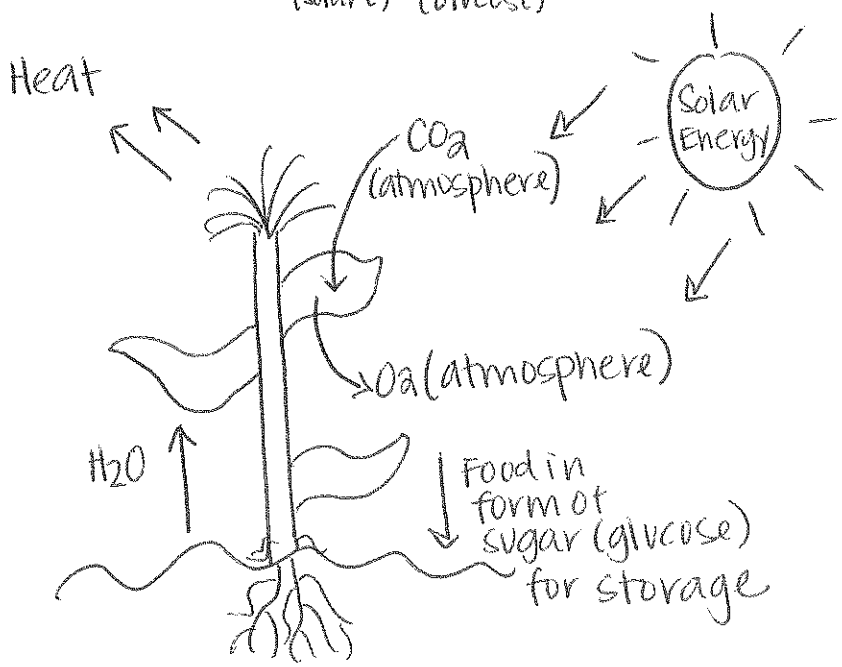
Air Notes

Air Properties

- Mixture of gases that surround the earth
  - 78% Nitrogen
  - 21% Oxygen
  - 1% Other gases (Argon, Carbon Dioxide, Neon, Helium, Other - which includes smoke, dust, water vapor)
- Air is everywhere
- Varies slightly from place to place
- Properties:
  - Odorless
  - Colorless
  - Tasteless
- Air that is smelled or seen is polluted
- Air is never pure, always contains substances in amounts that can vary slightly from time to time
- Where is air? Surrounds the earth in layers
  - Troposphere - closest layer to the earth; weather occurs here because a "cold trap" holds water and other molecules from drifting into space
  - Stratosphere - the protective ozone layer (protects against UV light penetration); the atmosphere is thin with few molecules Concentration of air
- Greatest concentration of gases is near the earth's surface
  - As elevation increases air becomes "thinner"
- Exhaled Air
  - 80% Nitrogen
  - 16% Oxygen
  - 4% Carbon Dioxide
  - Plants take in CO2 and use it for Photosynthesis
    - $6CO_2 + 12H_2O + \text{Light} \rightarrow C_6H_{12}O_6 + 6H_2O + 6O_2$

(Solar E) (Glucose)



Air Quality

- What is air quality?
  - The suitability of the air for a particular use
  - Usually refers to how suitable air is for use by living organisms
  - Outside air = ambient air
- Air Quality Standards
  - Maximum level of pollution allowed at one time in a geographic area
  - Standards are set by the federal government
    - Primary Standards - safe limits from a human health standpoint
    - Secondary Standards - non-health effects, such as damage to crops, property, wildlife
  - Pollutant Standard Index (PSI) was changed to the Air Quality Index (AQI) in 1999
    - An approach to report daily air quality
    - Tells how clean or polluted the air is and what associated health concerns you should be aware of
    - In Georgia we use a color coded "Smog Alert" scale
  - AQI
    - Based on a scale that runs from 0-500
    - Higher the AQI value, the greater the level of air pollution and the greater the health risk
    - AQI score of 100 generally corresponds to the national air quality standard for each pollutant
  - Indoor Air Quality
    - Studies of exposure to air pollutants indicate that indoor levels of pollutants may be 2 to 5 times greater than outdoor levels
    - Sources of indoor pollutants
      - Carpeting
      - Manufactured wood products
      - Combustible appliances (furnaces)
      - Household products without proper ventilation
  - Clean Air Act
    - Originally passed in 1970
    - Amended in 1977, 1990
    - Purpose was/is to set limits of how much of a pollutant can be in the air anywhere in the US
    - Since enacted:
      - Emissions of toxic lead have decreased 98%
      - Emissions of sulfur dioxide have decreased 35%
      - Emissions of carbon monoxide have decreased 32%

