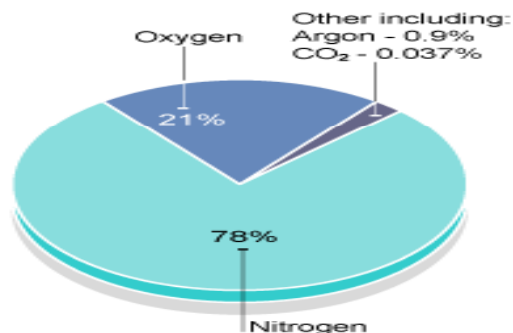


Air Pollution

Chapter 19

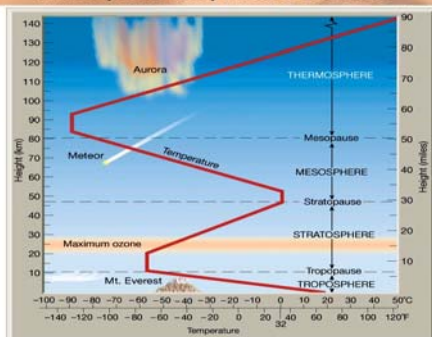


Gases in our Atmosphere



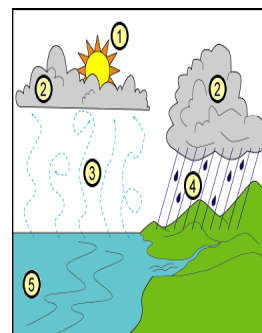
Layers of the Atmosphere - Review

Atmosphere Temperature Gradient



The Atmosphere performs additional ecosystem services

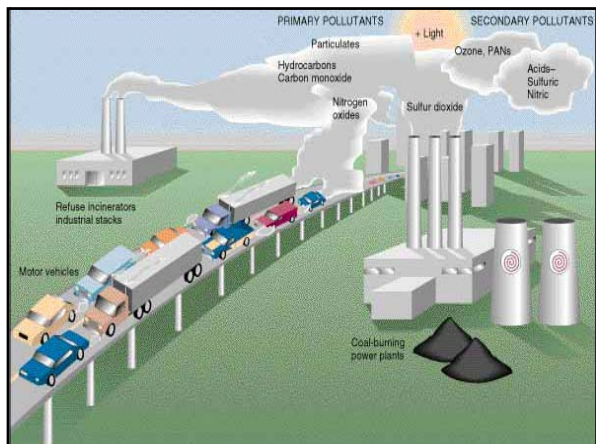
- Blocking the surface of the Earth from UV radiation.
- Moderating the Climate
- Redistributing water in the hydrological cycle



Air Pollution

- Gases, liquids or solids present in the atmosphere in high enough levels to harm humans, other organisms or materials

- **Primary Air Pollutants** – harmful chemicals that enter directly into the atmosphere.
- **Secondary Air Pollutants** – harmful chemicals that form from other substance that have been released into the atmosphere.



Major Air Pollutants

<p>Primary Pollutants</p> <ul style="list-style-type: none"> • Carbon Oxides <ul style="list-style-type: none"> - Carbon Monoxide (CO) - Carbon Dioxide (CO₂) • Nitrogen Oxides (NO_x) <ul style="list-style-type: none"> - Nitrogen dioxide (NO₂) - Nitrous Oxide (N₂O) • Sulfur Dioxide <ul style="list-style-type: none"> - SO₂ • Particulate Matter <ul style="list-style-type: none"> - Includes many things that could be pollutants <ul style="list-style-type: none"> • Examples - Lead (Pb) • Sulfuric Acid (H₂SO₄) 	<p>Secondary Pollutants</p> <ul style="list-style-type: none"> • Ozone - O₃ • Sulfur Trioxide
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Particulate Matter

- Consists of thousands of different solid and liquid particles that are suspended in the atmosphere.
- Reduces sunlight by scattering and absorbing sunlight.
- Microscopic particles are more dangerous than larger particles because they are inhaled more deeply into the lungs.

How Does PM become a problem for us?

