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## EARTH SCIENCE – UNIT 7 – CHAPTER 15 NOTES

### ATMOSPHERE

#### 15.1 Earth's Atmosphere

- 2 major gases: oxygen (21%) and nitrogen (78%)
- 3 trace gases: argon, carbon dioxide, and water vapor
- 7 super-trace gases: neon, helium, methane, xenon, krypton, hydrogen, and ozone
- The 3 trace gases and the 7 super-trace gases add up to 1% of the atmosphere.

**\*\*SHOW PIE CHART DIAGRAM OF ATMOSPHERIC GASES\*\***

#### 15.1 Layers of the Atmosphere

5. EXOSPHERE =
  - upper-most layer of the atmosphere
  - borders “outer space”
  - There is no clear boundary between the top of the exosphere and the beginning of space.
  - There are very few molecules in the exosphere.
4. THERMOSPHERE =
  - contains a layer of electrically charged particles (also called the ionosphere)
  - In the daytime, these particles interfere with radio transmission.
  - At night, these particles do not interfere with radio transmission.
  - Therefore, radio signals are “stronger” and go farther at night.
3. MESOSPHERE =
  - the middle layer of the atmosphere
2. STRATOSPHERE =
  - contains the ozone layer (which protects us from the sun's ultraviolet radiation)
  - contains the jet streams
1. TROPOSPHERE =
  - the lowest layer of the atmosphere
  - contains 75% of all atmospheric gases
  - contains weather, clouds, smog, dust, ice (snow), liquid water (rain)

#### 15.1 Pressure and Temperature

- HOT AIR: molecules are able to spread apart
  - low density
  - low air pressure
  - hot air always rises!

**\*\*SHOW DIAGRAM OF PARTICLES THAT ARE FOUND IN HOT AIR\*\***

- COLD AIR: molecules are packed tightly together
  - high density
  - high air pressure
  - cold air always sinks!

**\*\*SHOW DIAGRAM OF PARTICLES THAT ARE FOUND IN COLD AIR\*\***

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### 15.1 Pressure, Temperature, and the Atmosphere

- Air pressure is highest in the troposphere, and becomes less and less as you move up in the air.
- The exosphere has the lowest air pressure because it contains so few gas particles.
- As you move up in the troposphere, the temperature decreases until you reach the stratosphere.
- As you move up in the stratosphere, the temperature increases until you reach the mesosphere.
  - The stratosphere contains ozone, which absorbs sunlight, making it get hotter.
- As you move up in the mesosphere, the temperature decreases until you reach the thermosphere.
- As you move up in the thermosphere and exosphere, the temperature increases.
  - The thermosphere contains electrically-charged particles, making it get hotter.
- Therefore, the divisions of the atmosphere into its 5 layers are primarily based on temperature variations.

### 15.1 The Ozone Layer: CFC's and The Ozone Hole

#### - SILENT READING

1. What is the cause of CFC's? (Where do they come from?)
2. What is the effect of CFC's? (How do they impact the atmosphere?)

### 15.2 Energy From the Sun

- reflection = when the light bounces off of an object (in this case, the Earth)
  - absorption = when the light does not bounce off of an object and is taken into it
  - thin atmosphere: most of the sun's energy is reflected back into space (bounces off Earth)
    - EX: Mercury or Mars (weather is warm/hot in the daytime and freezing cold at night)
  - thick atmosphere: most of the sun's energy is absorbed or trapped
    - EX: Venus (weather is very hot in the daytime and very hot at night)
  - medium atmosphere: some of the energy is reflected and some is absorbed/trapped
    - EX: Earth (moderate temperatures during the daytime and at night)
- \*\*SHOW DIAGRAMS OF THIN, THICK, AND MEDIUM ATMOSPHERES\*\***

### 15.2 Radiation

- the transfer of energy through electromagnetic waves
  - does NOT require direct contact with the heat source (you don't touch it)
  - EX: tanning on a beach
  - EX: sitting in front of a fireplace or campfire
  - Energy is ALWAYS transferred from the warmer object to the cooler object!
  - It is NEVER transferred from the cooler object to the warmer object.
  - Some radiation is reflected back into space and some is absorbed.
- \*\*SHOW DIAGRAM OF ABSORPTION AND REFLECTION\*\***

- 1. 15%: Energy is absorbed by the clouds and atmosphere.
- 2. 50%: Energy is absorbed by Earth's surface.
- 3. 5%: Energy is reflected off of Earth's surface.
- 4. 30%: Energy is reflected off of the clouds and atmosphere.