Pollution & Pollutants

- Air Pollution - the presence of substances in the air that damage it's quality
  - Includes gases and small solid particles
  - Most pollution can be reduced, prevented, or regulated in some way
  - Some air pollution is part of life processes and cannot be stopped
- Sources of Air Pollution
  - Human Activities: Factories, automobiles, heating and cooling systems all produce substances that pollute the air; we can take steps to reduce the amount of polluting substances that are released
  - Natural Processes: Many natural events and processes on earth create air pollution, including volcanic ash, decay of organic material, plant pollen, and natural fires
- Air Pollutant - a material that causes air pollution
  - Include: dust, gases, and droplets of materials
  - Some are more dangerous that others - i.e. smoke versus steam
  - Some air pollution is seasonal - i.e. pollen from flowers
  - Other pollutants result from home heating units, food and fiber processing plants, and climate conditions
- Types of Air Pollutants
  - Primary Pollutants - substances directly produced by a process
    - Ash from a volcanic eruption
    - Carbon monoxide gas from a motor vehicle
  - Secondary Pollutants - not emitted, rather they form in the air when primary pollutants react or interact
    - Ozone - one of the secondary pollutants that make up smog
- Common Air Pollutants (See additional sheet)
  - Ozone
  - Nitrogen Dioxide
  - Particulate Matter
  - Sulfur Dioxide
  - Carbon Monoxide
  - Lead
  - Volatile Organic Compounds (VOCs)

6 Common Air Pollutants

Pollutant	Type	Composition	Causes	Health and Environmental Impacts	Prevention/Reduction
Carbon Monoxide	Primary	CO- gas formed when carbon in fuel is not burned completely CO	Motor vehicle exhaust, other nonroad engines and vehicles, industrial processes, residential wood burning, natural fires	Health effects include cardiovascular effect and central nervous system effects, contributes to the formation of smog	Control of motor vehicle emissions, permits required by large industrial facilities
Sulfur Dioxide	Primary	Sulfur oxide gases, dissolve easily in water, prevalent in all raw materials (oil, coal and ore); Form when fuel containing sulfur is burned and when gasoline is extracted from oil or metals or extracted from ore SO2	Electric utilities especially those that burn coal, industrial facilities (petroleum refineries, cement manufacturing and metal processing facilities), locomotives, large ships and some nonroad diesel equipment	Contributes to respiratory illness in children and elderly, causes formation of acid rain, visibility impairment, plant and water damage, aesthetic damage	installing pollution control equipment at coal-fired power plants, reducing pollution from industrial processing facilities, reducing the average sulfur content of fuels burned, and using cleaner fuels like natural gas for residential and commercial heat
Lead	Primary	Metal found naturally in the environment as well as in manufactured products Pb	Historically major cause was emissions from vehicles but no longer using lead based fuels, now causes are highest from metal processing	Health effects include: Damage to organs, affects brain and nerves, affects heart and blood, animals and plant harmed if lead is ingested, can enter water systems and cause reproductive problems and death in fish	Removed lead from gasoline, now targeting emissions control for industries processing metals and making batteries

Ozone ✓	Secondary	O_3- Gas composed of three oxygen atoms, created by a chemical rx between nitrogen oxides, volatile organic compounds and sunlight, "bad" ozone is ground level ozone, O3	Motor vehicle exhaust, industrial emissions, gasoline vapors and chemical solvents and natural sources, sunlight and hot weather cause ozone to form in harmful concentrations	Can irritate lung airways, aggravates asthma, reduced lung capacity, repeated exposure can cause permanent lung damage, interferes with ability of plants to produce and store food, damage to leaves of trees, reduces crop yields, increases plant vulnerability to disease, pests and weather	Reducing NOx emissions from power plants and industrial combustion sources, introducing low emissions cars, using cleaner gasoline, improving vehicle inspection programs
Nitrogen Oxides ✓	Primary	Highly reactive gases which contain nitrogen and oxygen in varying amounts, colorless and odorless, form when fuel is burned at high temp as in a combustion process NO2	Motor vehicles, electric utilities and other industrial, commercial and residential sources that burn fuels, can also form naturally	Leads to formation of ozone and acid rain, transmitted over long distances, particles in the air cause health risks like breathing problems and lung damage, water quality deterioration, global warming, toxic chemicals, visibility impairment	Emissions standards for motor vehicles, emission standard for electric utilities, NOx transport rule for 21 states Proper formation
Particulate Matter ✓	Primary or Secondary	Complex mixture of extremely small particles and liquid droplets, components include acids, organic chemicals, metals, and soil or dust particles	Some emitted directly from a sources such as a construction site, unpaved roads, fields, smokestacks or fires; others form in reactions in the atmosphere of chemicals such as sulfur dioxides and nitrogen oxides	Health risks because of inhalation of particles, lung problems and may even enter bloodstream, visibility reduction, aesthetic damage, environmental damage such as polluting oceans and stream when particles settle on water or the ground	Regulated by EPA Clean Air Act along with additional standards and programs

Ozone Shield

+ Ozone Layer: area in stratosphere where ozone is highly concentrated [O_3]
  - absorbs most of the ultraviolet [UV] light from sun [sunscreen for Earth]

