0ugj1Q4 Paper


Polar cells
Rising air
Polar easterlies
Ferrel cell
Sinking air
60 N
Westerlies
30 N
Trade winds
Rising air
0
Hadley cells
30 S
Westerlies
60 S
Polar easterlies
The COMET Program

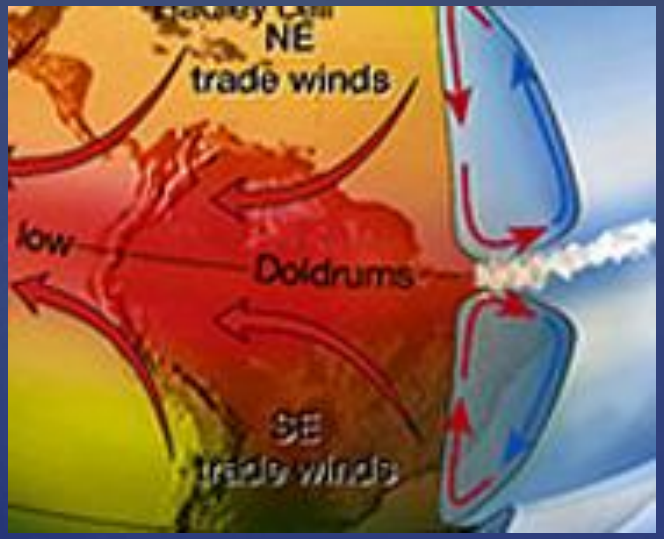
Global Air Circulation Animation

- Prevailing winds are named based on the direction they originate from

- http://www.youtube.com/watch?v=DHrapzHPCSA

Prevailing Winds and Climate Zones

- Regions where prevailing winds pass over water before reaching land have higher amounts of precipitation (ie: South American rainforest)



Prevailing Winds and Climate Zones

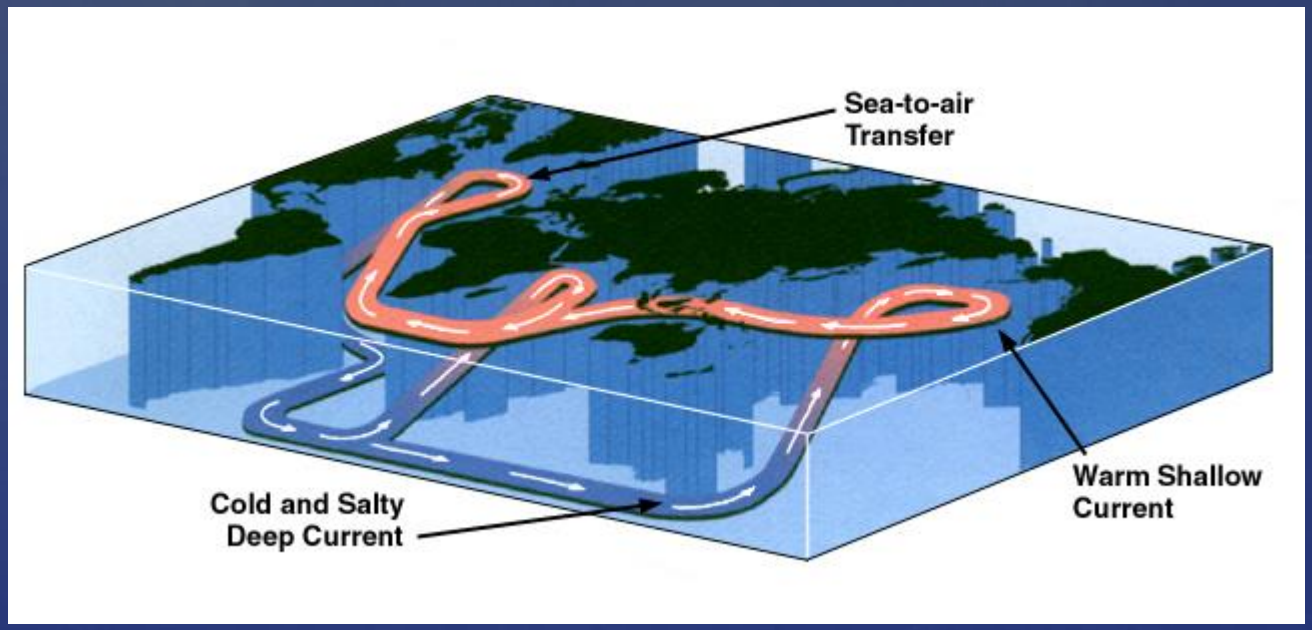
- Prevailing winds from the North Pole will be cold and dry and cause areas that receive this wind to be cold and dry (ie: Northern Canada)

