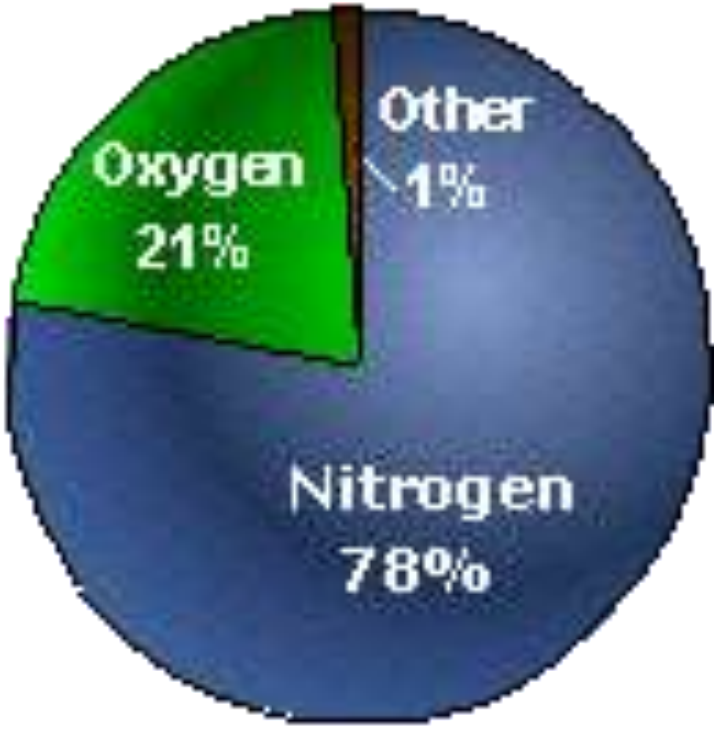
Atmosphere

Composition



- Nitrogen (N_2, 78%)
- Oxygen (O_2, 21%)
- Argon (Ar, 1%)
- other components are also present include Water (H_2O, 0 - 7%), Ozone (O_3, 0 - 0.01%), Carbon Dioxide (CO_2, 0.01-0.1%),

Present composition of the lower Atmosphere

Gas	Symbol	Percent by Volume
Nitrogen	N_2	78.08 %
Oxygen	O_2	20.94 %
Argon	Ar	0.934 %
Carbon Dioxide	CO_2	0.033 %
Neon	Ne	0.00182 %
Helium	He	0.00052%
Methane	CH_4	0.00015 %
Krypton	Kr	0.00011 %
Hydrogen	H	0.00005 %
Nitrous oxide	N_2O	0.00005 %
Xenon	Xe	0.000009 %

