**Natural Pollutants**

1. **Volcanoes –** SO, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. **Forest Fires –** CO, CO2, NO, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. **Windstorms -** \_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. **Plants (Live) –** hydrocarbons, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. **Plants (Decaying) –** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, H2S

6. **Soil –** viruses, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. **Sea –** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Anthropogenic Pollutants** – Human activity products – very concentrated.

1. Carbon monoxide - \_\_\_\_ Vehicles 2. Sulfur oxides - \_\_\_\_\_ Industry

3. Nitrogen Oxides - \_\_\_\_\_ Vehicles 4. Particulates – \_\_\_\_ Vehicles, Industry

5. Hydrocarbons – \_\_\_\_\_ Vehicles, Industry

6. Photochemical oxidants – Formed from the reaction of light and HC and NO. Ground level

 Ozone (O3), Formaldehyde, and Peroxyacylnitrate (PAN) are a few examples.

**HUMAN IMPACT**

Altering natural balance of cycles in the atmosphere

Add \_\_\_\_ more carbon dioxide

Burn fossil fuels releasing \_\_\_\_\_\_\_\_\_\_\_ into air = more acid rain (nitric acid)

Add \_\_\_\_\_\_\_\_ from burning coal and refining petroleum = more acid rain (sulfuric acid)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – 1. 2X the arsenic as nature 2. 7X the cadmium 3. 17X the lead

**3 Processes That Cause Air Pollution**

1. Combustion – Hydrocarbon (HC) + Oxygen → \_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_

2. Evaporation – Vaporization of any liquid. \_\_\_\_\_\_\_\_\_\_\_\_\_\_, Solvents, etc.

3. Friction – Rubber tires

**Primary Pollutants** – pollutants released from \_\_\_\_\_\_\_\_\_\_\_\_\_ sources that may undergo change in the atmosphere and become something more harmful.

**Secondary Pollutants** – may be more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than the chemicals from which they came from. i.e. sulfur dioxide gas mixing with oxygen and water to become \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**PRIMARY POLLUTANTS** **SECONDARY POLLUNANTS**

1. CO – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1. SO3 – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. CO2 – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 2. HNO3 – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. SO2 – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 3. H2SO4 – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. NO – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 4. H2O2 – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. NO2 – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 5. O3 - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. Hydrocarbons 6. PAN’s – peroxyacyl nitrates

7. Particulates

**Effects Of Climate And Temperature On Air Pollution**

1. **Gray-Air Cities** – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, cold moist climates. Sulfur oxides mix with moisture to create \_\_\_\_\_\_\_\_\_ – mixture of smoke and fog. Heavily industrialized cities.

2. **Brown-Air Cities** – \_\_\_\_\_\_\_\_\_\_, non-industrialized cities. Mainly hydrocarbon and nitrogen oxides from automobile and electrical plant pollution. React in the presence of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to form many secondary pollutants.

 These reactions are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ because they involve chemicals and light.

**Photochemical Smog**

 \_\_\_\_\_\_\_\_\_\_ cities

 \_\_\_\_\_\_\_\_\_\_ smog

 Mostly ozone, aldehydes, PAN’s, and nitric acid

 Formed from the NOx from cars/factories and volatile organic compounds (VOC’s)

 These VOC’s are methane, propane, benzene, chlorofluorocarbons (CFC’s) mixing in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Smog Chemistry**

 N2 + O2 =2NO \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ engine of car and then into air to 🡪

 2NO + O2 = 2NO2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ brown haze – choking odor to 🡪

 3NO2 + H2O = 2HNO3 + NO \_\_\_\_\_\_\_\_\_\_\_\_\_ produces acid rain and some NO2 gases go onto 🡪

 NO2 + UV energy = NO + O which then go to 🡪

 O + O2 = O3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Industrial Smog**

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cities

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ air smog

 Mostly sulfur dioxide and sulfuric acid as well as suspended particles (ASH)

 Mostly caused by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Smog Chemistry**

 S + O2 = SO2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ then to 🡪

 SO2 + O2 = 2SO3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_then to 🡪

 SO3 + H2O = H2SO4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_then to 🡪

 H2SO4 + 2NH3 = (NH4)2SO4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_salt and soot give air gray color

**Factors Affecting Air Pollution**

1. \_\_\_\_\_\_\_\_\_\_\_

2. Location

3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. Precipitation

5. **Temperature Inversion** - normal circumstances air temperature falls around \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ increase altitude. Pollutants rise and disperse. When a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ lid forms over a cooler air, the cooler air cannot rise up through it. Thus the pollutants at ground level increase at ground level.

