

**Chapter 13 - Atmospheric Science and Air Pollution**

- I. Atmosphere (describe the composition, structure, and function, define atmosphere)
  - a. Troposphere (bottom layer, drives weather, troposphere) – the bottom most layer of the atmosphere; it extends to 11 km (7 mi) above sea level
  - b. Stratosphere (little vertical mixing, ozone layer) – the layer of the atmosphere above the troposphere; it contains the ozone layer and extends 11-50 km (7-31 mi) above sea level
  - c. Mesosphere (burns up meteors) – the layer of atmosphere above the stratosphere, 30-50 mi
  - d. Thermosphere (top layer that extends to space/exosphere) – the top one
- II. Relate weather and climate to atmospheric conditions (weather vs. climate)
  - a. Sun's influence on weather and climate
  - b. Convective Circulation – a circular current (of air, water, magma, etc.) driven by temperature difference. In the atmosphere, warm air rises into regions of lower atmospheric pressure, where it expands and cools and then descends and becomes denser, replacing warm air that is rising. The air picks up heat and moisture near ground level and prepares to rise again, continuing the process
  - c. Thermal inversion – A departure from the normal temperature distribution in the atmosphere, in which a pocket of relatively cold air occurs near the ground, with warmer air above it. The cold air, denser than the air above it, traps pollutants near the ground and can thereby cause a buildup of smog.
  - d. Global Patterns
    - i. Hadley cells – SEE BELOW
    - ii. Ferrel cells – SEE BELOW
    - iii. polar cells – SEE BELOW
    - iv. Coriolis effect – SEE BELOW
- III. Outdoor Air Quality – identify major outdoor pollutants and assess strategies for pollution control (pollutants, air pollution, outdoor air pollution)
  - a. Natural sources (fires, volcanic eruptions, windblown dust from erosion, dust storms)
  - b. Human caused outdoor air pollution (Clean Air Act (EPA – Environmental Protection Agency) - U.S. legislation to control air pollution, first enacted in 1963 and amended multiple times since, most significantly in 1970 and 1990. Funds research into pollution control, sets standards for air quality, encourages emissions standards for automobiles and for stationary point sources such as industrial plants, imposes limits on emissions from new sources, funds a nationwide air quality monitoring system, enables citizens to sue parties violating the standards, and introduced an emissions trading program for sulfur dioxide.
    - i. Monitors – CO, SO<sub>2</sub>, NO<sub>x</sub>, VOCs, particulate matter, Pb
    - ii. Primary pollutants – A hazardous substance, such as soot or carbon monoxide, that is emitted into the troposphere directly from a source.
    - iii. Secondary pollutants – A hazardous substance produced through the reaction of primary pollutants with one another or with other constituents of the atmosphere
    - iv. Residence time – In a biogeochemical cycle, the amount of time a nutrient typically remains in a given pool or reservoir before moving to another. OR in the atmosphere, the amount of time a gas molecule or a pollutant typically remains aloft.
    - v. Criteria pollutants -
      1. Carbon monoxide (CO)
      2. Nitrogen dioxide (NO<sub>2</sub>) and nitrogen oxides (NO<sub>x</sub>)
      3. Tropospheric ozone (O<sub>3</sub>) – ground-level ozone

# Environmental Biology Study Guide

**Wenbin Ji**



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