Agenda:

- Start chapter 4 notes
- Class time for HW

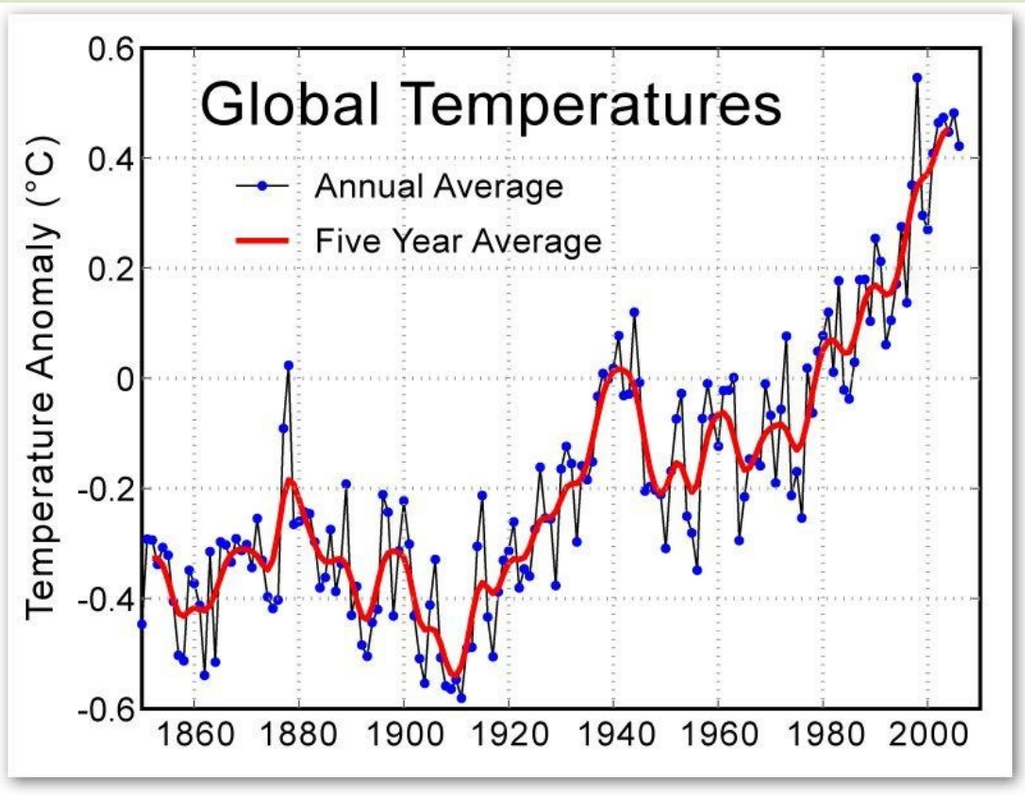
Bell Work:

Write a brief description of what you think the plot/story line for the population growth video should be!

Global Processes Determine Weather and Climate

- **<u>Weather-</u>** the short term conditions of the atmosphere in a local area. These include temperature, humidity, clouds, precipitation, wind speed and atmospheric pressure.

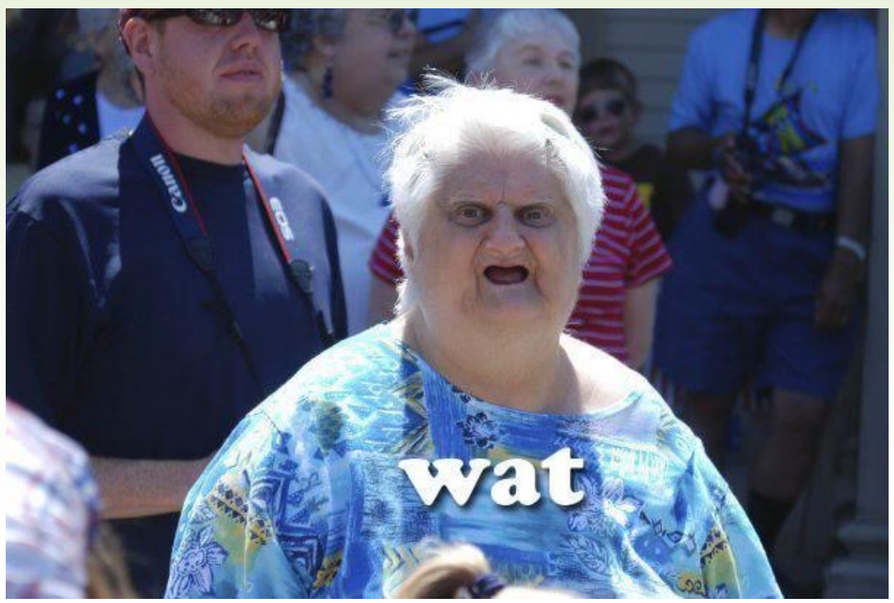
- **<u>Climate-</u>** The average weather that occurs in a given region over a long period- typically several decades.



Global Processes Determine Weather and Climate

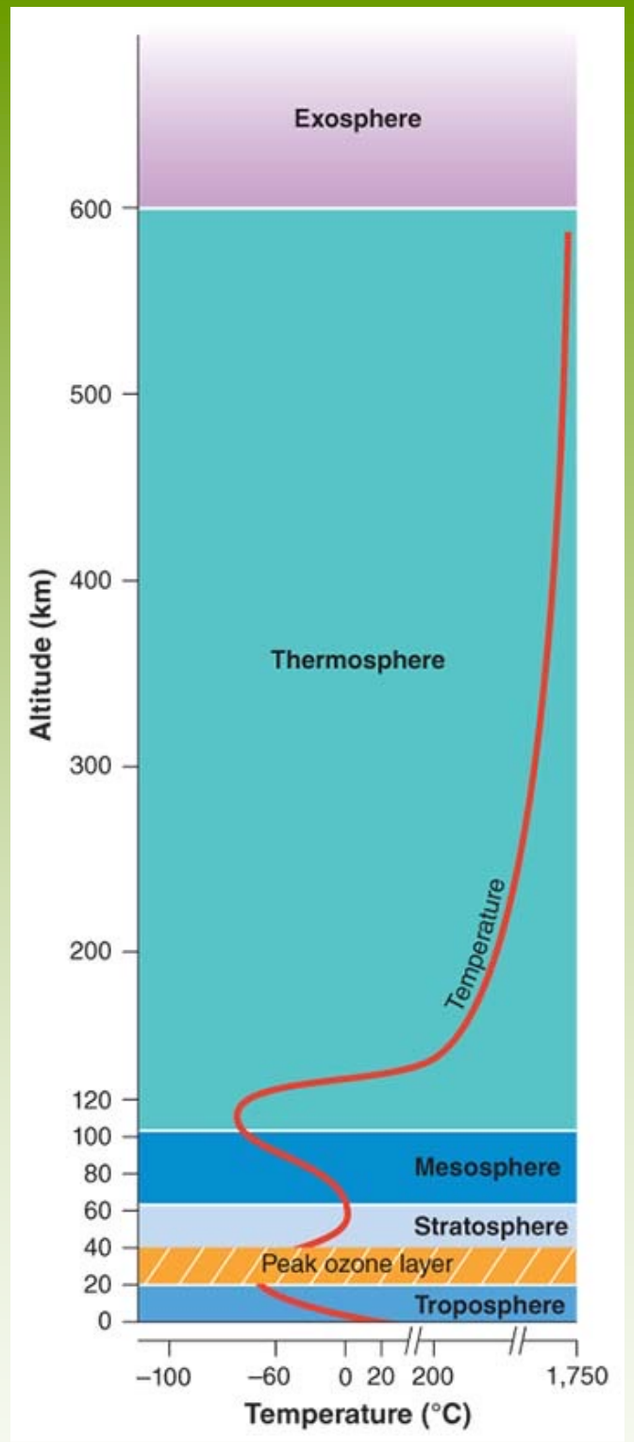
- Differences in temperature and weather determine what can live in certain regions

- Processes include *unequal heating of the Earth by the Sun, atmospheric convection currents, the rotation of the Earth, Earth's orbit around the Sun on a tilted axis, and ocean currents*



Earth's Atmosphere

- Pull of gravity on gas molecules keeps atmospheric layers in place
- Gravitational pull lessens with increasing distance from earth thus molecules are more densely packed closer to Earth



Less Dense

Dense

Earth's Atmosphere

- **<u>Troposphere-</u>** the layer closest to Earth's surface extending roughly 16 km (10 miles) above Earth.
    - Densest layer of atmosphere where the weather occurs and temperature decreases with distance from Earth
- **<u>Stratosphere-</u>** above the troposphere, this extends from roughly 16 to 50 km (10-31 miles).
    - UV radiation warms the atmosphere at higher altitudes
    - Ozone (O_3) forms here and absorbs cancer-causing UV radiation