Water vapor varies depending on the location. From 0.01% to 5%

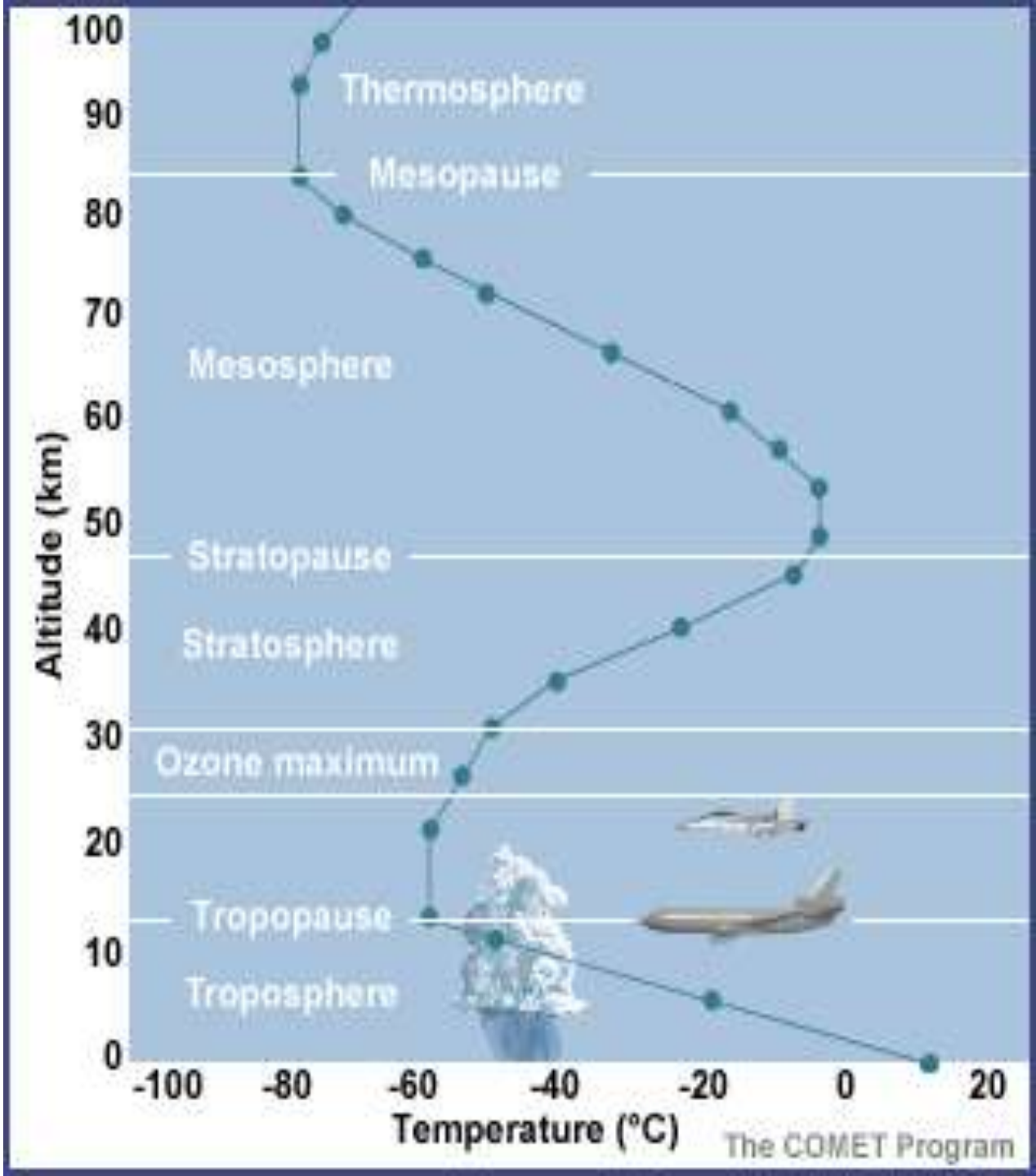
Earth's Atmosphere

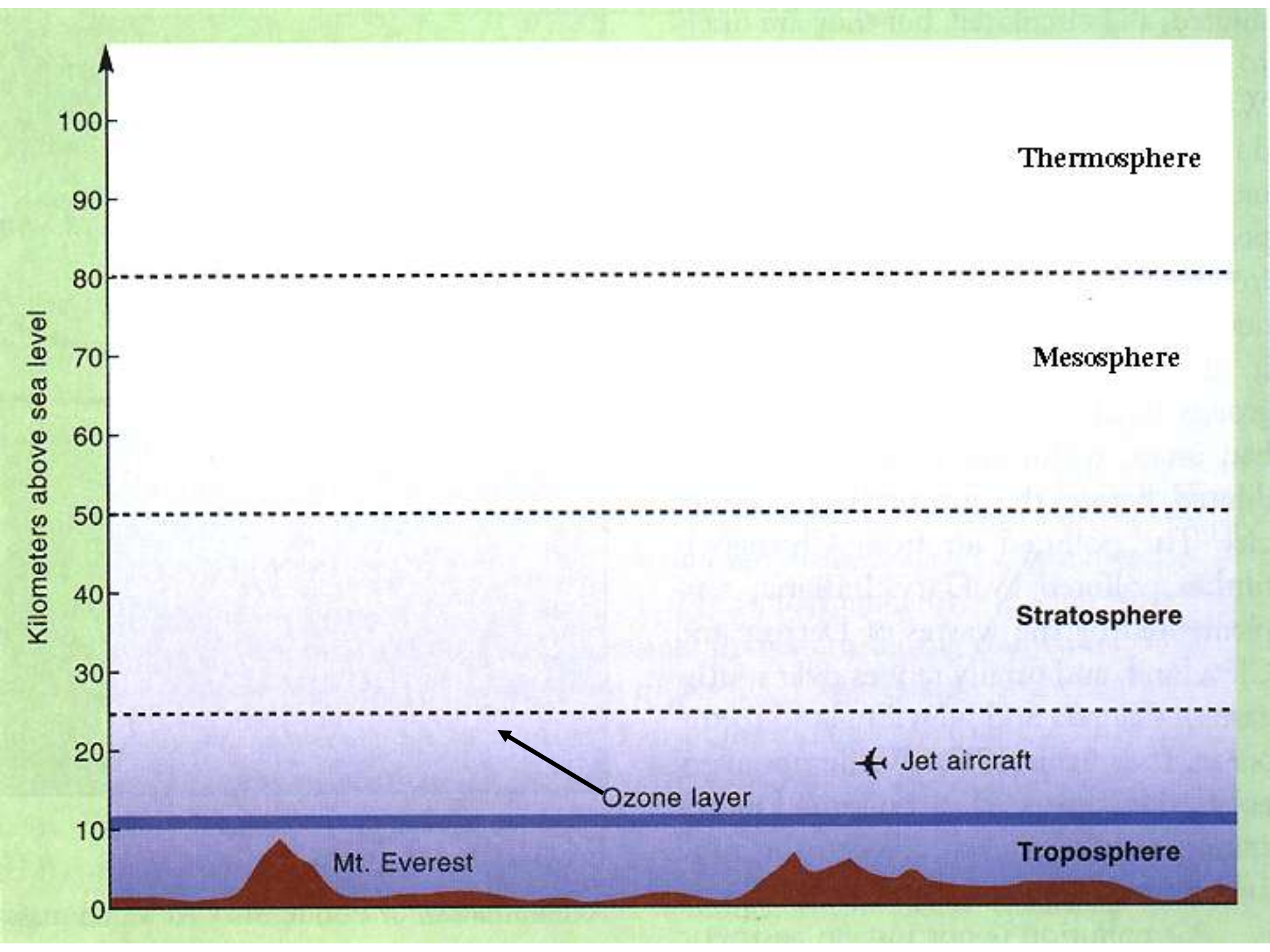
- the atmosphere is a thin shell (120 km).

http://www.gsfc.nasa.gov/gsfc/earth/pinatuboimages.htm

Atmosphere Layers

- Exosphere
- Thermosphere
- (Ionosphere)
- Mesosphere
- Stratosphere
- Troposphere




Kilometers above sea level
100
90
80
70
60
50
40
30
20
10
0
Thermosphere
Mesosphere
Stratosphere
Troposphere
Ozone layer
Jet aircraft
Mt. Everest

Troposphere

- 8 to 14.5 kilometers high (5 to 9 miles)
- most dense
- the temperature drops from about 17 to -52 degrees Celsius
- almost all weather is in this region

Stratosphere

- extends to 50 kilometers (31 miles) high
- dry and less dense
- temperature in this region increases gradually to -3 degrees Celsius, due to the absorption of ultraviolet radiation
- ozone layer absorbs and scatters the solar ultraviolet radiation
- ninety-nine percent of "air" is located in first two layers
- every 1000-m 11% less air pressure

Mesosphere

- extends to 85 kilometers (53 miles) high
- temperatures again fall as low as -93 degrees Celsius
- called the middle atmosphere by scientists