Energy Transfer in the Oceans

- As water travels to the poles, it gets colder and saltier and therefore more dense
  - Surface water evaporates and sea ice forms (both reject salt)

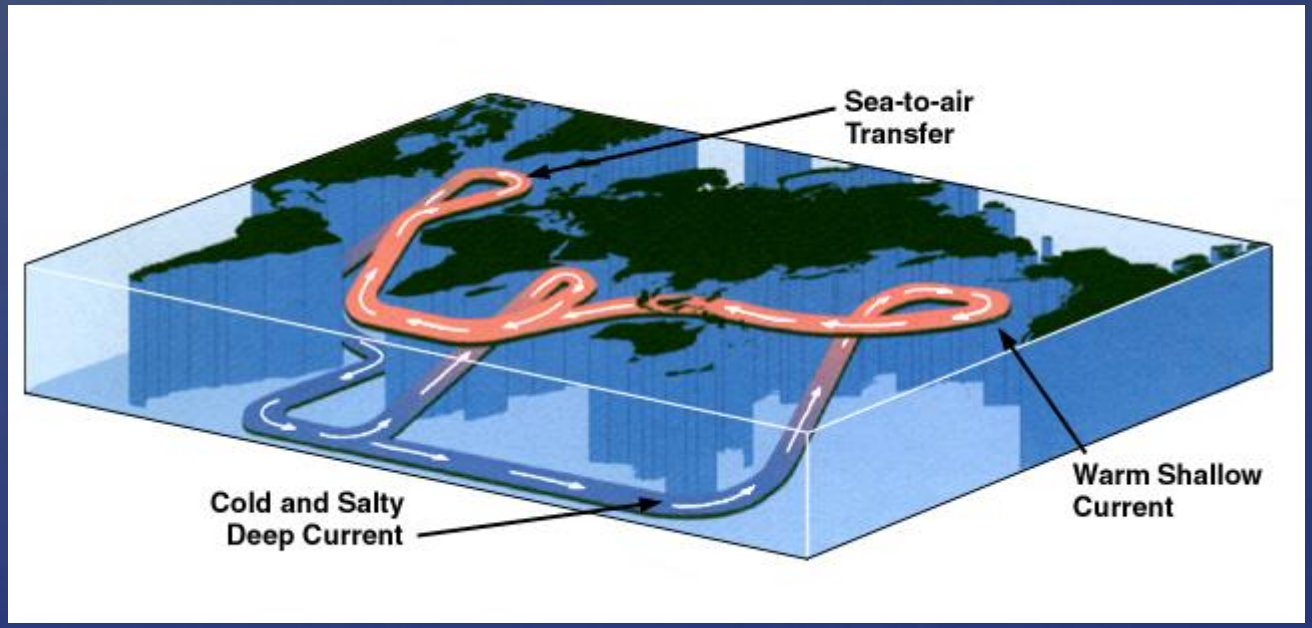
Energy Transfer in the Oceans

- Dense water at the poles will sink to the ocean floor
- Warmer surface water from the equator flows towards the poles to take its place



Thermohaline Circulation

- The continuous flow of water around the world's oceans driven by differences in water temperature and salinity
- http://www.youtube.com/watch?v=w_8mw-1HYFg
- http://www.youtube.com/watch?v=FuOX23yXhZ8