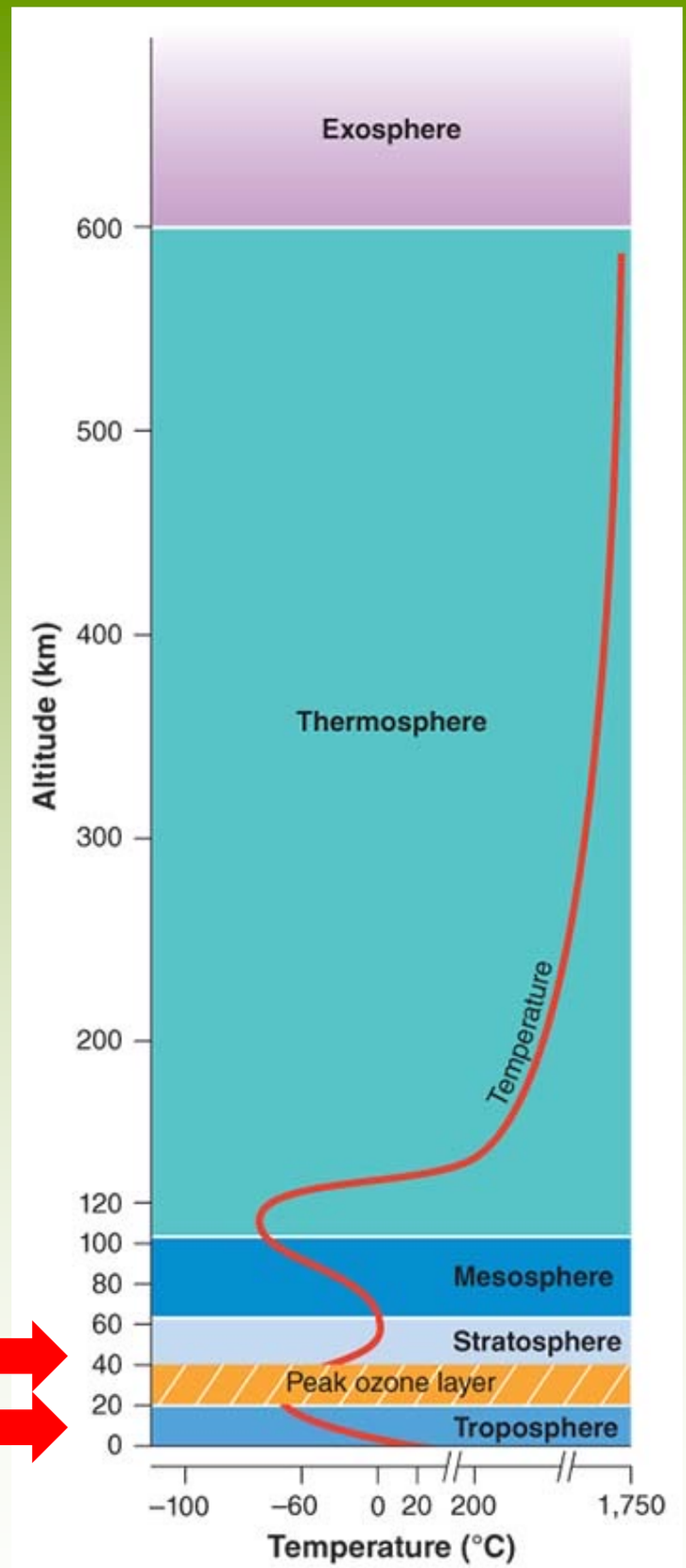


Figure 4.1
Environmental Science for AP®

Earth's Atmosphere

- *Mesophere, thermosphere*, and *exosphere* are the least dense layers of the atmosphere because they are further from the Earth's gravitational pull

- Thermosphere blocks harmful X-ray and UV radiation

- Contains gas molecules that glow and produce light when hit by solar energy and driven by the magnetic fields of the Earth at the North and the South poles :

  - North: aurora borealis

  - South: aurora australis

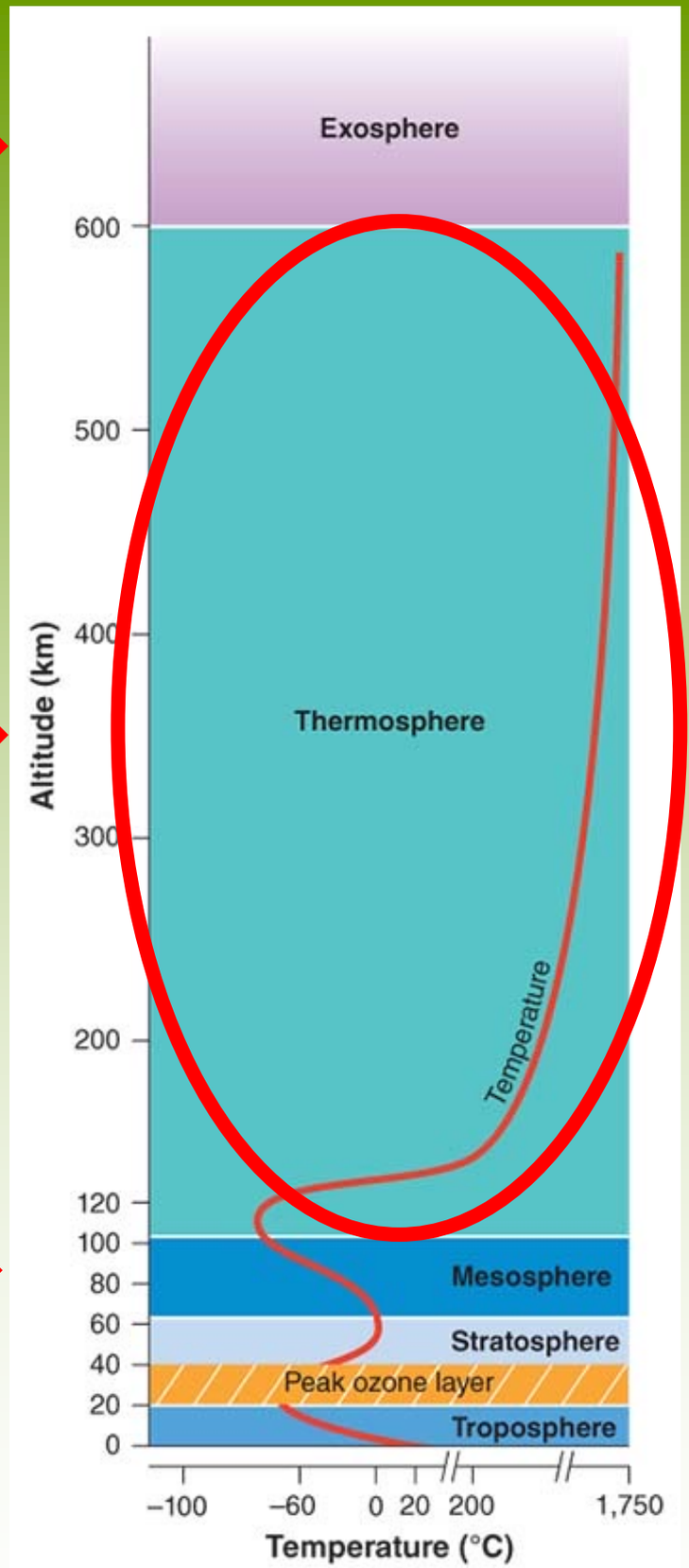


Figure 4.1
Environmental Science for AP®

Unequal Heating of Earth

- As the Sun's energy passes through the atmosphere and strikes land and water, it warms the surface of Earth. But this warming *does not occur evenly* across the planet.

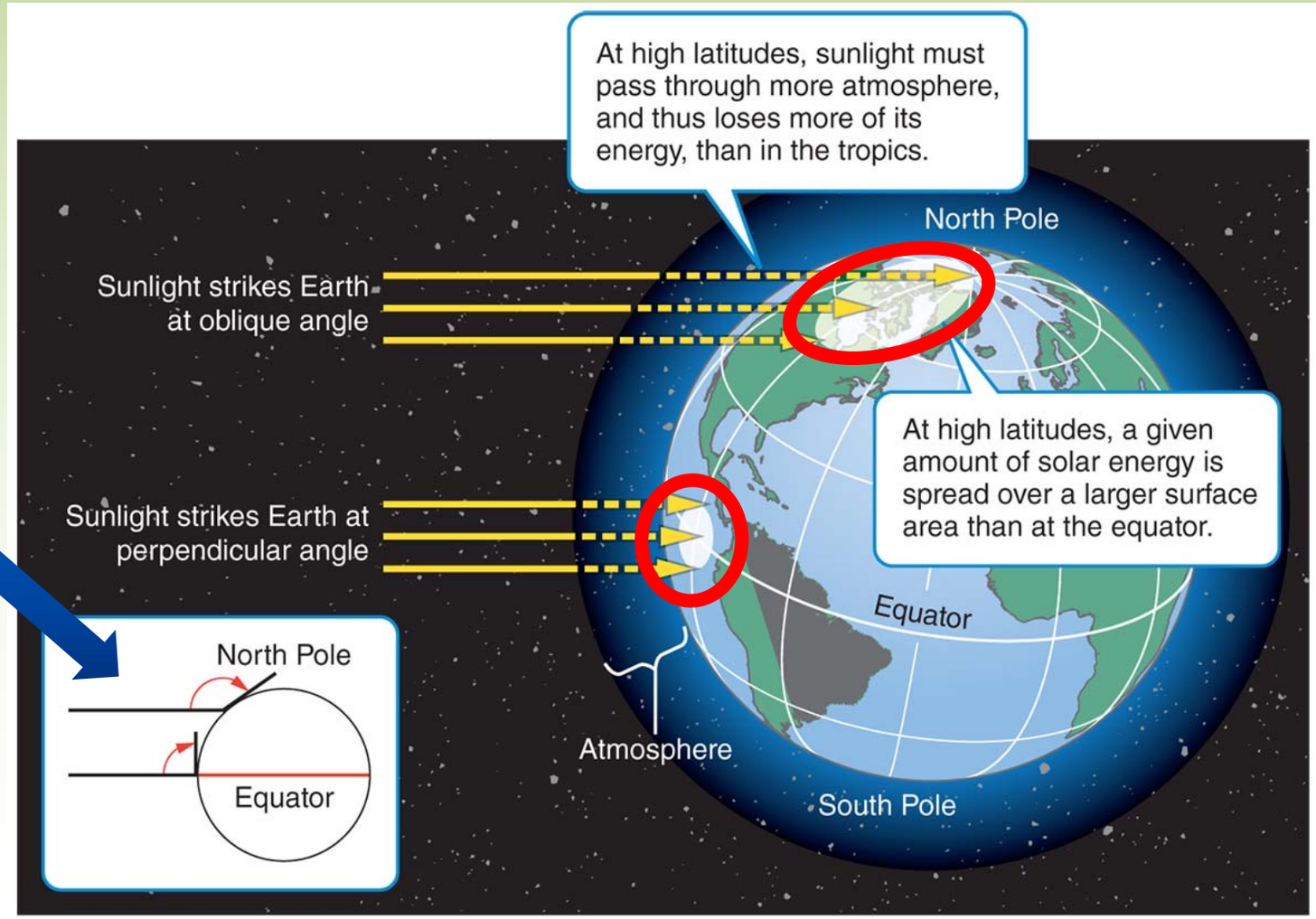
Unequal Heating of Earth

- This unequal heating is due to 3 factors:

    1. The variation in angle at which the Sun's rays strike

    2. The amount of surface area over which the Sun's rays are distributed

Sun's rays travel a shorter distance to reach the tropics so not as much heat is lost traveling through the atmosphere



Tropical areas receive more solar energy per m^2 because the perpendicular angel covers less surface area than oblique angels

Unequal Heating of Earth

3. Some areas of the Earth reflect more solar energy than others

- **albedo** – the % of incoming sunlight that is reflected from a surface

- A white surface has higher albedo than a black surface, so it tends to stay cooler