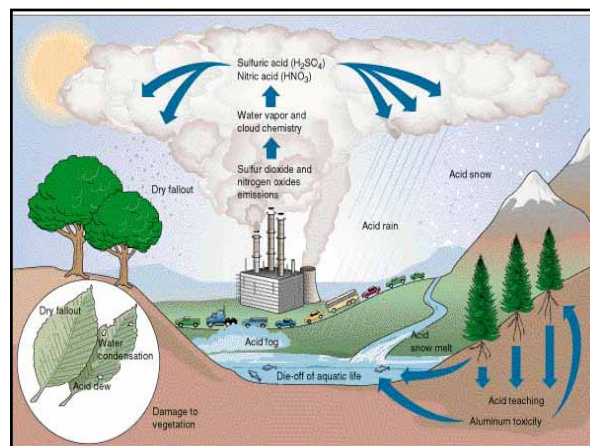
TRANSITION METALS LIKE: CHROMIUM, IRON AND COPPER ACT ON CELLS TO RELEASE TOXIC OXYGEN SPECIES

POLYAROMATIC HYDROCARBONS: THEY CAN ADHERE TO DNA

Particle diameter: 0.03 μm < Ø < 3 μm 3 μm < Ø < 10 μm Ø < 10 μm

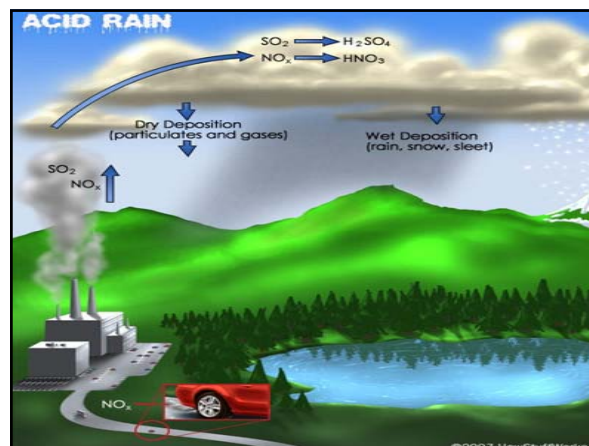
Nitrogen Oxides (NO_x)

- Nitrogen dioxide (NO₂)
- Nitrous Oxide (N₂O)
- Inhibit plant growth
- Aggravate asthma
- Corrode metals and cause textiles to fade and deteriorate.
- Nitrous Oxide traps heat = greenhouse gas.



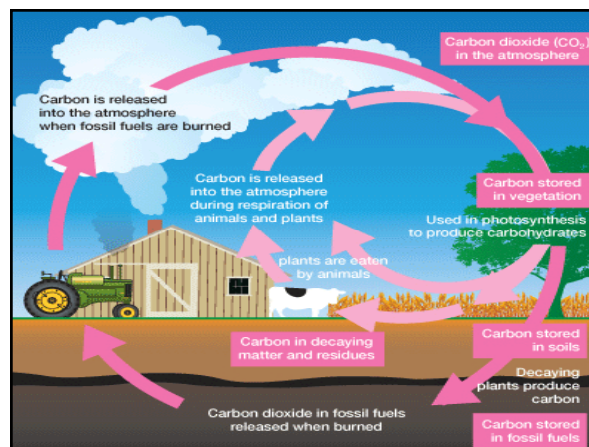
Sulfur Oxides

- SO_2 is a colorless, non-flammable, has a strong irritating odor. (PP)
- SO_3 – reacts with water to form sulfuric acid. (SP)
- Damage plants and irritate the respiratory tracts of humans



Carbon Oxides

- **Carbon Monoxide (CO)** – colorless, odorless, tasteless gas that is poisonous and reduces the blood's ability to transport oxygen.
- **Carbon Dioxide (CO₂)** – colorless, odorless, tasteless gas that is a greenhouse gas associated with global warming.