Thermosphere

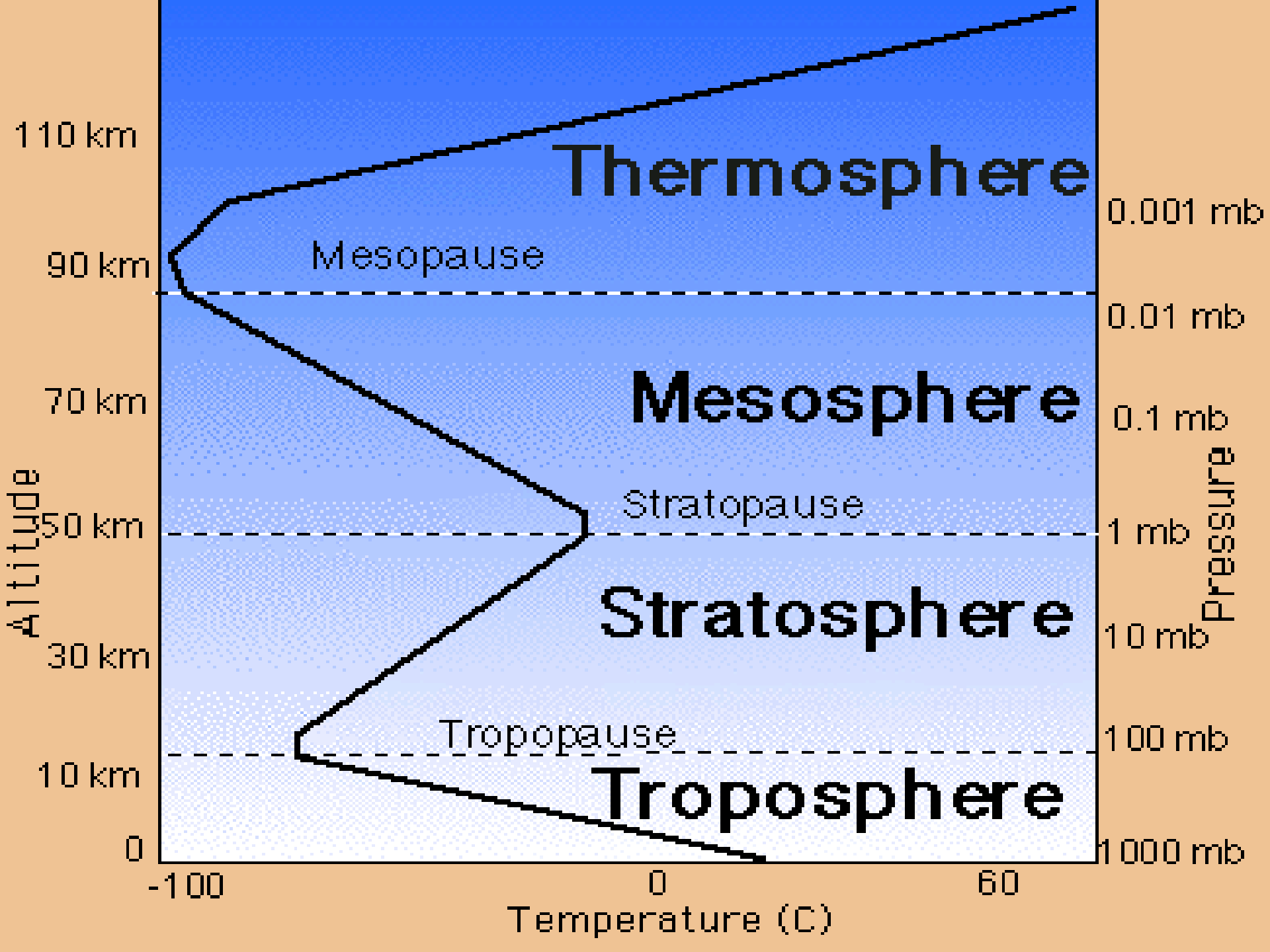
- extends to 600 kilometers (372 miles) high
- temperatures go up as altitude increases due to the Sun's energy
- temperatures in this region can go as high as 2000 degrees Celsius
- known as the upper atmosphere

Exosphere

- starts at the top to the thermosphere and continues until it merges with interplanetary gases, or space (372 to 6200 miles)
- hydrogen and helium are the primary components and are only present at extremely low densities

Ionosphere

- when solar energy is absorbed directly by air molecules, the atoms gain or lose electrons and become charged particles called ions
- many gas molecules at altitudes of 80 - 400 km (mesosphere and thermosphere) have electrically charged particles
- reflects many types of radio waves allowing them to bounce around the world

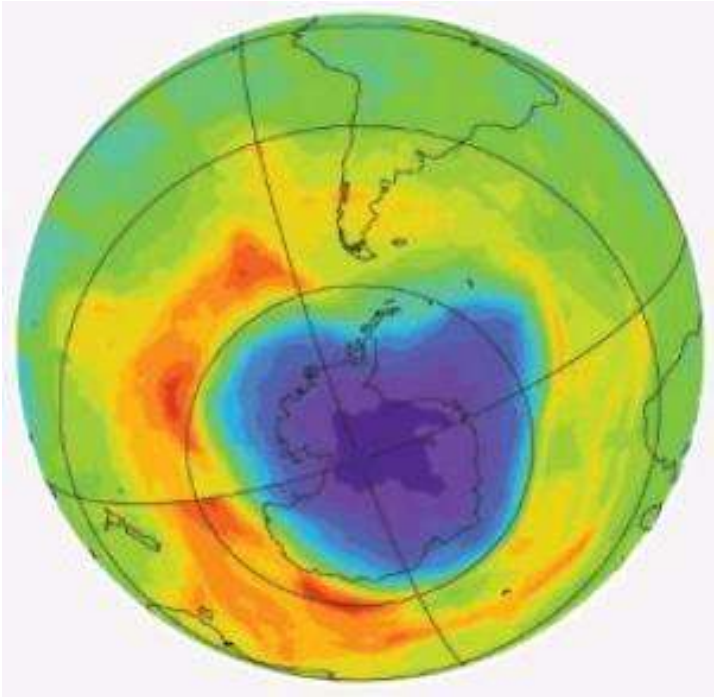

110 km
90 km
70 km
50 km
30 km
10 km
0
Altitude
Thermosphere
Mesopause
Mesosphere
Stratopause
Stratosphere
Tropopause
Troposphere
0.001 mb
0.01 mb
0.1 mb
1 mb
10 mb
100 mb
1000 mb
Pressure
-100
0
60
Temperature (C)

Atmospheric Pressure

- The lower the elevation the higher the pressure

Ozone Layer

- Layer in the stratosphere that protects form UV layer
- Ozone O_3
- Depletion of ozone



Energy from the Sun

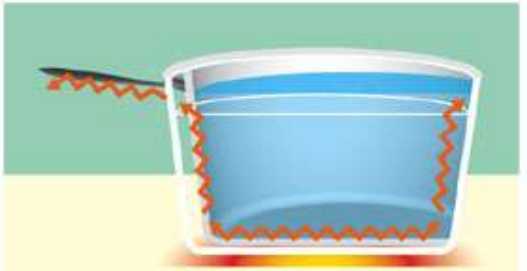
- Energy is transferred in three ways
  - Radiation
    - Transfer of energy by electromagnetic waves
  - Conduction
    - Transfer of energy by matter in direct contact
  - Convection
    - Transfer of energy by direct flow of the fluid