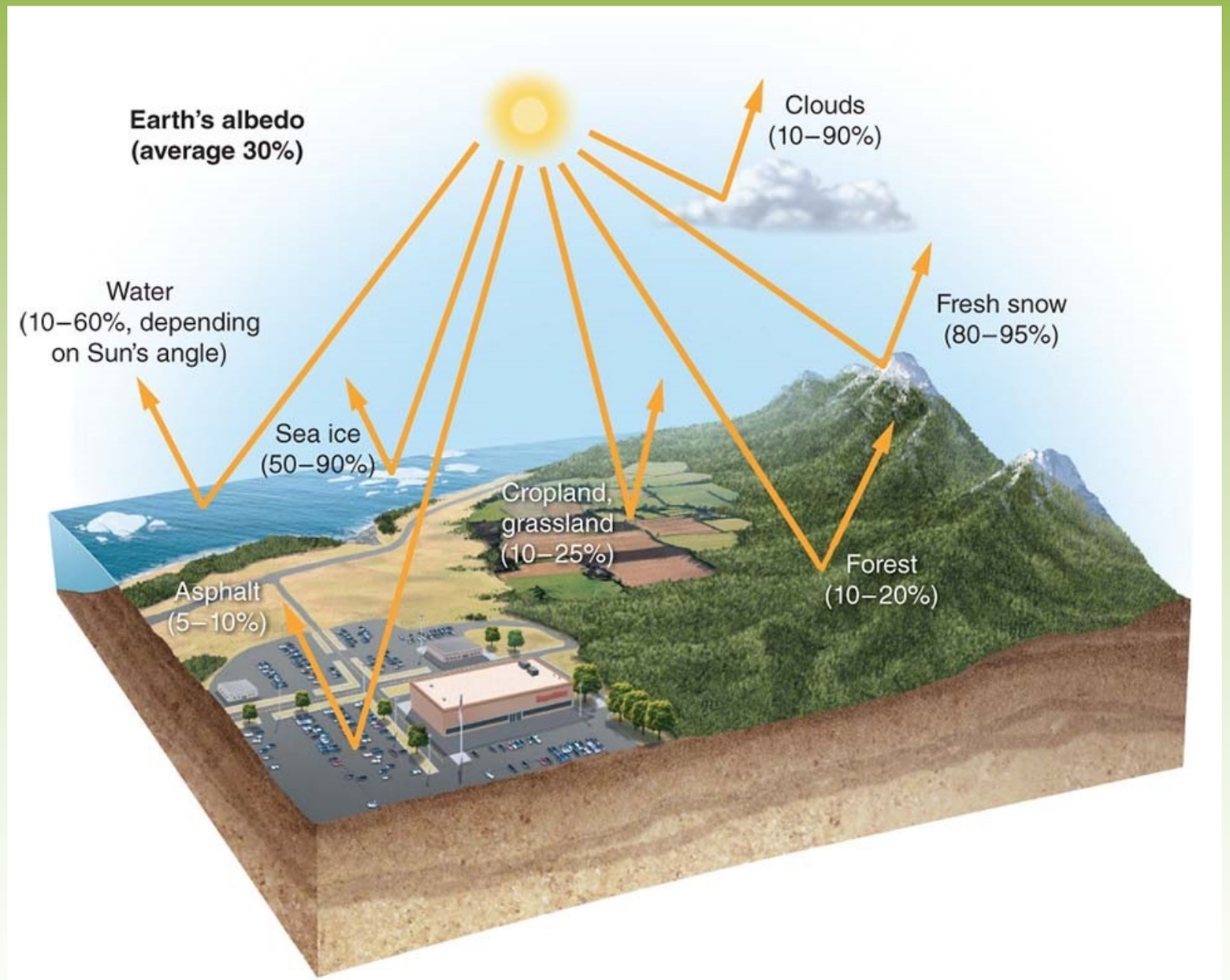


Figure 4.4
Environmental Science for AP®

Atmospheric Convection Currents

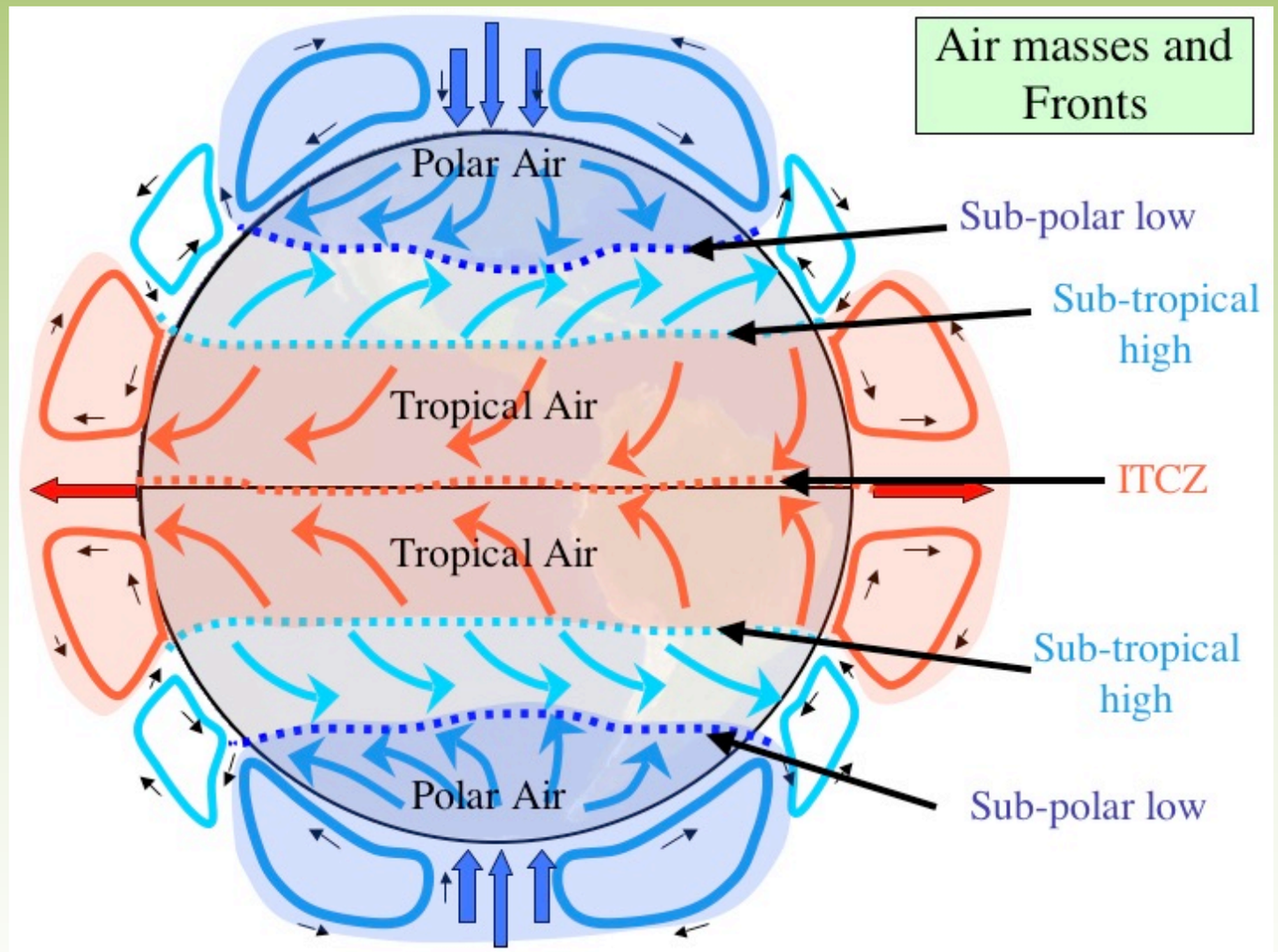
Air has four properties that determines its movement:

1. **<u>Density</u>**

2. **<u>Water vapor capacity</u>**

3. **<u>Adiabatic heating or cooling</u>**

4. **<u>Latent heat release</u>**



Atmospheric Convection Currents

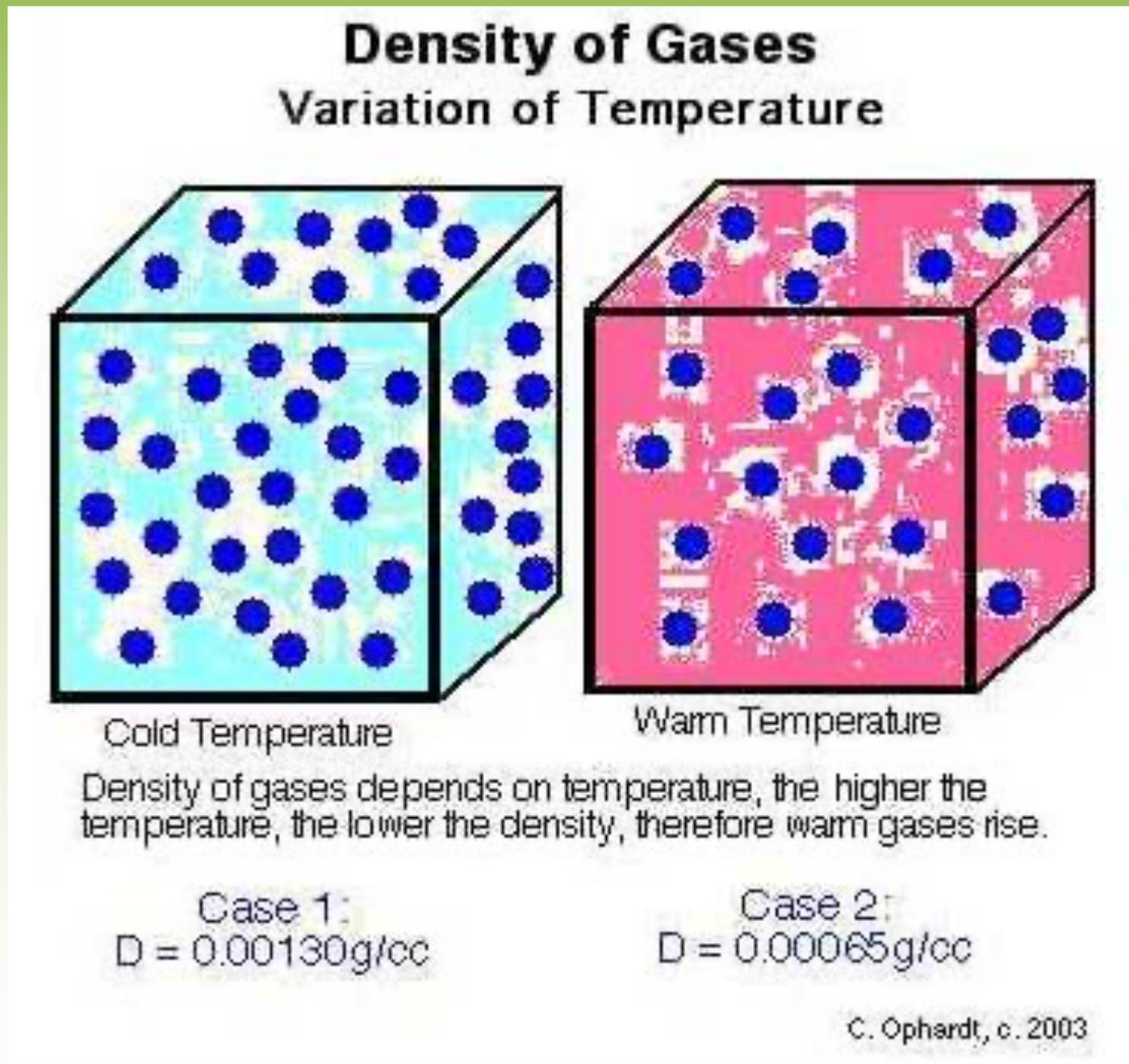
Air has four properties that determines its movement:

1. **Density**

- Less dense air rises, and dense air sinks

- At constant atmospheric pressure, warm air has a lower density than cold air

- Warm air rises and cold air sinks



Atmospheric Convection Currents

Air has four properties that determines its movement:

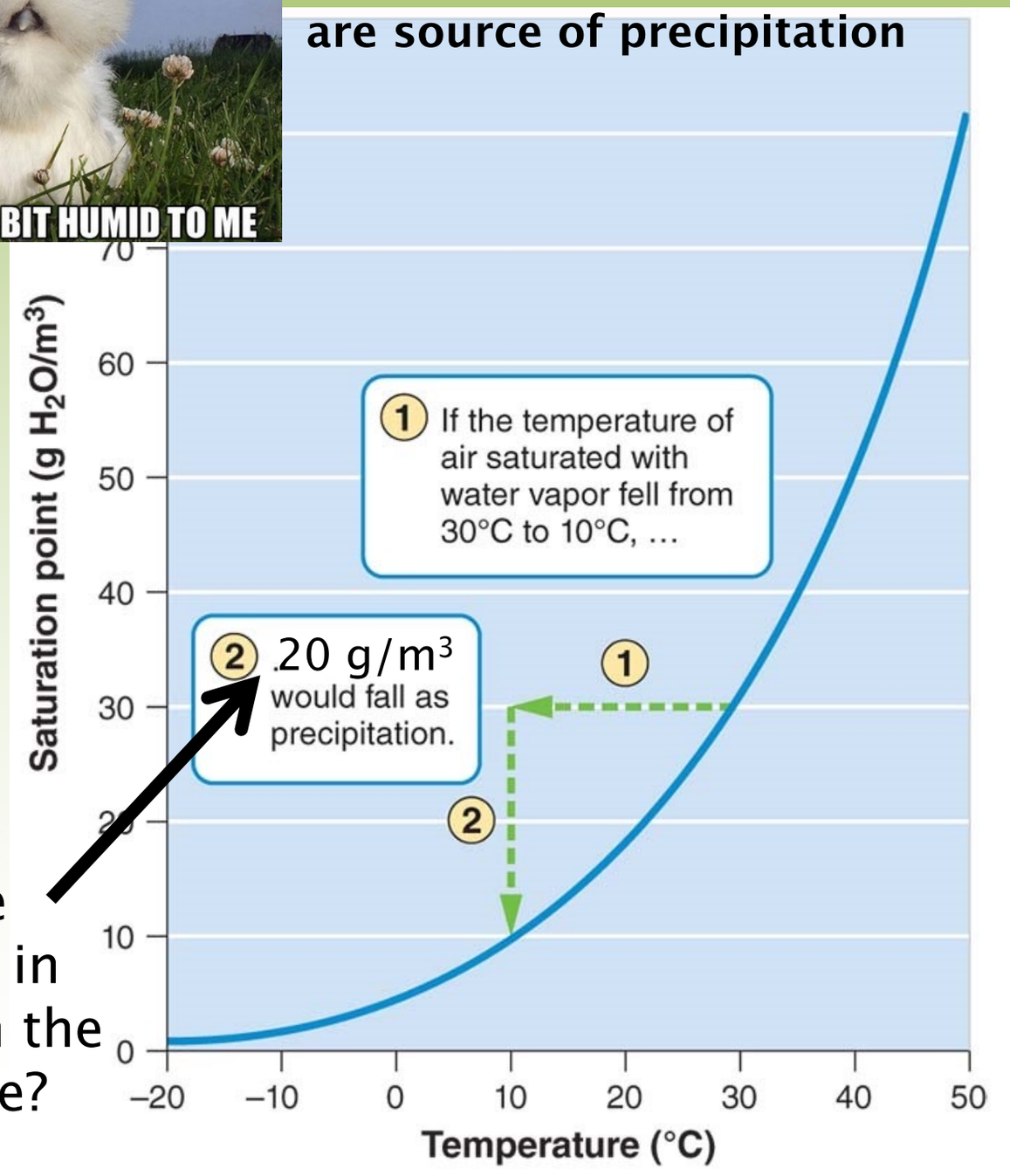
When air cools and the saturation point drops, H_2O vapor condenses into liquid water that forms clouds which are source of precipitation

2. **<u>Water vapor capacity</u>**

- Warm air has a higher capacity for water vapor than cold air

- Maximum amount of water that can be in the air at a given temperature is called the **<u>saturation point</u>**

What value goes in #2 in the figure?



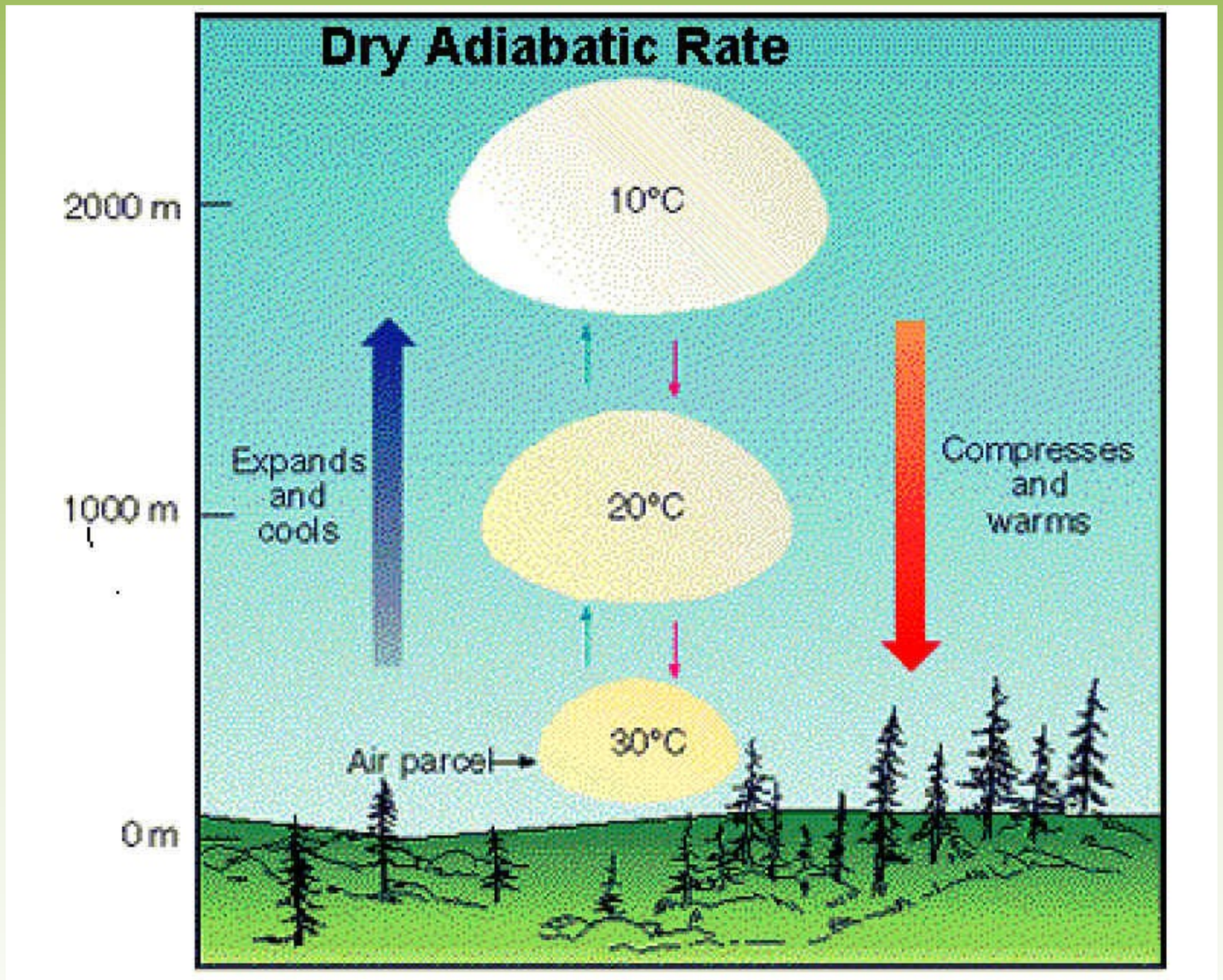
Atmospheric Convection Currents

Air has four properties that determines its movement:

3. **<u>Adiabatic cooling or heating</u>**

- **<u>Adiabatic cooling</u>** - as air *rises*, the pressure on it *decreases* which allows the air to *expand* in volume, which *lowers* air temperature

- **<u>Adiabatic heating</u>** - as air *sinks*, the pressure on it *increases* which allows the air to *decrease* in volume, which *raises* air temperature



