

## Global Change Review

### Greenhouse Gases

- Carbon Dioxide (CO<sub>2</sub>)
  - Source: combustion of fossil fuels; deforestation
- Water vapor (H<sub>2</sub>O)
  - Most abundant (nonanthropogenic) greenhouse gas & the greatest contributor to global warming
- Methane (CH<sub>4</sub>)
  - Source: Anaerobic decomposition/respiration (ex. Landfills, bottom of wetlands, animal digestion- cow flatulence)
- Nitrous Oxide (N<sub>2</sub>O)
  - Source: Denitrification (nitrogen cycle); agricultural soil management (ex. Commercial inorganic fertilizers)
- Chlorofluorocarbons (CFC's; ie. CCl<sub>2</sub>F<sub>2</sub>); *pollutant*
  - Source: coolants used in air conditioners, freezers, & refrigerators; aerosols
  - Exclusively anthropogenic
  - Potent greenhouse gases (more than CO<sub>2</sub>) b/c they are more efficient at absorbing thermal radiation
- Ozone (O<sub>3</sub>); *pollutant*
  - Formed in the troposphere by photochemical reactions; anthropogenic

### The Greenhouse Effect

- NATURAL warming of the earth's atmosphere; Needed to sustain life on earth
- Greenhouse gases absorb IR radiation

### Global Climate Change

- Occurs because of an increased concentration of greenhouse gases in the TROPOSPHERE absorb *outgoing IR* (infrared) radiation
- \*AP Tip: "Carbon Dioxide is a greenhouse gas and can lead to global climate change."
  - Then state example of WHY there may be an increase in this gas
- Anthropogenic Causes:
  - Deforestation- leads to a net ↑ of CO<sub>2</sub>
  - Combustion of fossil fuels
    - Carbon that has been *sequestered* is released into the atmosphere, leading to a net increase of CO<sub>2</sub>
- Effects:
  - Temperature changes
    - Positive feedback cycle- Higher temps lead to faster decomposition → boosts rate at which CO<sub>2</sub> is added to atmosphere → more CO<sub>2</sub> promotes higher temperatures
    - Melting of polar ice caps, glaciers, & permafrost = rising sea levels
      - Troposphere will contain more water vapor
    - Possible increased frequency of heat waves, altered precipitation patterns & storm intensity, and shifting ocean currents
    - \*Periodic fluctuation of CO<sub>2</sub> concentration is due to seasonal variations in photosynthetic activity

- \*Depending on source, temp ↑ between .5°C - .8°C
  - Species
    - Temperature induced changes affecting growing season for plants → alters habitats
    - Species with a low range of tolerance may die → disrupts food webs → possible extinction of species (decrease biodiversity)
- Solutions:
  - Kyoto Protocol- Global legislation to reduce greenhouse gases
  - Carbon Sequestering- taking CO<sub>2</sub> out of the atmosphere
    - Ex. Store carbon in soil, pasture, forests, or oceans

**Ozone** (“Good up high; Bad nearby”)

- Stratospheric Ozone
  - O<sub>3</sub> protects earth by filtering UV radiation
  - Ozone Depletion
    - CFC (anthropogenic chemicals from coolants & aerosols) deplete the good ozone.
    - Causes a hole (mostly in the Antarctic) that lets in more UV radiation
    - More UV radiation causes
      - ↑Skin cancer (esp. in Australia) and cataracts in humans
      - ↓Photosynthesis in plants
    - Solutions
      - Montreal Protocol- Global legislation to reduce CFC’s