Types of Heat Transfer

Convection

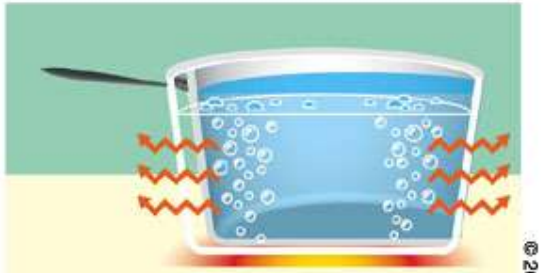
Heating water in the bottom of a pan causes some of the water vaporize into bubbles. Because they are lighter than the surrounding water, they rise. Water then sinks from the top to replace the rising bubbles. This up and down movement (convection) eventually heats all of the water.

Conduction



Heat from a stove burner causes atoms or molecules in the pan's bottom to vibrate faster. The vibrating atoms or molecules then collide with nearby atoms or molecules, causing them to vibrate faster. Eventually, molecules or atoms in the pan's handles are vibrating so fast it becomes too hot to touch.

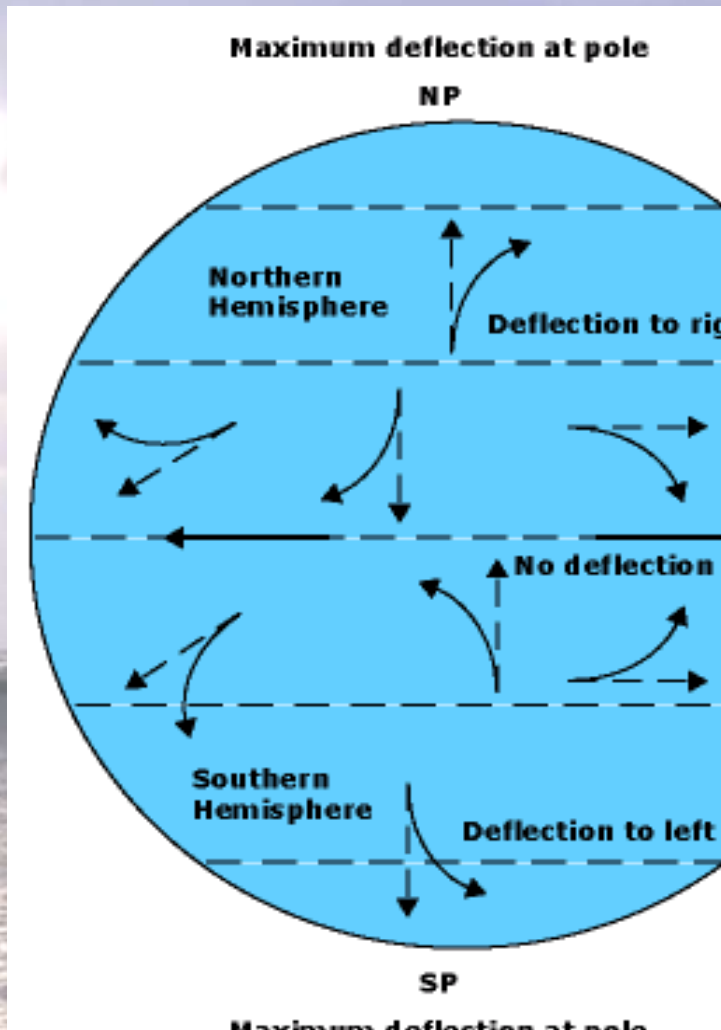
Radiation



As the water boils, hear from the hot stove burner and pan radiate into the surrounding air, even though air conducts very little heat.

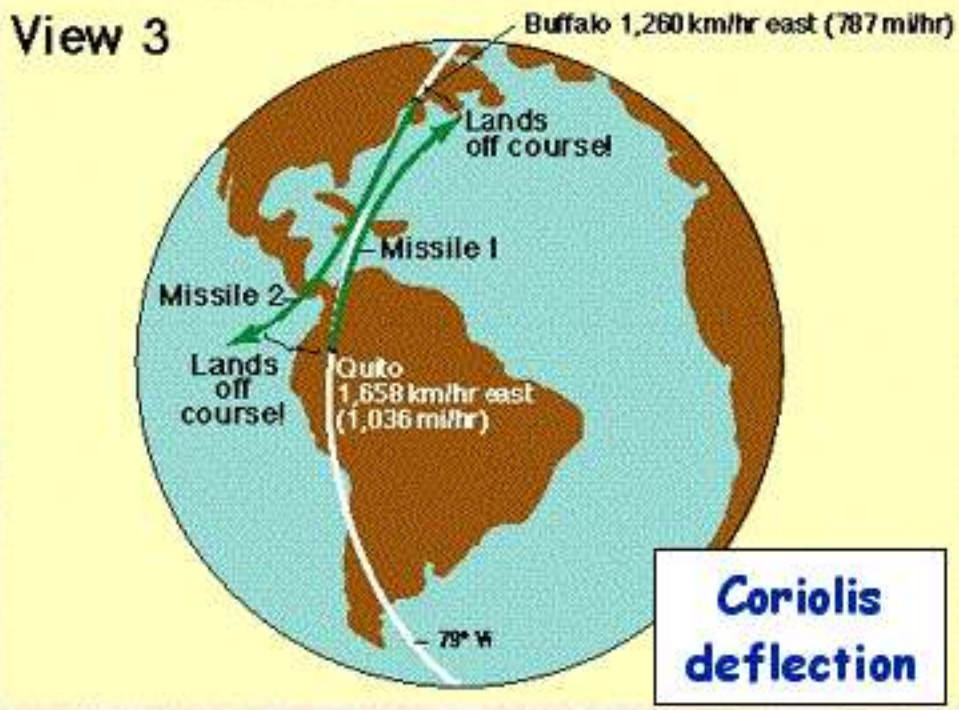
Air Movement

- **Surface winds page 412 in Text**
  - **Caused by corialis effect**
  - **Caused by convection currents**