Atmospheric Convection Currents

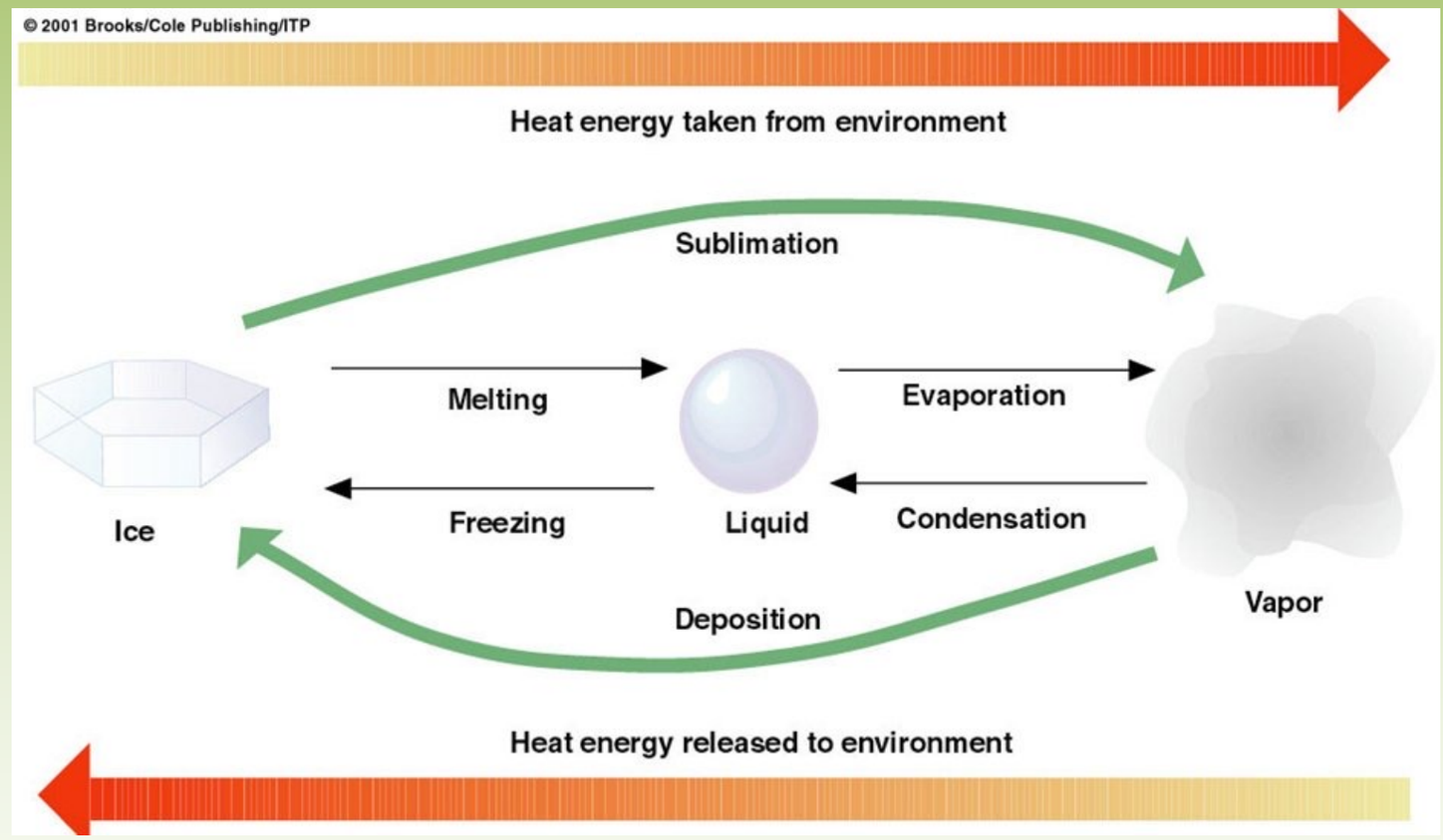
Air has four properties that determines its movement:

4. **<u>Latent heat release</u>**

- The reverse process of evaporation!

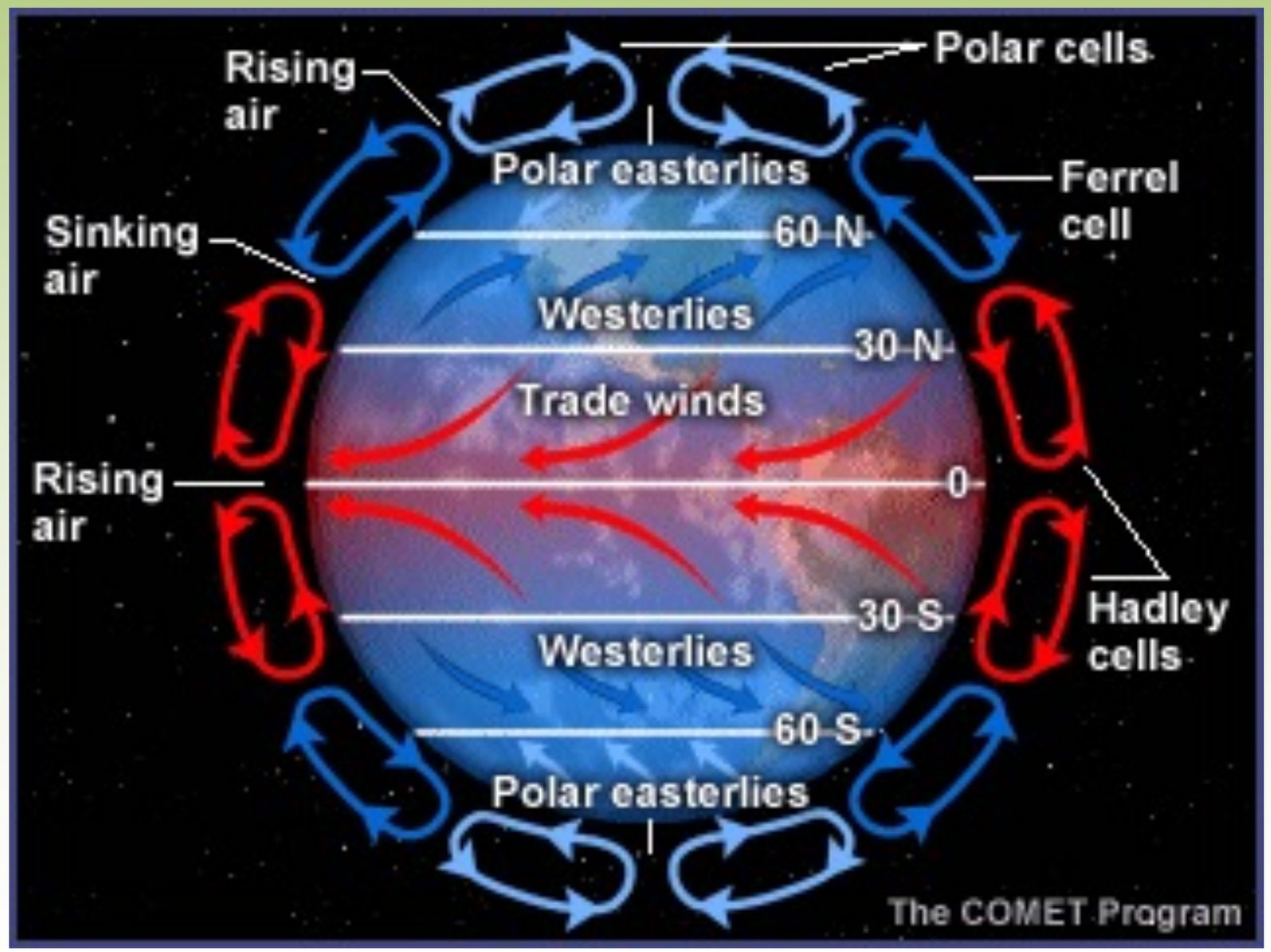
- When water vapor in the atmosphere condenses into liquid water and energy is released

- Important because wherever condensation occurs, the air becomes warmer and will rise



Formation of Convection Currents

- **<u>Atmospheric convection currents</u>** are global patterns of air movement that are initiated by the unequal heating of Earth.



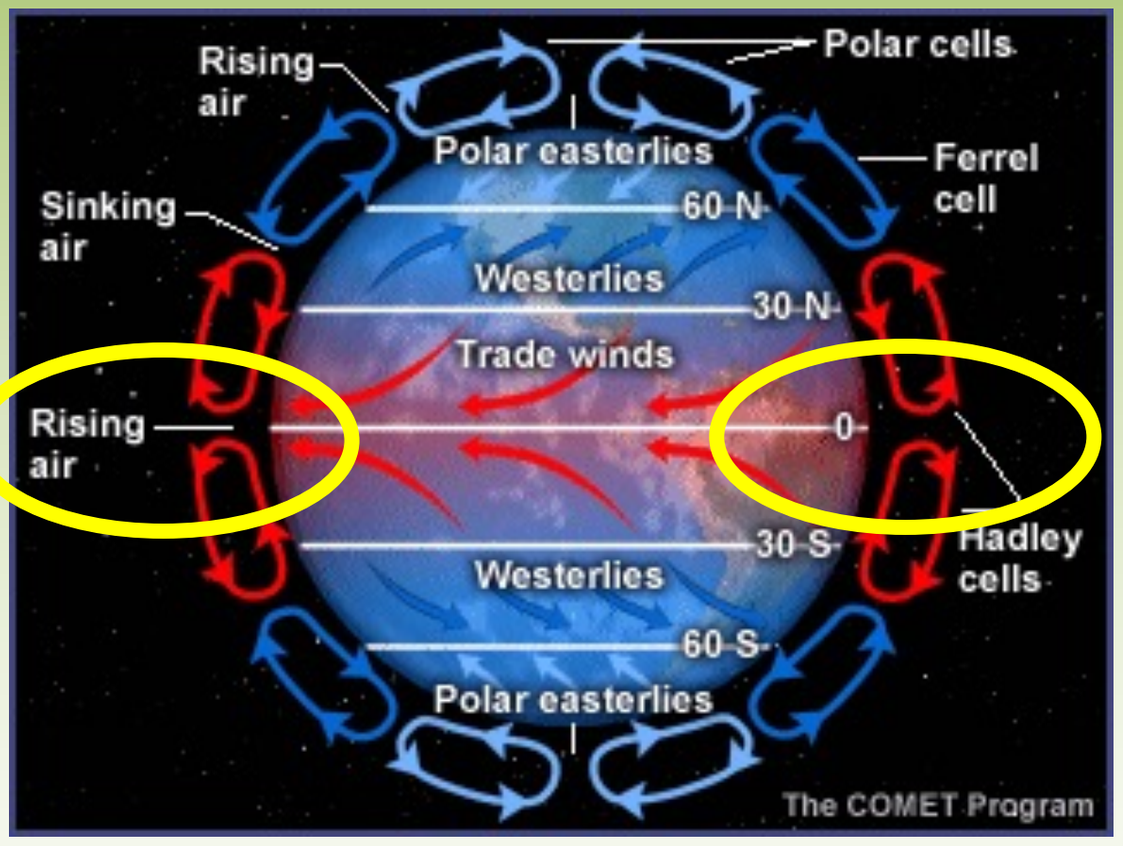
Formation of Convection Currents

- *In the tropics*, the warming of humid air at the surface *decreases its density* and it begins to rise