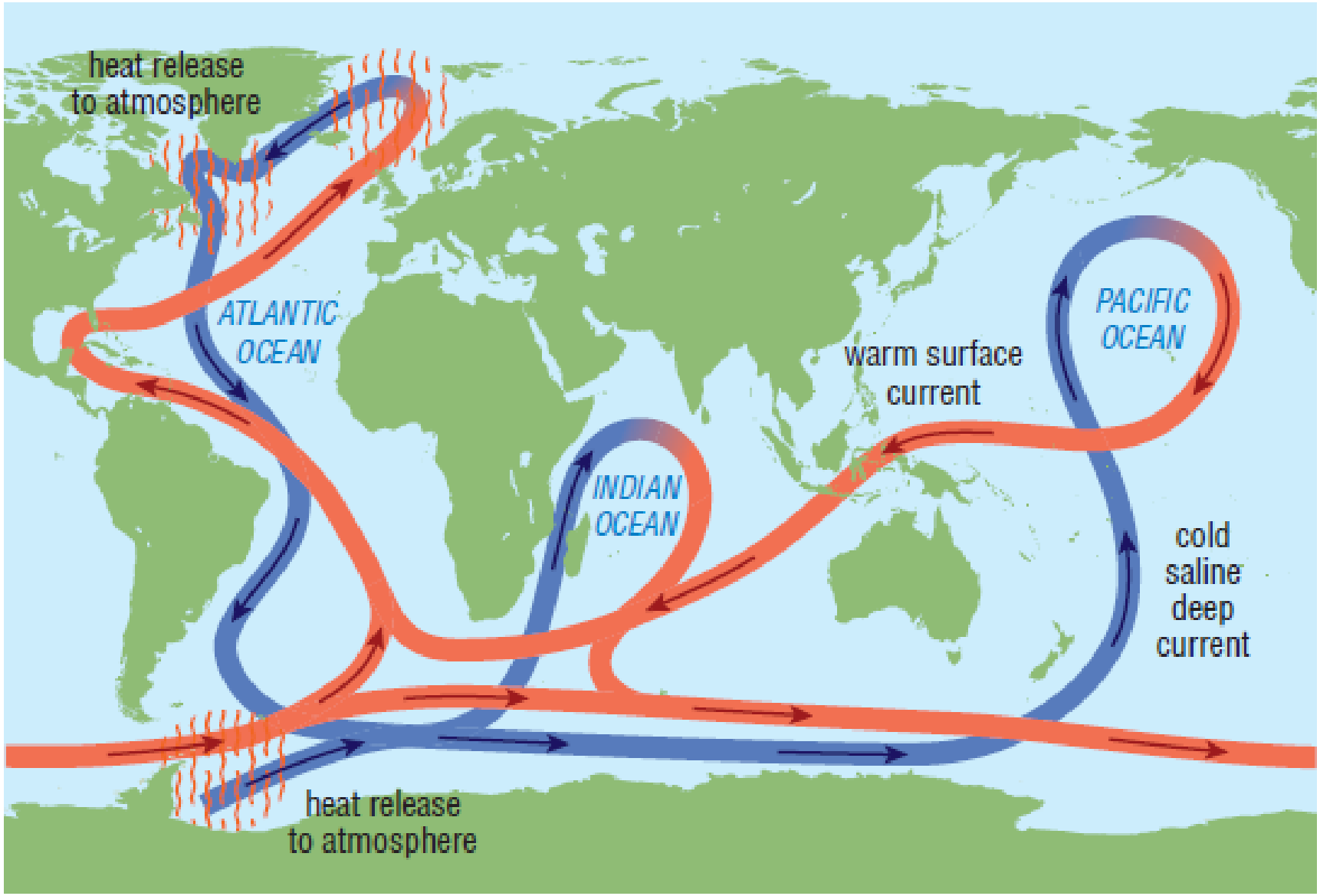


Figure 5 Red lines show warm ocean currents and blue lines show cold ones. Warm water currents travel on the surface, but cold water currents travel deep down in the ocean.

Ocean Currents & Climate Zones

- Warm ocean currents heat the air above them which moves to the land and produces rain

- Cold ocean currents cool the air above them causing cool, dry air to reach the land creating desert areas

Homework

- Read Section 8.8 (pg. 344-347)
  - answer questions #1, 4-7