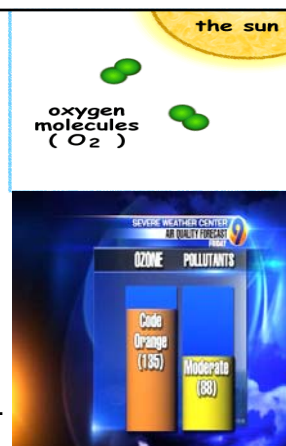
Hydrocarbons

Diverse group of organic compounds that only contain hydrogen and carbon.

- VOC's (Volatile Organic Compounds) - Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. Health Effects - Eye, nose, and throat irritation; headaches, loss of coordination, nausea; damage to liver, kidney, and central nervous system
- Methane (CH₄) most simple – colorless, odorless gas, principle component of natural gas, sulfur is added to NG so we can detect the odor or explosive methane gas.

Ozone

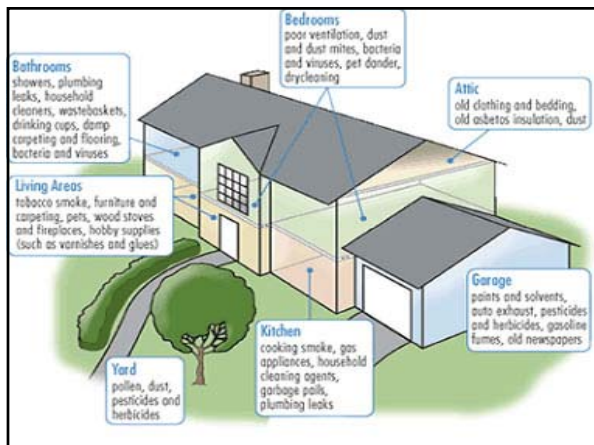
- O₃ – pollutant in the troposphere . . .
- Ozone near the surface (troposphere) is a human made pollutant.
- Secondary Pollutant that forms when sunlight catalyzes reactions between nitrogen oxides and volatile hydrocarbons.





Hazardous Air Pollutants

- Chlorine, lead, hydrochloric acid, formaldehyde, radioactive substances and flourides are potentially harmful and may pose long term health risks for people that work in/around chemical factories.



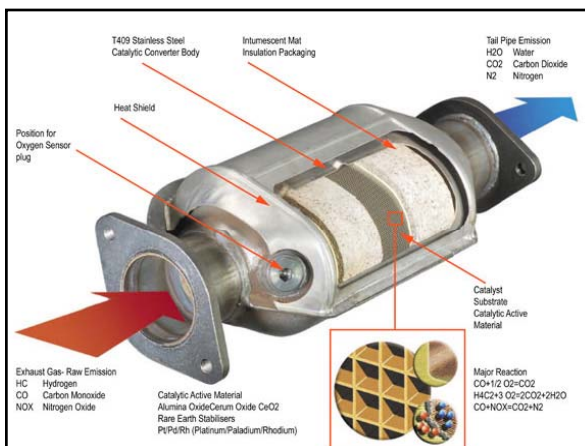
Sources of Outdoor Pollution

- Mobile Services** – automobiles and trucks release significant quantities of nitrogen oxides, carbon oxides, particulate matter, and hydrocarbons as result of the combustion of gasoline.
- One heavy duty truck emits as much particulate matter as 150 automobiles.
- According to the California Air Resources board a 2 hour ride on a 100 horsepower jet ski produces as much pollution as driving 139,000 miles in a car.

Controlling Air Pollutants

- Catalytic Converters in Cars

How Catalytic Converters Work



Effects of Air Pollution

	MAJOR SOURCES	HEALTH EFFECTS	ENVIRONMENTAL EFFECTS
SO₂	Industry	Respiratory and cardiovascular illness	Precursor to acid rain, which damages lakes, rivers, and trees; damage to cultural relics
NO_x	Vehicles; industry	Respiratory and cardiovascular illness	Nitrogen deposition leading to over-fertilization and eutrophication
PM	Vehicles; industry	Particles penetrate deep into lungs and can enter bloodstream	Visibility
CO	Vehicles	Headaches and fatigue, especially in people with weak cardiovascular health	
Lead	Vehicles (burning leaded gasoline)	Accumulates in bloodstream over time; damages nervous system	Fish/animal kills
Ozone	Formed from reaction of NO _x and VOCs	Respiratory illness	Reduced crop production and forest growth; smog precursor
VOCs	Vehicles; industrial processes	Eye and skin irritation; nausea; headaches; carcinogenic	Smog precursor

How weather and topography affect Air Pollution

Variation in temperature results in air circulation patterns that help dilute and disperse air pollutants.