- As it rises it experiences *adiabatic cooling* which causes the air to reach its saturation point leading to condensation, cloud formation, and precipitation

- *Condensation* also causes latent heat release which offsets some adiabatic cooling and makes the air expand further and rise more rapidly through the troposphere

- These processes cause air to rise continuously from Earth's surface near the equator, forming a river of air flowing upward into the troposphere



Formation of Convection Currents

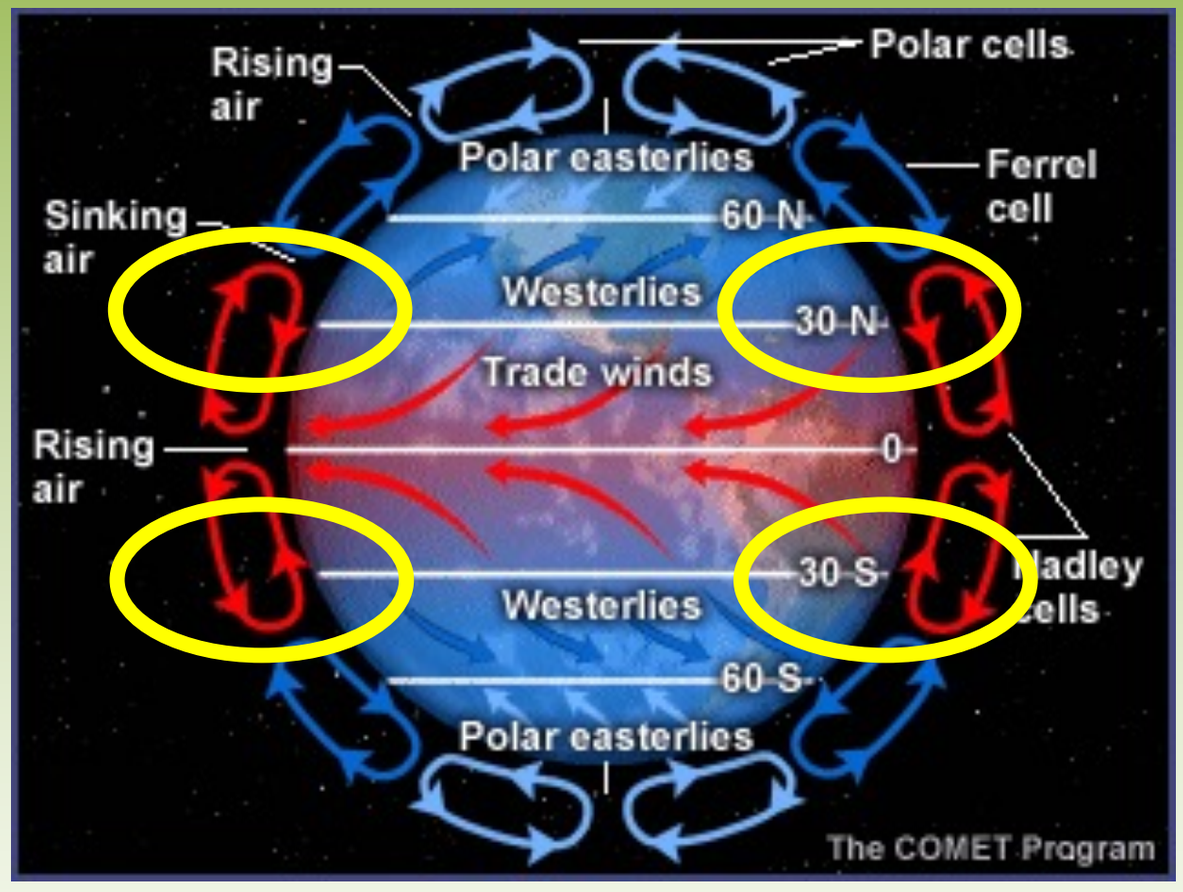
- *Air near the top of the troposphere* is chilled by *adiabatic cooling* and contains relatively little water vapor

- As warmer air rises from below, this cold, dry air is *displaced horizontally* both north and south of the equator

- Displaced air eventually begins to sink at *approximately 30° N and S*

- As it sinks if it experiences higher *atmospheric pressures* and the reduction in volume causes *adiabatic heating* so it is hot and dry when it reaches the earth

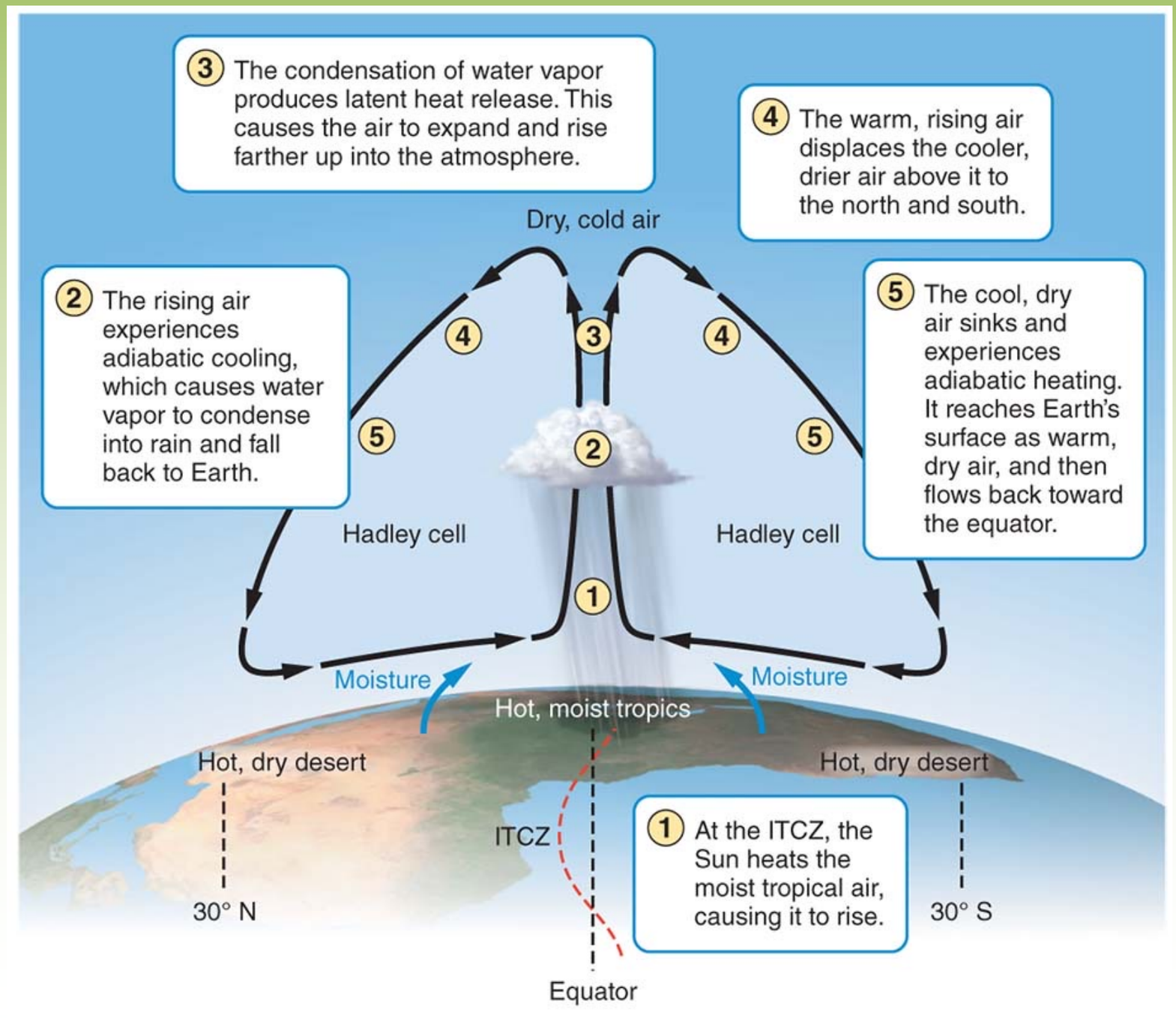
- This air moves along the Earth's surface back towards the equator to *replace the rising air*, completing the cycle

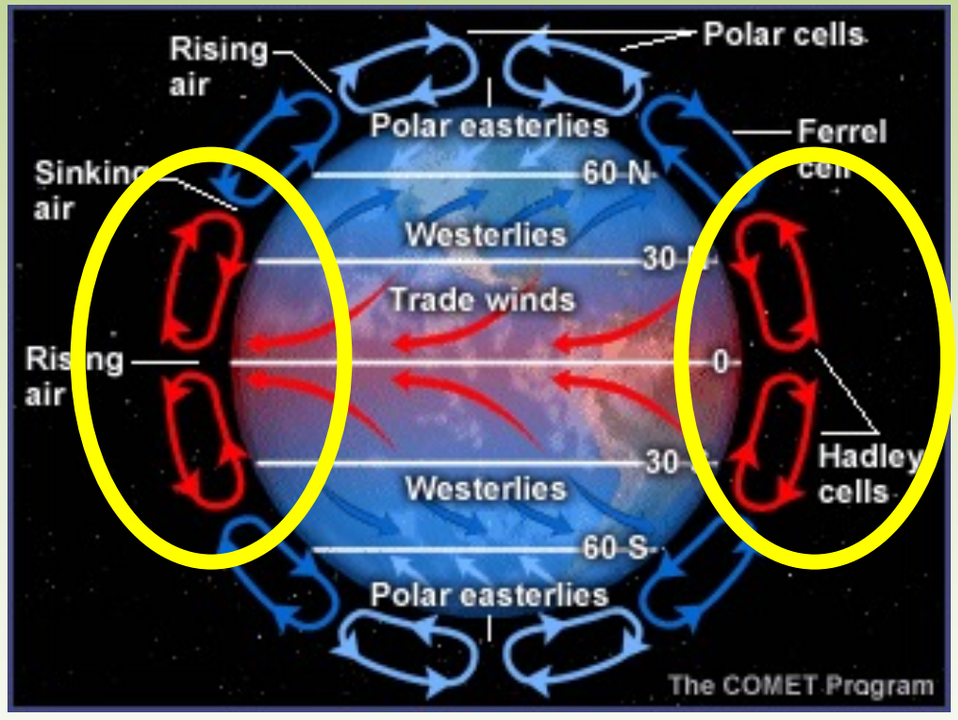


Explains why regions at 30°N and S are typically hot, dry deserts

Formation of Convection Currents

- The convection currents that cycle between the equator and 30° N and S in this way are called **<u>Hadley cells</u>**