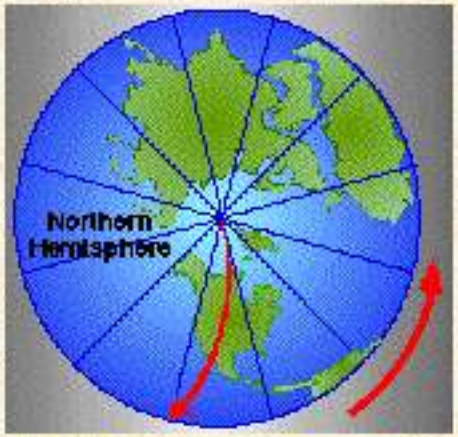


Coriolis Effect:

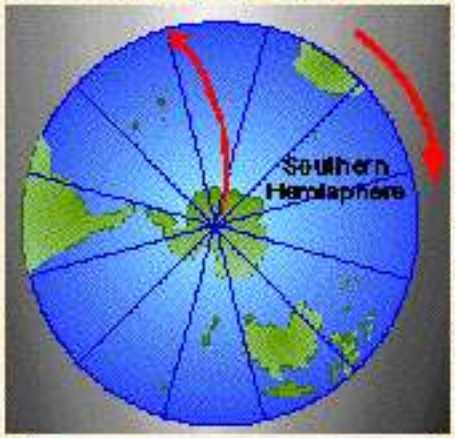
- rotation of Earth deflects objects moving through the air
- deflected to right in northern hemisphere
- deflected to left in southern hemisphere
- no deflection at equator



