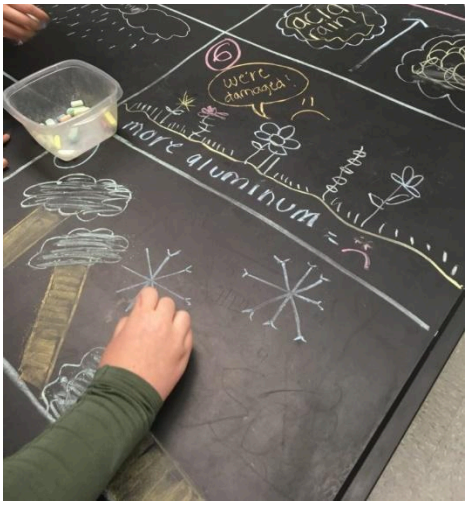
Atmospheric Processes and Air Pollution Drawings



Directions:

1. You must create a graphic design of the following processes.
2. <u>Each bullet point must have a picture</u> (except formulas).
3. Connect pictures with arrows as applicable—they won't all connect.
4. Each of the three processes should take an **entire side of a piece of paper**. You will have 3 pages to turn in:
    a. Tropospheric Ozone Formation
    b. Stratospheric Ozone Depletion
    c. Acid Rain

Tropospheric Ozone Formation

- Tropospheric ozone formation begins with the burning of petroleum oil which releases NO_x out of the exhaust pipe.
- Volatile organic carbons which come from gasoline pumps, other fuels, solvents, vegetation, scented products also contribute to the formation of ozone.
- Normal Process
    - NO_2 + sunlight --> NO + O
    - $O + O_2$ --> O_3
    - Then, it cycles back: $NO + O_3$ --> NO_2 + O2
- VOCs can speed up the reaction and increase Ozone
    - NOx + VOCs + sunlight --> O_3
- Ozone is much worse in the summer due to sunlight driving the reaction and heat vaporizing more VOCs.

- Breathing ozone can trigger a variety of health problems
    - chest pain
    - coughing
    - throat irritation
    - bronchitis
    - asthma
    - Scar lung tissue
- Ozone interferes with the ability of sensitive plants to produce and store food and harms their appearance.
- Ozone degrades (breaks down) and cracks rubber items such as tires
- Ways to prevent Ozone: Ride a bike, walk, carpool, hybrid/electric/high mpg vehicle.

Acid Deposition (Acid Rain)

- Sources
    - Burning of coal (mostly power plants for electricity) releases SO_2
    - Burning of petroleum (from transportation) releases NO_2.
    - These combine with water in the atmosphere to create acid rain.
- $2SO_2 + O_2 \rightarrow 2SO_3$ **then** $SO_3 + H_2O \rightarrow H_2SO_4$ (sulfuric acid)—the biggest culprit of acid rain
- $3NO_2 + H_2O \rightarrow 2\ HNO_3 + NO$ (Nitric Acid)
- Acid Rain clouds blow north to Canada which makes the Canadians angry. Eh.
- Acid rain dissolves marble and limestone which can eat away at tombstones, statues and buildings.
- Changes soil chemistry
    - Leaches nutrients from soils
    - Elevates aluminum in the soil hindering water and nutrient uptake by plants.
    - Crop damage
- Lakes
    - Become more acidic which hurts the organisms in the lake
    - Have increased levels of heavy metals due to the acid
- Forests have decreased ability to withstand cold weather.
- Mitigation methods
    - Add $CaCO_3$ (Calcium carbonate) to lakes and soil to bring the pH up.
    - Wet scrubbers on coal power plant smokestacks.
- Prevention methods
    - Electricity conservation (turning off lights, Energy Star appliances etc.)
    - Alternative fuel/high mpg/electric cars and transportation.

Stratospheric Ozone Depletion

- Normal Ozone formation in the stratosphere:
  - $O_2 + O \rightarrow O_3$
  - then $O_3 + UV \rightarrow O_2 + O$
  - then repeated.
- Chloroflourocarbons (CFCs) from refrigerators, aerosol cans and air conditioners rise to the stratosphere.
- The chlorine atom in CFCs rob an Oxygen atom from ozone molecule.
  - $CCl_3F + UV \rightarrow CCl_2F + CL$
  - then $Cl + O_3 \rightarrow ClO + O_2$
- Forms over Antarctic, because of ice crystals in the atmosphere which promote Cl atoms robbing O atoms from Ozone.
- Worst in the Antarctic Spring (September) due to a build-up of ice during winter.
- Montreal Protocol (International Treaty) banned CFCs
- More UV hitting the Earth increases
  - skin cancer
  - eye cataracts (film over eyeballs)
  - crop damage
  - reduces the productivity of the ocean's plankton.

Keep this paper in your binder. It is a good list to study for your exam and AP Exam!