**Acid Deposition**

* Acid Rain - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Acid Deposition – \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (solid or gas)
* Natural Rain is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (without acid). CO2 dissolved from air forms weak \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Acid Rain**

* Wet and \_\_\_\_\_\_ deposition due to secondary pollutants
* pH of \_\_\_\_\_ in Eastern US – regional problem
* buffering soil is good – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ based
* \_\_\_\_\_\_ and below is dangerous – adding lime is least effective



**Acid Associated Problems**

* Humans – bronchitis, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Buildings – premature aging
* Trees – weakens leaves, tree becomes vulnerable to pests.
* Soil – releases \_\_\_\_\_\_\_\_\_\_ (toxic) which kill fish when metals run off into water.
* Areas affected are usually \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from industrial areas or dense urban zones.
* Vegetation and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ receive the most damage.

**Acid Prevention and Protection**

* Natural buffers in soil, \_\_\_\_\_\_\_\_\_\_\_\_\_ (Ca+2) and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Mg+2) can react with and neutralize acids. Thin soils offer no buffer protection.
* Reduce energy use.
* Switch from \_\_\_\_\_\_\_\_\_\_ to cleaner energy source.
* Remove \_\_\_\_\_\_\_\_\_\_\_\_\_ from coal before burning.
* Remove SO2, NOx, and particulates from smokestacks with use of \_\_\_\_\_\_\_\_\_\_\_\_.
* Remove NO2 from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Ozone – O3**

* Beneficial in upper atmosphere (stratosphere) – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Harmful in troposphere (ground-level) – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Causes respiratory problems at ground level.
* \_\_\_\_\_\_\_\_\_\_\_\_\_ – ozone contributor at ground level
* Only pollutants not reduced in past 30 years – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Atmospheric Ozone is depleted by \_\_\_\_\_\_\_\_\_\_\_\_
* Chloroflorocarbons are found in:

 1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 2. Fire extinguishers

 3. Plastic foam containers

 4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* Cl + O3 → ClO + O2
* ClO → Cl + O
* Free Chlorine (Cl) will continue as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and destroy 100,000’s of ozone molecules.
* Protects us from harmful \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (UV) rays from the sun
* Damage from UV rays include skin cancers, egg formation in aquatic life, and decrease in photosynthesis in plants.

**Toxicity**

**Acute** – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – lung irritation, inflammation of respiratory tract, eye irritation, dizziness.

**Chronic** – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – emphysema, bronchitis, heart attack

**Perceived risk** – Greater than \_\_\_\_\_\_\_\_\_\_\_\_\_\_ risk. Protection is legislated or mandated.

**Actual risk** – Risk is \_\_\_\_\_\_\_\_\_\_\_\_\_ than perceived risk. We are generally not concerned.

**Toxicity** measures how\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a substance is in causing injury, illness, or death.

Factors that deal with toxicity:

* Dose
* Frequency of exposure
* Age and size of exposed individual
* Health of detoxification system (liver, etc.)
* Genetic make-up

**5 factors that can affect the amount of harm a substance can cause**

* **Solubility** – Water or fat \_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **Persistence** – Some \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ break down, some remain
* **Bioaccumulation** – Molecules are stored in body.
* **Biomagnification** – Accumulate at greater levels as you go up \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **Chemical Interactions**:

 **Antagonistic** – One chemical \_\_\_\_\_\_\_\_\_\_\_\_ effect of another

 **Synergistic** – One chemical \_\_\_\_\_\_\_\_\_\_\_\_\_ effect of another.

**Indoor Air Pollution**

* CO - dizziness, headache, heart attack
* asbestos - lung cancer
* NO - lung irritation, asthma
* trichloroethane - aerosols, dry cleaning
* radon - gas from U-238 breakdown
* tobacco smoke - lung cancer, bronchitis, emphysema
* formaldehyde - particle board, furniture
* styrene - carpet, plastics