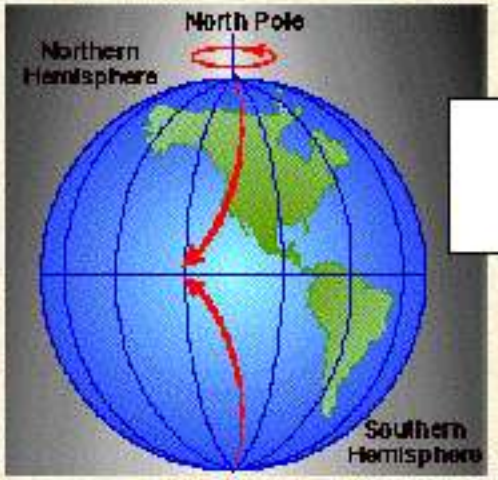
Coriolis deflection



N. hemisphere



S. hemisphere



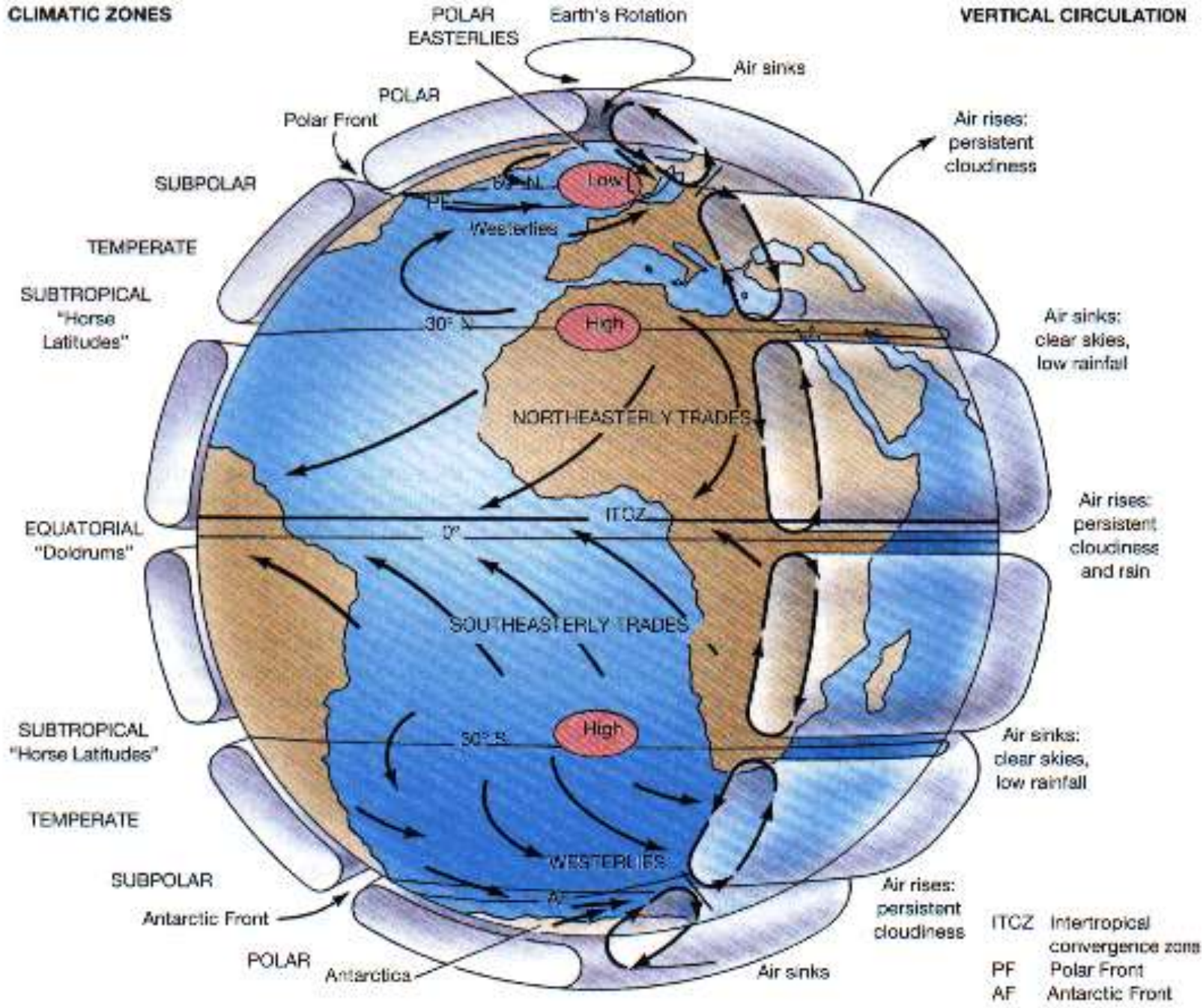
net effect

The Coriolis Effect

Caused by the earth's rotation

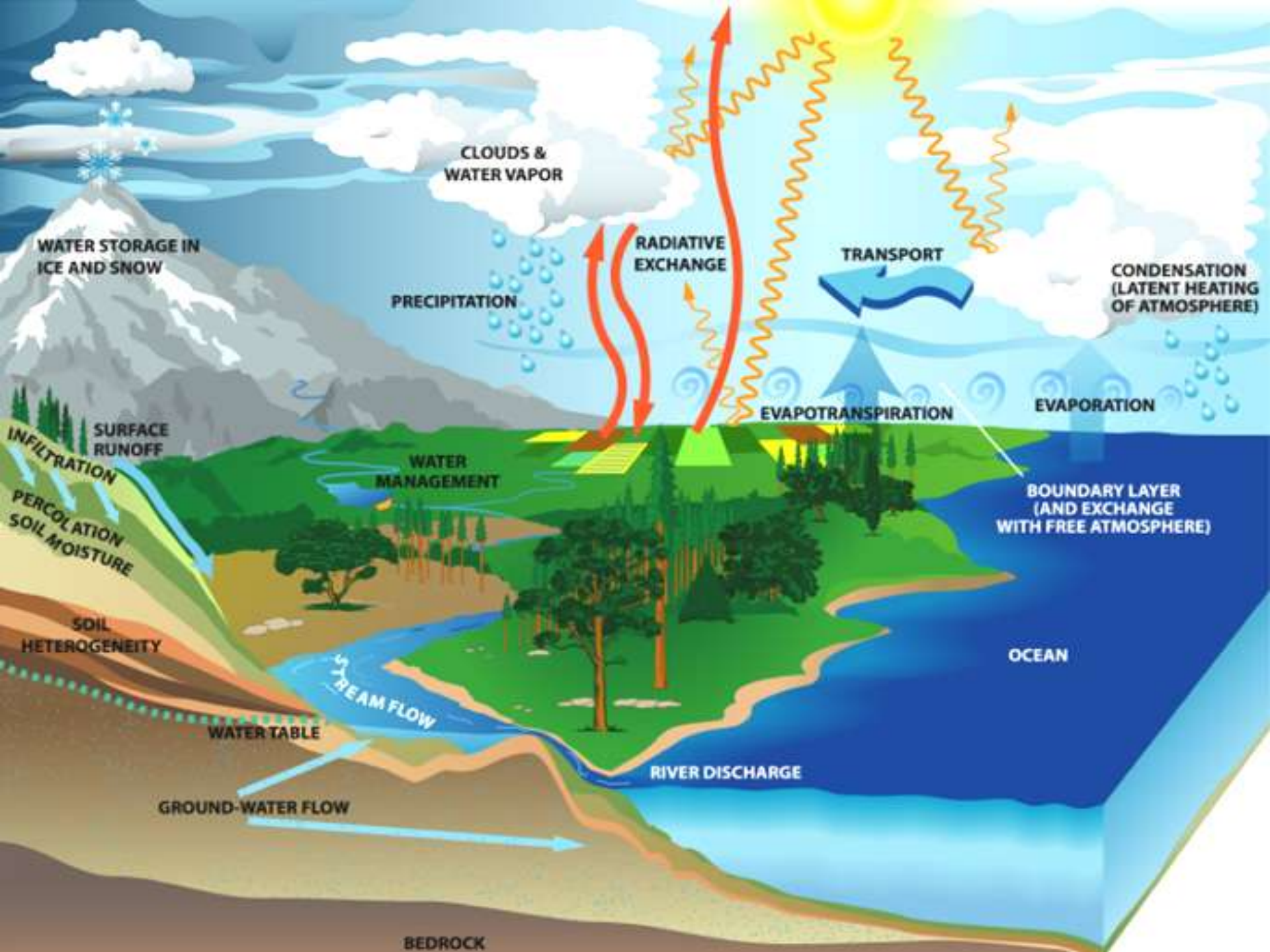
Objects deflect to the right in the Northern hemisphere

Objects deflect to the left in the Southern Hemisphere


CLIMATIC ZONES
VERTICAL CIRCULATION
POLAR EASTERLIES
Earth's Rotation
Air sinks
POLAR
Polar Front
Air rises: persistent cloudiness
SUBPOLAR
Low
PF
Westerlies
TEMPERATE
SUBTROPICAL "Horse Latitudes"
30° N
High
Air sinks: clear skies, low rainfall
NORTHEASTERLY TRADES
ITCZ
EQUATORIAL "Doldrums"
0°
Air rises: persistent cloudiness and rain
SOUTHEASTERLY TRADES
SUBTROPICAL "Horse Latitudes"
30° S
High
Air sinks: clear skies, low rainfall
TEMPERATE
WESTERLIES
SUBPOLAR
AF
Antarctic Front
Air rises: persistent cloudiness
POLAR
Antarctica
Air sinks
ITCZ Intertropical convergence zone
PF Polar Front
AF Antarctic Front

