CH18 - Air Pollution

The Atmosphere

- The atmosphere is the thin layer of gases that surrounds the Earth
  - 78% _____
  - 21% oxygen
  - 0.9% argon
  - 0.1% water vapor, carbon dioxide, neon, helium and other trace gases

Layers of the Atmosphere

- The _____ extends from the Earth's surface up to about 10 km.
  - It contains 75-80% of the atmosphere's gases
  - Layer in which most weather occurs
- The Stratosphere extends from 10 km to about 50 km above the Earth
  - contains the _____ layer which absorbs the majority of the ultraviolet radiation from the sun
- The Mesosphere extends from 50 km to about 80 km above the Earth
  - The coldest layer of the atmosphere, dropping as low as -90^{o} C
- The Thermosphere extends from 80 km into outer space
  - The lower layer of the thermosphere is the ionosphere (80 km to 550 km) that can reflect radio waves back to Earth. It cannot reflect television waves, which have a shorter wavelength
  - The upper layer of the thermosphere is the exosphere, which extends for thousands of kilometers above the Earth, blending into the _____ of interplanetary space

Air Pollution

- Air pollution is the presence of one or more chemicals in the atmosphere in quantities and duration that cause harm to humans, other forms of life, and materials
- Products of natural events and human activities are called _____ pollutants
- Some primary pollutants may react with one another or with the basic components of air to form new pollutants called _____ pollutants

Major Classes of Air Pollutants

- Carbon Oxides (CO, CO_2)
- Sulfur Oxides (SO_2, SO_3)
- Nitrogen Oxides (NO, N_2O)
- _____ _____ Compounds – VOC's (CH_4, CFC's)
- Suspended Organic Particles (dust, soot, pesticides)
- _____ Oxidants (O_3, H_2O_2)
- Radioactive Substances (radon-222, plutonium-239)
- Toxic Compounds (mostly carcinogens)

Smog

- Air pollution known as photochemical smog is formed when _____ and _____ react with heat and sunlight to produce a variety of pollutants.
- Industrial smog consists mostly of sulfur dioxide formed from the burning of _____ and heavy oil

Air Pollution Control

- There are several ways to lower the amount of air pollution created before it actually enters the atmosphere.
  - _____ Converters – used in automobiles to convert CO, NO_x and hydrocarbons to less harmful gases (like CO_2)
  - Wet & Dry _____ – gases in smokestakes are passed through CaO (lime) or $CaCO_3$ (calcium carbonate) to remove SO_2, accumulating in a sludge.
  - Electrostatic Precipitators – removes _____ using an induced electric charge
  - Vapor Recovery Nozzle – on a gasoline pump minimized gas fumes from escaping
  - Afterburners – an additional combustion process

Acid Deposition

- Acid Deposition is the mixture of acidic rain, snow, fog, cloud vapor, and particles that reach the earth's surface.
- Effects of acid deposition include
    - direct damage to _____ foliage, bark and roots
    - soil acidification and death of microorganisms
    - lake _____ and stress of aquatic life

Indoor Air Pollution

- Air pollution is not limited to the outdoors. Buildings with particularly poor air quality are said to have sick-building syndrome. The EPA estimates 17% of U.S. commercial buildings are "sick".
- Causes of sick-building syndrome may include the presence of tobacco smoke, formaldehyde, gasoline, _____ gas, asbestos, carbon monoxide, VOCs and some species of fungi and _____.

Human Health

- Exposure to air pollutants, particularly cigarette smoke may lead to several human health issues
    - Lung _____
    - Asthma – muscle spasms in the bronchial walls
    - Chronic bronchitis – inflammation of cells lining the bronchi and bronchioles
    - _____ – damage to air sacs in lungs

Radon

- Radon-222 is a colorless, odorless, radioactive gas that is produced by the decay of uranium-238 in rocks and soil. The gas can seep upward through _____ and accumulate in unventilated lower levels of buildings.

Clean Air Acts

- The U.S. Congress passed Clean Air Acts in 1970, 1977, and 1990, and impose the following strategies
    - EPA establishment of national _____ _____ _____ standards (NAAQs)
    - EPA establishment of national emission standards for toxic air pollutants
    - Recent legislation, such as the "Clear Skies Initiative" (2003) have actually reduced the effectiveness of the Clean Air Act

Clean Air Acts – Deficiencies

- Continued reliance on pollution _____ rather than prevention
- Failure to sharply increase fuel efficiency standards for cars and light trucks
- No requirement for stricter emission standards for fine particulates
- Giving municipal trash incinerators 30-year permits
- Weak standards for _____
- Weak standards for emissions of CO_2 and other greenhouse gases