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### 15.2 Conduction

- the transfer of energy when molecules bump into each other
- requires a direct contact with the heat sources (the 2 objects must touch each other)
- Energy is ALWAYS transferred from the warmer object to the cooler object!
- It is NEVER transferred from the cooler object to the warmer object.
- Warmer objects have fast-moving molecules (more energy).
- Cooler objects have slow moving molecules (less energy).
- EX: ice melting into a glass of soda (the soda is the warmer object)
- EX: walking barefoot on hot pavement (the pavement is the warmer object)
- EX: a baby touching a hot stove (the stove top is the warmer object)

### 15.2 Convection

- the transfer of energy when molecules by the flow of a heated material (liquid or gas)
- warm air: molecules spread out  
takes up more volume  
is less dense  
has a lower air pressure
- cold air: molecules are close together  
takes up less volume  
is more dense  
has a higher air pressure
- Hot air rises and cool air sinks due to DENSITY differences.
- Hot air is less dense, so it rises. Cool air is more dense, so it sinks.
- This produces a circular movement of air called a convection current.
- \*\*DRAW DIAGRAM OF A CONVECTION CURRENT\*\*
- EX: The attic is the warmest part of a house. The basement is the coolest.
- EX: Convection currents in Earth's upper mantle cause divergent or convergent boundaries.

### 15.3 Movement of Air

- wind =
  - the movement of air from high pressure to low pressure
  - caused by the uneven heating of Earth's surface
  - uneven heating is caused by Earth's tilt of 23.5°
  - winds are named based on where they come FROM
  - EX: a westerly wind blows from west to east
  - EX: an easterly wind blows from east to west
- cold air =
  - originates at the poles
  - sinks because it has a high density and a high air pressure
- warm air =
  - originates at the equator
  - rises because it has a low density and a low air pressure
- Coriolis Effect =
  - the effect of Earth's rotation on air and water
  - northern hemisphere = clockwise movement of water and air
  - southern hemisphere = counter-clockwise movement of water and air

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### 15.3 Surface Winds

- global wind patterns caused by the uneven heating of Earth's surface
- creates convection currents in Earth's atmosphere

- Polar Easterlies:	east → west	90°N (north pole) – 60°N
- Prevailing Westerlies:	west → east	60°N – 30°N
- Trade Winds:	east → west	30°N – equator
- Doldrums:	no movement	equator
- Trade Winds:	east → west	equator – 30°S
- Prevailing Westerlies:	west → east	30°S – 60° S
- Polar Easterlies:	east → west	60°S – 90°S (south pole)

**\*\*SHOW DIAGRAM OF EARTH'S SURFACE WINDS\*\***

- jet streams =
  - narrow belts of strong winds in the stratosphere that blow primarily from west to east at the border between the different surface winds
  - located at 60°N, 30°N, 30°S, and 60°S
  - planes save fuel when flying east
  - planes try to avoid jet streams when flying west

### 15.3 Daily Winds

1. Sea Breeze =

- In daytime, sunlight heats the land more than the water.
- The air over the land is heated by conduction and rises.
- Cool, more dense air over the water sinks and moves over the land.
- This is called a sea breeze because the wind comes FROM the water TO the land.
- EX: The wind blows from the ocean back onto the beach.
- THE WIND BLOWS FROM THE WATER TO THE LAND (DAYTIME ONLY).

2. Land Breeze =

- At night, the land cools more quickly than the water.
- The air over the land becomes cooler than the air over the water.
- The cooler, more dense air over the land sinks and moves over the water.
- The warm air over the water rises and moves over the land.
- This is called a land breeze because the wind comes FROM the land TO the water.
- EX: The wind blows from the beach back into the ocean.
- THE WIND BLOWS FROM THE LAND TO THE WATER (NIGHT-TIME ONLY).

**\*\*SHOW DIAGRAMS OF A SEA BREEZE AND A LAND BREEZE\*\***