Water Cycle - See page 406

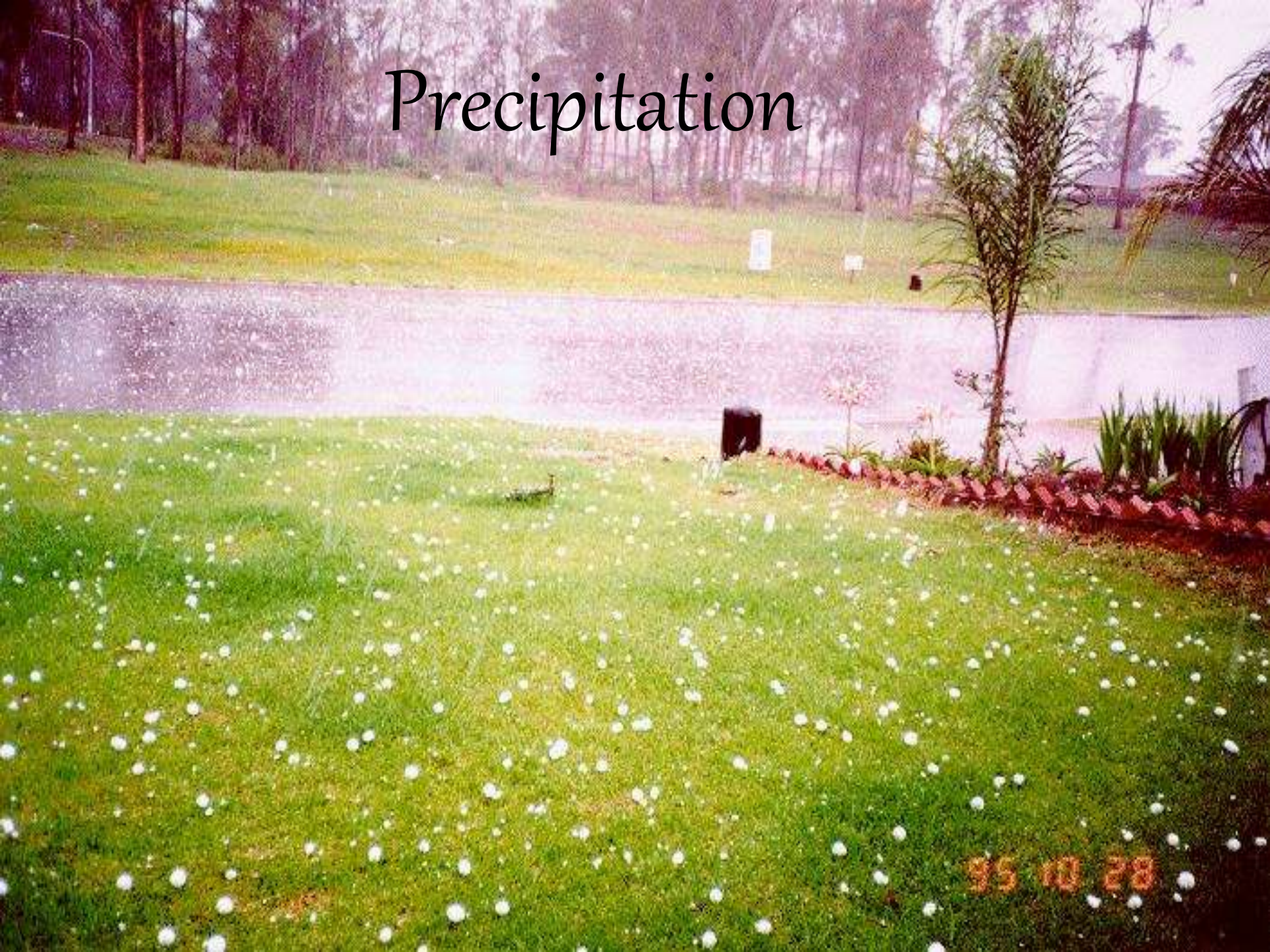
1. Evaporation
2. Condensation
3. Precipitation


CLOUDS &
WATER VAPOR
WATER STORAGE IN
ICE AND SNOW
PRECIPITATION
RADIATIVE
EXCHANGE
TRANSPORT
CONDENSATION
(LATENT HEATING
OF ATMOSPHERE)
EVAPOTRANSPIRATION
EVAPORATION
SURFACE
RUNOFF
INFILTRATION
WATER
MANAGEMENT
BOUNDARY LAYER
(AND EXCHANGE
WITH FREE ATMOSPHERE)
PERCOLATION
SOIL MOISTURE
SOIL
HETEROGENEITY
OCEAN
STREAM FLOW
WATER TABLE
RIVER DISCHARGE
GROUND-WATER FLOW
BEDROCK