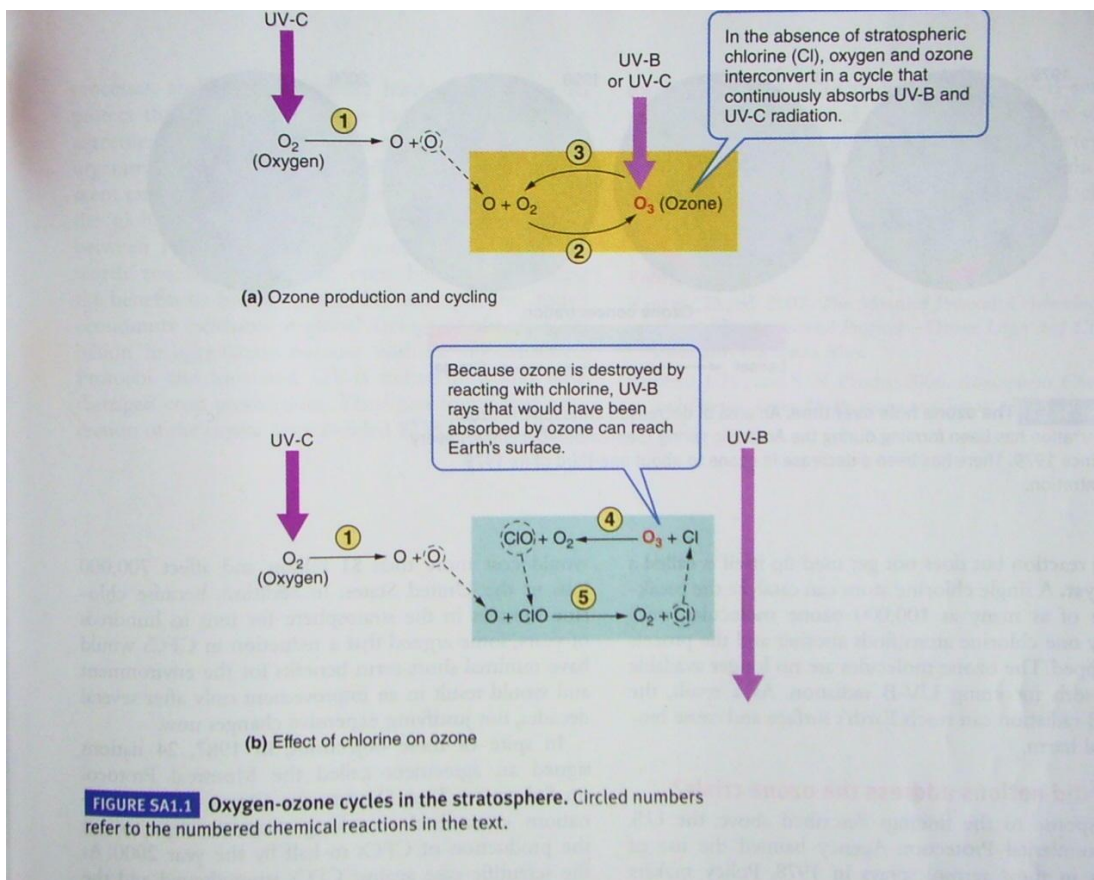
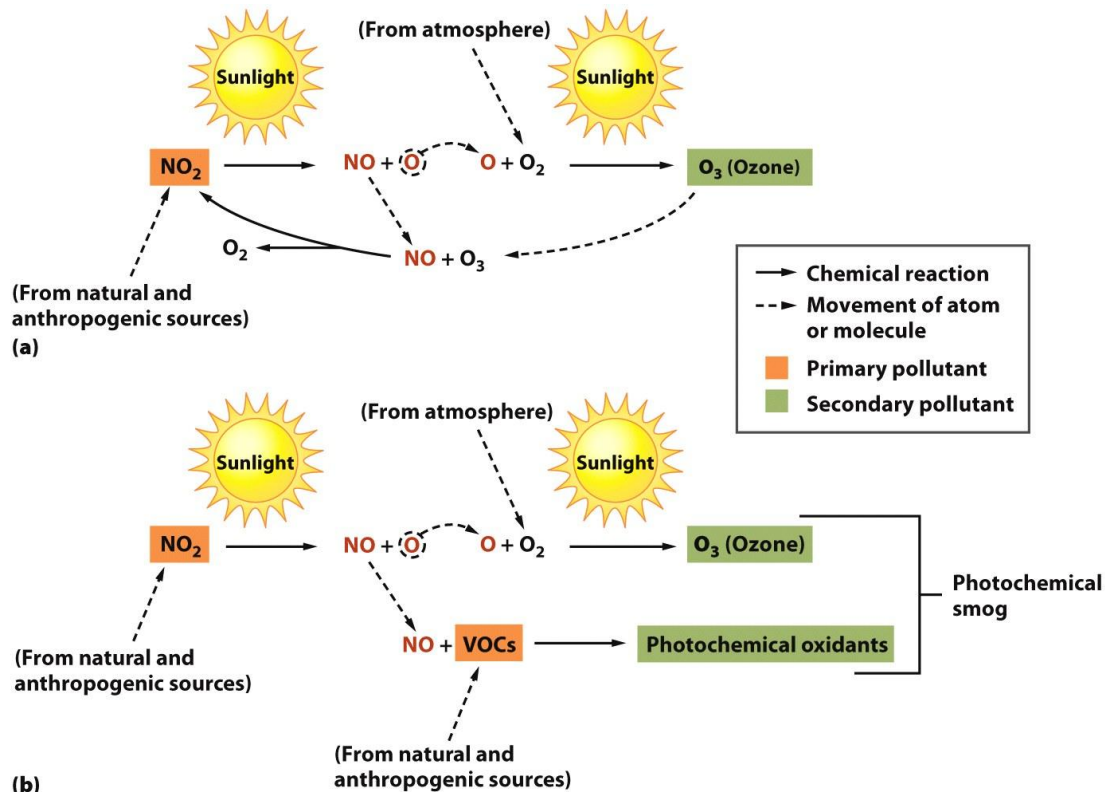


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- Tropospheric Ozone (*pollutant AND greenhouse gas*)
  - Secondary pollutant caused by photochemical reactions; “Photochemical Smog”
  - $\text{NO}_x + \text{VOCs} + \text{sunlight} \rightarrow \text{O}_3$ 
    - \* $\text{NO}_x$  & VOCs are from fossil fuels
  - Effects:
    - Humans
      - Respiratory distress such as aggravating asthma & bronchitis; irritates eyes, nose, throat & lungs; coughing
    - Environment
      - Disrupts photosynthesis in plants; Leaves wither & turn brown
        - Crop damage; ↓ yields
      - Greenhouse gas and can lead to global climate change



**Figure 15.7**  
*Environmental Science*  
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