Formation of Convection Currents

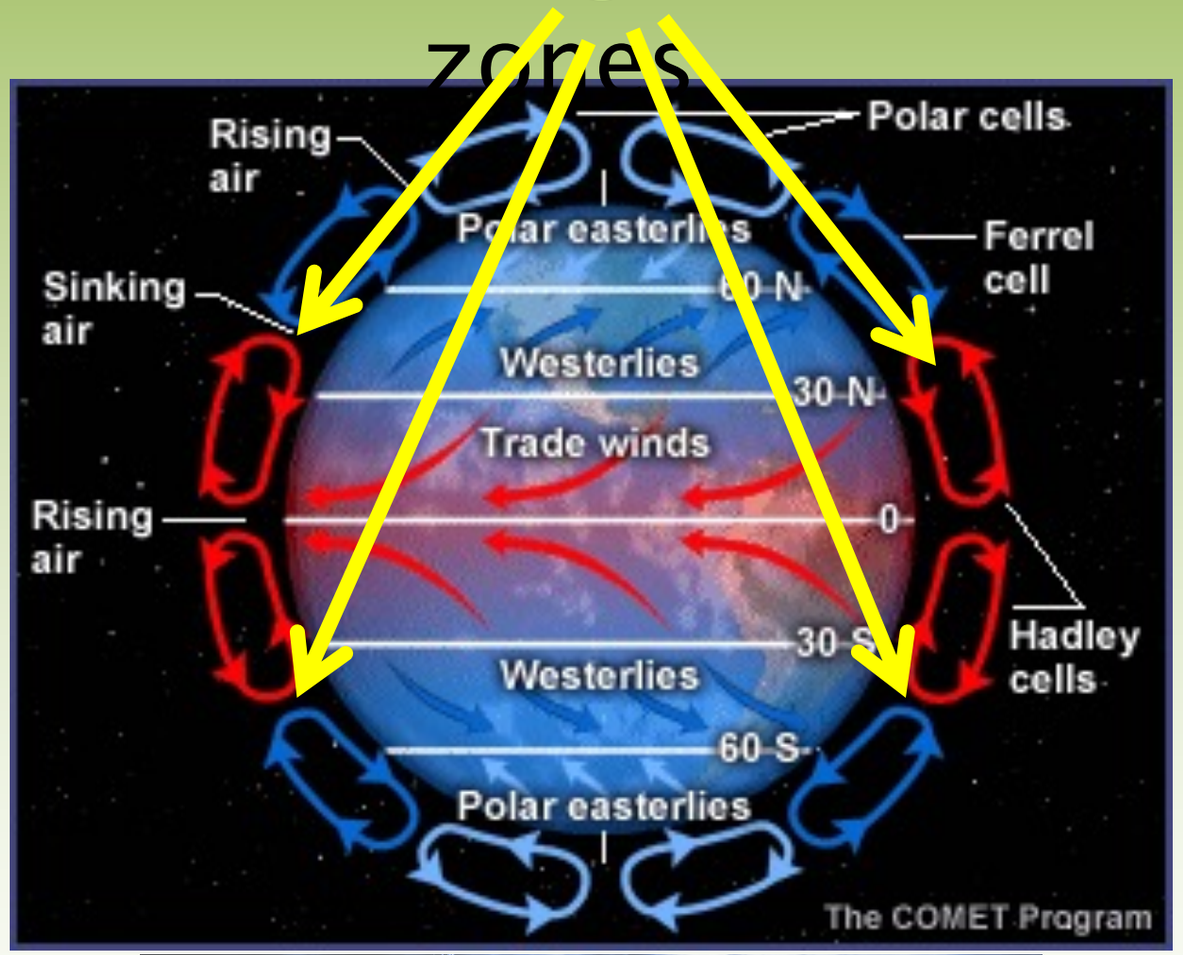
- The area of earth that receives the most intense sunlight, where the ascending branches of the two Hadley cells converge is called the **<u>intertropical convergence zone (ITCZ)</u>**

- Typified by intense thunderstorm activity

- *Latitude of the ITCZ moves north and south* of the equator

- Due to the *tilted axis of Earth's rotation,* the area receiving the most sunlight shifts between 23.5° N and 23.5° S

- Explains the seasonal patterns of precipitation in the tropics



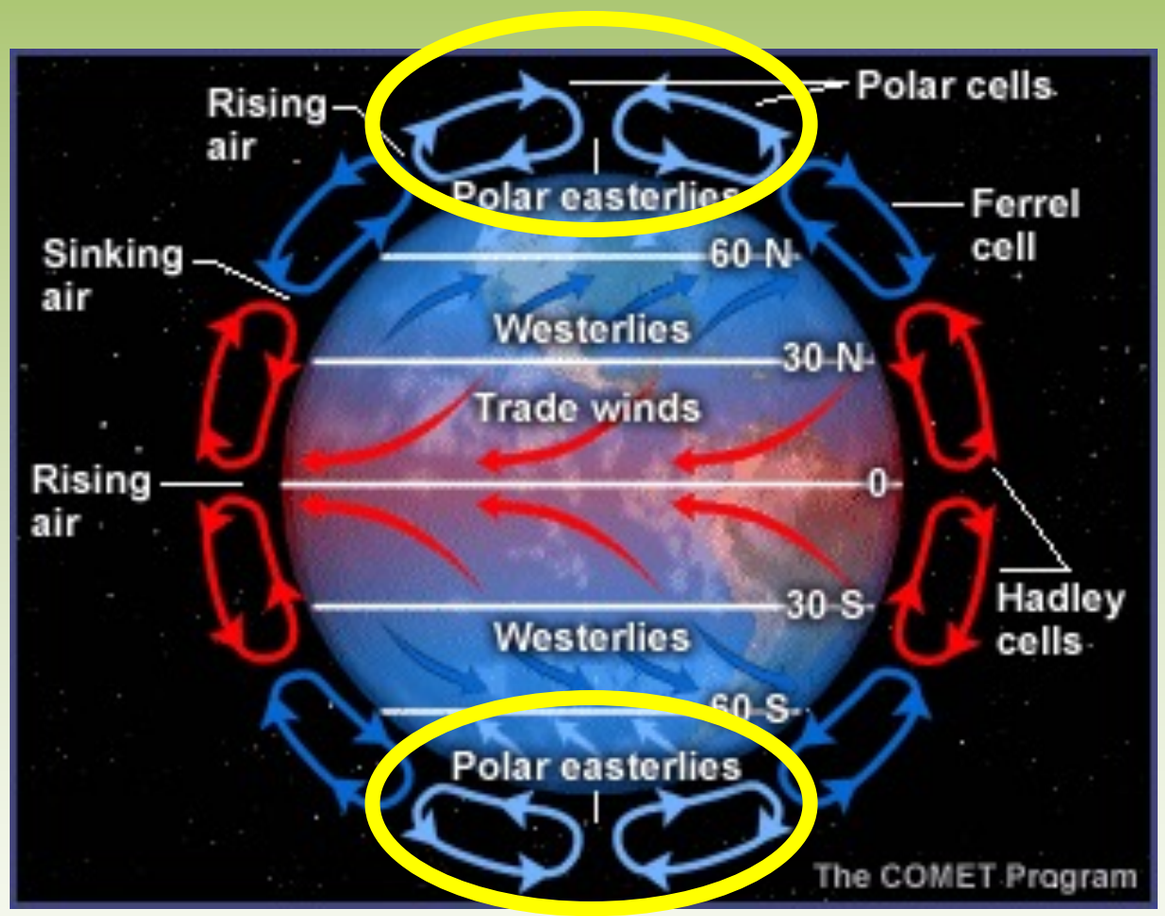
Formation of Convection Currents

- The **polar cells** are convection currents that are formed by air that *rises at 60° N and S and sinks at the poles (90° N and S)*

- At 60° N and S *rising air cools* and *water vapor condenses* into precipitation

- *Air dries as it moves towards the poles*, where it sinks back to Earth's surface.