Evaporation

Condensation

Precipitation



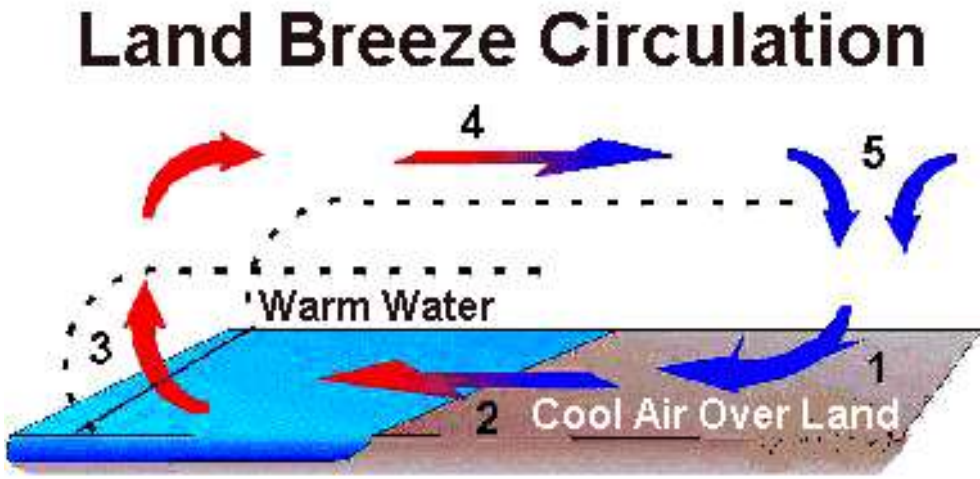

Transpiration

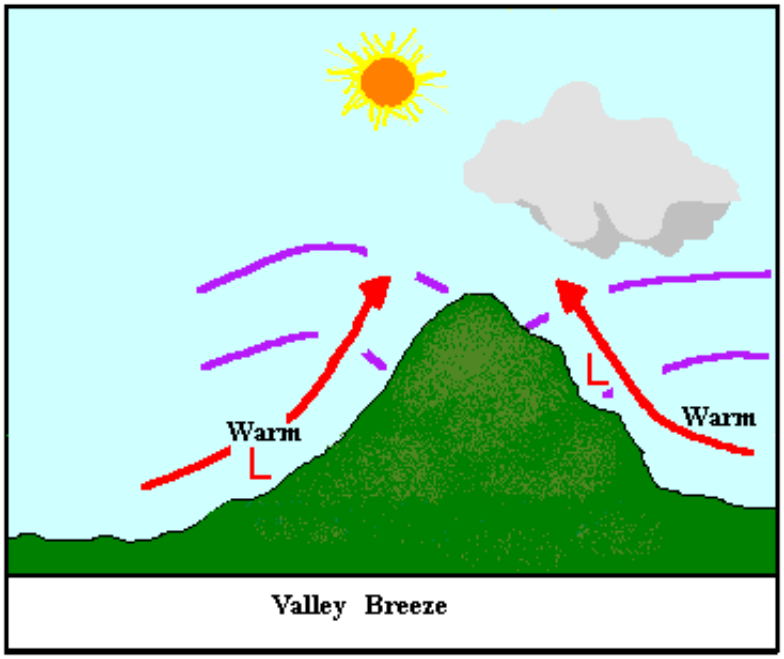
High Altitude winds

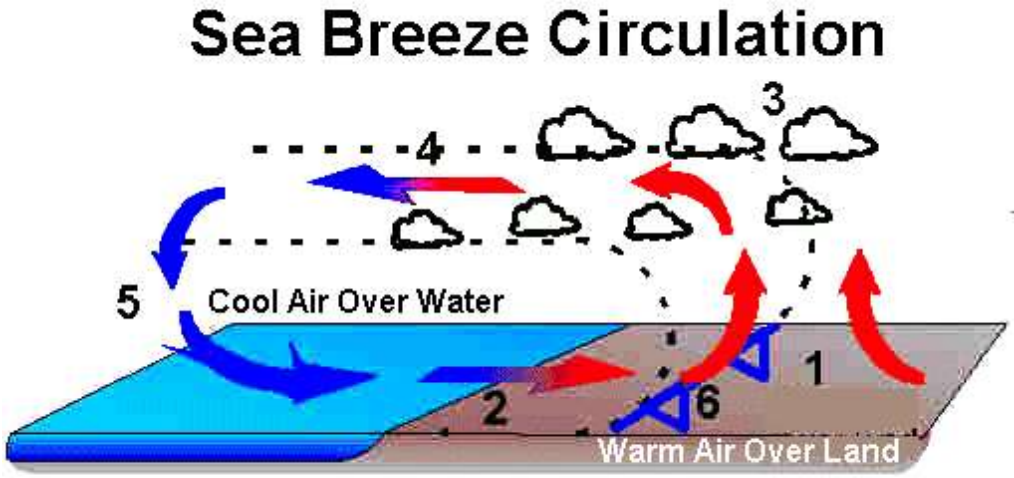
- **Jet stream**

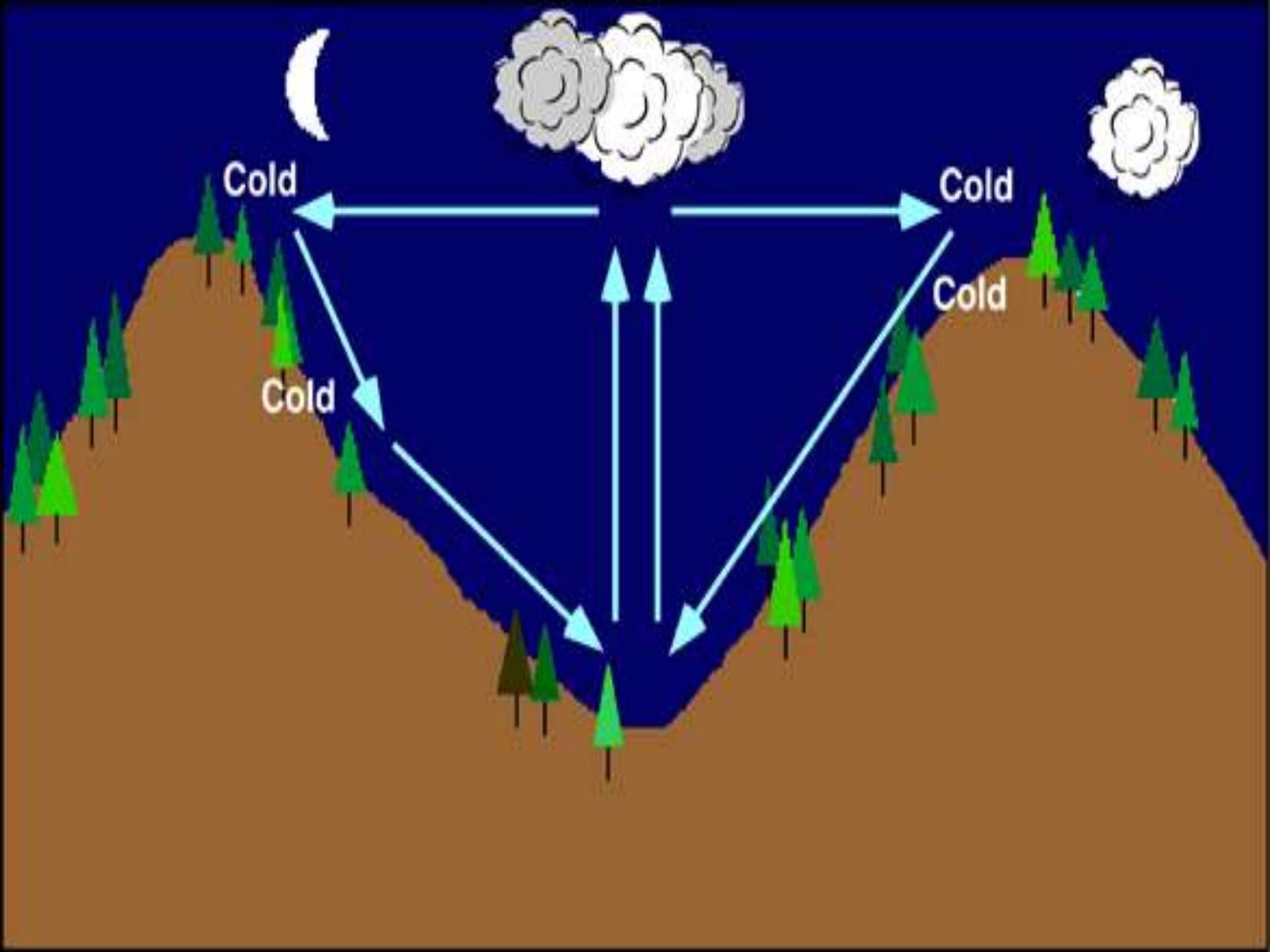
C. Daily and seasonal winds

1. Sea breeze
2. Land Breeze
3. Mountain breeze








Cold
Cold
Cold
Cold

Quiz

1. Name the three ways that heat is transferred.
2. Name the layers of the Atmosphere from the earth outward.
3. What is the corialis effect?
4. What is the prevailing wind from 30 to 60 degrees?