+ Damage to Ozone
  - CFCs [chlorofluorocarbons]: human made chemicals that depleat ozone
    - molecules break apart in stratosphere
    - 1 Cl atom from CFC can destroy 100,000 ozone molecules

+ Ozone Hole
  - Thinning of stratospheric ozone that occurs over the South Pole during spring
  - first noticed in 1979
  - Hole lasts for several months
  - Effects on Humans
    - Damages DNA
    - ↑ skin cancer, cataracts
    - ↓ immune response
  - Effects on Plants & Animals
    - Death of eggs
    - Mutations
    - ↓ populations
    - Death of phytoplankton
    - Disruption in food chain
    - ↓ in Photosynthesizers
    - ↓ crop yields

*Pollution notes? *Quiz on Tues. open-note

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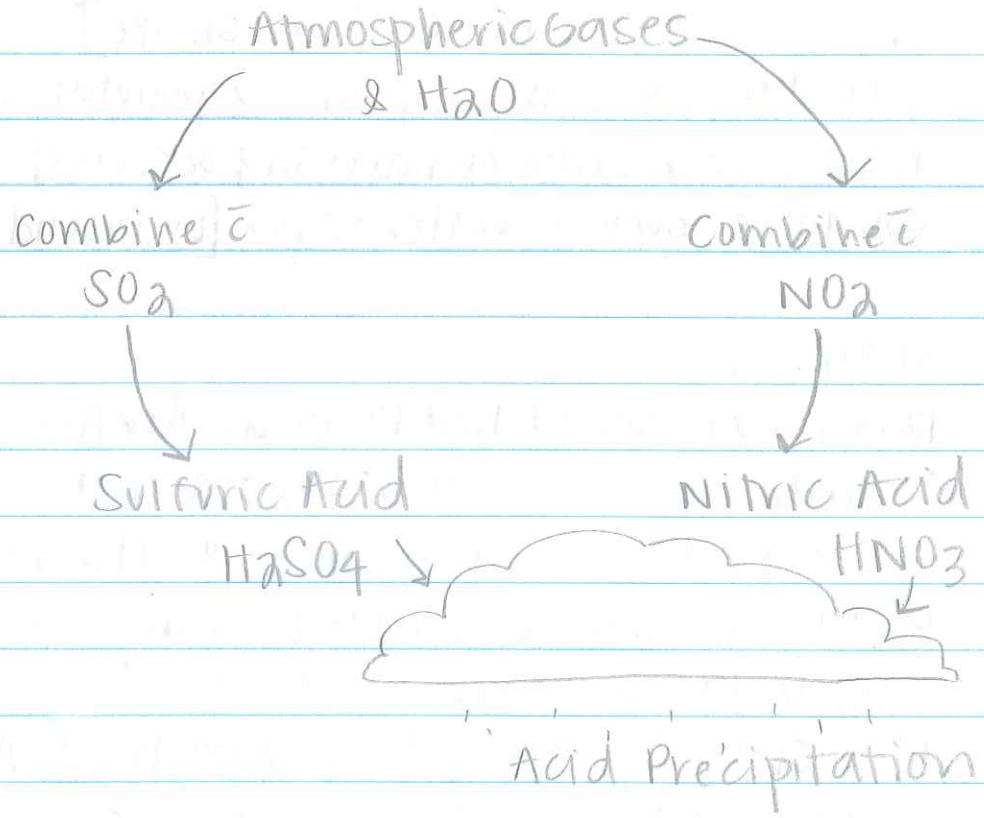
Air Pollution-

- Air Pollution: when harmful substances build up in the air to unhealthy levels
  - Primary: pollutant put directly into air by human activity [Ex. soot from smoke]
  - Secondary: form when primary pollutants react w/ each other or naturally occuring substances such as water vapor [Ex. Ground Ozone]

- Hx of Air Pollution
  - 1273: King Edward I had 1st Clean Air Act w/ making it illegal to burn "sea-coal"
    - ~ produced a lot of smoke & little heat
  - 1300: King Edward II forbade burning coal while Parliment was in session
  - 1970: Clean Air Act [1990]: gives the EPA authority to regulate vehicle emissions in US [↓ lead in gasoline & ↑ use of catalytic converters], requires industries to use scrubbers [pollution control devices] to remove the more harmful substances entering the air

- Acid Precipitation: precipitation that contains a high concentration of acid
  - When fossil fuels are burned they release

oxides of sulfur & nitrogen; when combined c̄ water they form sulfuric acid & nitric acid
- can kill living things



-causes a drop in pH of soil & water
↳ known as "acidification"
↑ soil acidity = nutrient dissolution & gets washed away
↑ acidity = ↑ aluminum & other toxic materials; these cause root damage & leaching into aquatic environments which interferes c̄ oxygen & salt exchange in fish & slowly suffocates them