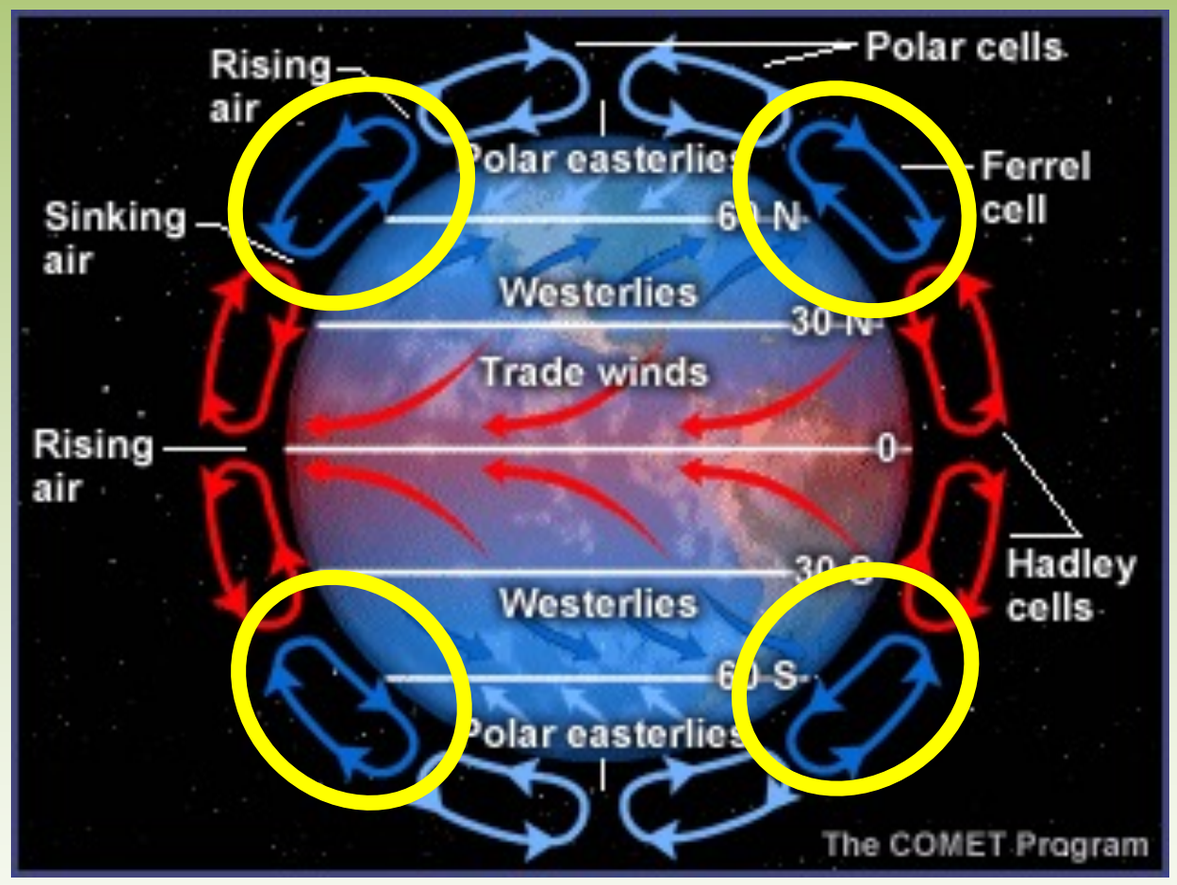
- At the poles the air moves across the surface back to 60° N and S, completing the cycle



Formation of Convection Currents

- Between Hadley and polar cells are **<u>ferrel cells</u>**

- Air circulation *does not form distinct convection cells*, but is driven by the air movement in the Hadley and polar cells



- At the Earth's surface, *warmer air from Hadley cells* moves toward the poles from 30° N and S and *cooler air from the polar cells* moves towards the equator from 60° N and S

- Allows wide range of warm and cold air currents to circulate between 30° and 60°

- Pattern of air circulation is responsible for location of rainforests, deserts, and grasslands

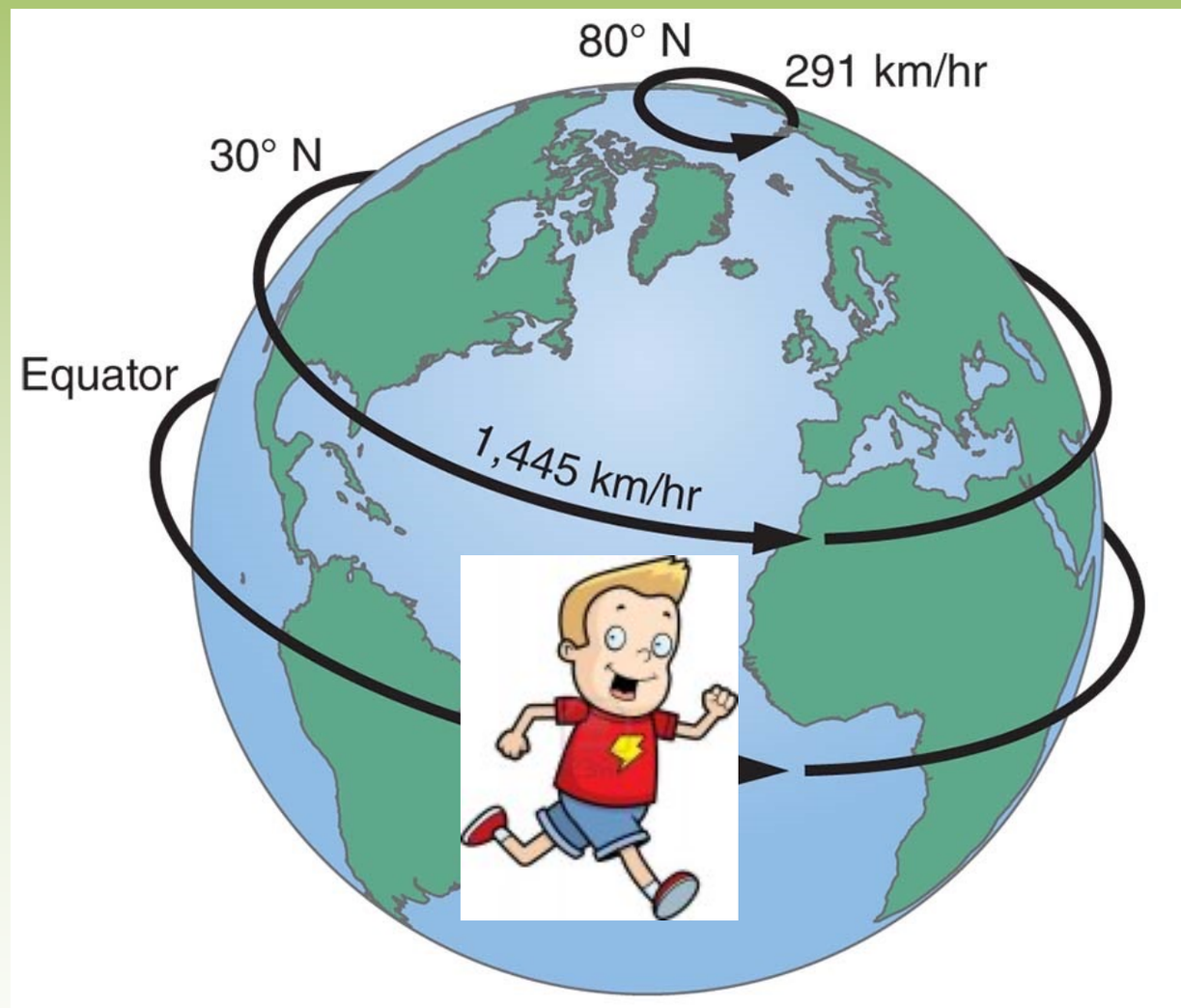
Formation of Convection Currents

The *rotation* of the Earth also influences air flow, weather and climate!

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)?



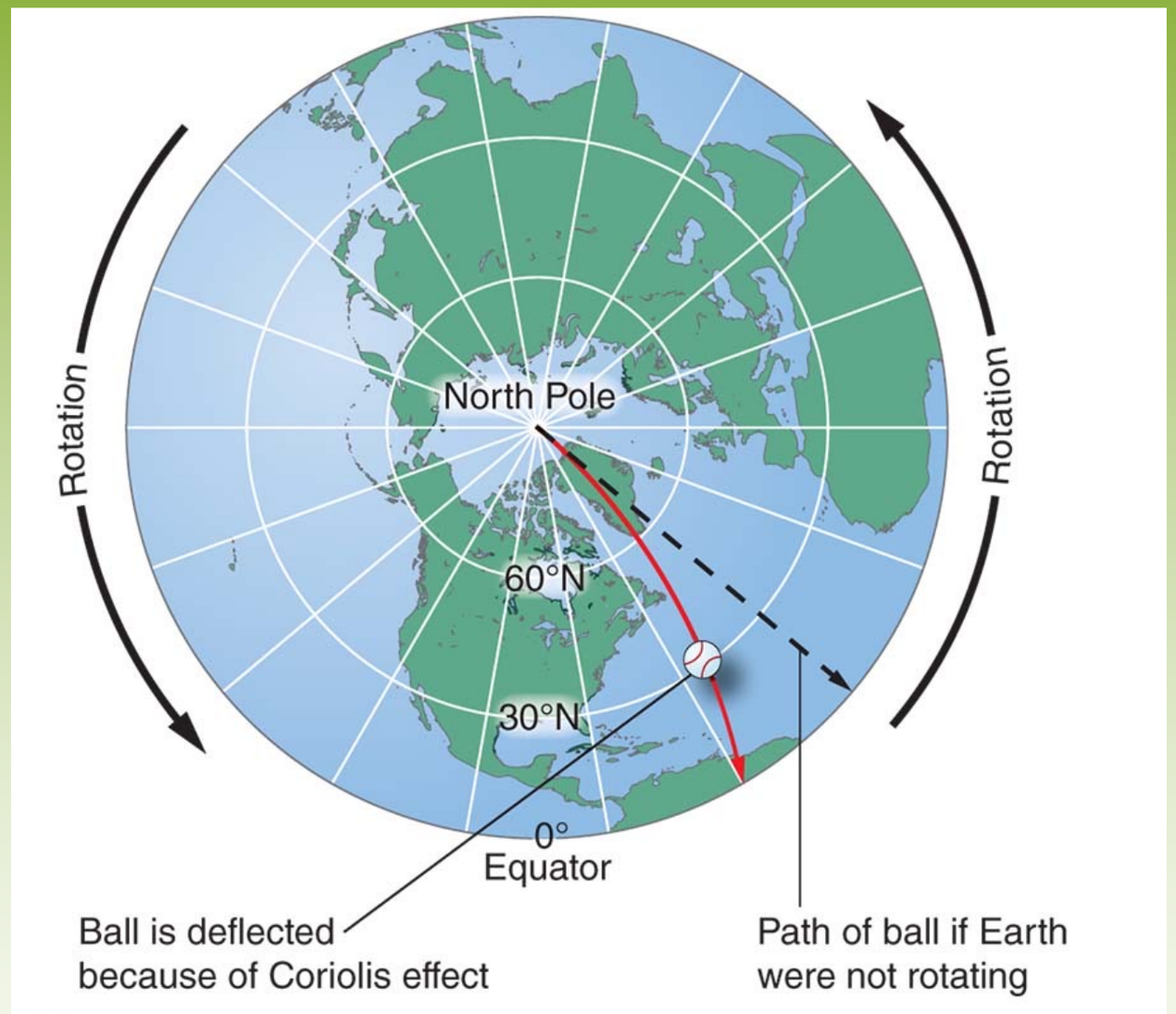
Earth's Rotation and the Coriolis Effect

- 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**