In a temperature inversion the air near the ground is colder than at higher levels and pollutants remain trapped near the ground.

Cities located in valleys, near the coast or on the leeward side of mountains experience these often.

Urban Heat Islands and Dust Domes

Streets, rooftops and parking lots absorb solar radiation during the day and radiate heat into the atmosphere at night.

Heat released by human activities such as fuel combustion is highly concentrated in city.

Urban heat islands affect local air currents and weather conditions - example increasing thunderstorms

Clean Air Act

First Passed in 1970 and then updated twice in 1977 and 1990.

Authorizes the EPA to set limits on the amount of air pollutants: Focus on: lead, particulate matter, sulfur dioxide, carbon monoxide, nitrogen oxides and ozone.

98% decrease in the amount of lead in the air from 1970 -2001 because of the switch to unleaded gasoline.

Comparison of 1970 and 2002 Emissions

Pollutant	Change (%)
CO	-48%
NO _x	-17%
VOC	-51%
SO ₂	-52%
PM ₁₀	-34%
Pb	-98%

Indoor Air Pollution

Sick building syndrome - presence of air pollution inside office buildings that can cause eye irritations, nausea, headaches, respiratory infections, depression and fatigue.

Asthma and Indoor Air Pollution - rare disease until the middle of the 20th century. Amount of people that suffer from asthma has doubled since 1970.

Radon

Colorless, tasteless gas produced naturally by the radioactive decay of uranium in the Earth's crust.

Radon can only harm the body when it is ingested or inhaled.

The radioactive particles lodge in the tiny passages of the lungs and damage the surrounding tissue.

Estimated that exposure to radon causes 12% of all lung cancers.

Asbestos

Asbestos fibers in the lungs:
 1. Long, thin, needle-like fibers
 2. Fibrous mesothelioma starts in the abdomen
 3. Fibrous mesothelioma starts in the pleura, or lining of the chest, around the lung
 4. Fibrous mesothelioma starts in the pleura, or lining of the chest, around the heart

Asbestos locations in a house:
 Roof sheath, eaves and ties; Braided-lath strips; Water tank; Roofing felt; Spray coatings to walls, baseboards, etc.; Lathing; Gaskets; Air handling unit; Bath panets; Floor coverings, linoleum and paper backing, linings to suspended floor; Panel beneath window; Lagging on boiler, pipework and paper lining under roof asbestos pipe lagging; Panel fitting to lift shaft; Panel behind under heater; Loose asbestos in heating cavity; Tin, tiles, caissons and fibrous stone ceilings; Cables to wall cavities; Loose asbestos in wall cavities; Ducts and steam pipes; Roof cladding; Soffit boards; Damp proof course; Paraffin to vertical and horizontal beams; Boiler flue.

Text:
 Is a natural mineral that does not burn or conduct electricity.
 Used for fire-retardant materials - electrical insulation, roofing and pipe insulation.
 Asbestos fibers are easily inhaled into the lungs.
 Mesothelioma - a rare and almost always fatal cancer of the body's internal linings. (can be diagnosed 20-40 years after exposure)

Noise Pollution

Prolonged exposure to noise damages hearing.

Noise causes increased heart rates, dilated pupils and causes muscle contraction.

How Loud is Too Loud?

Noise-induced hearing damage is related to the duration and volume of exposure. Government research suggests the safe exposure limit is 85 decibels for eight hours a day. Some common decibel levels:

40	60	85	90	105	110	115	120	140
Raindrops	Normal conversation	Busy city traffic	Hair dryers	Rock concerts	Chain-saws	An iPod at peak volumes	Jack-hammers	Gunshot, fireworks

Sources: dangeroudecibels.org; WSI research