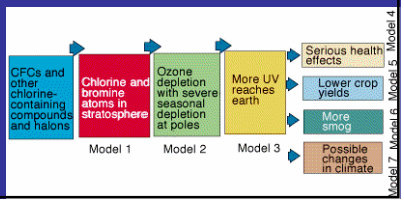
ISSUE: Ozone Depletion

Background

- Where is the ozone "layer"?
- What is its purpose?
- What do scientists say is happening to it?
  - Supporting evidence:
    - 1979→1994, 4% ozone loss globally
- Why care?



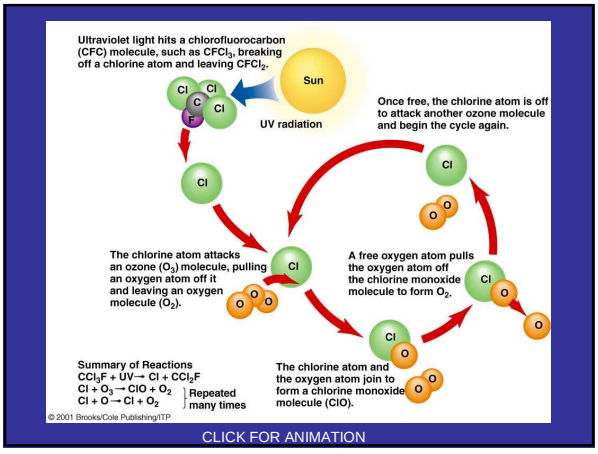
Causes of Ozone Depletion

- Primary cause?
  - Discovered?
  - A.k.a.?
  - Benefits?
  - Uses?
  - Can be released by burning?

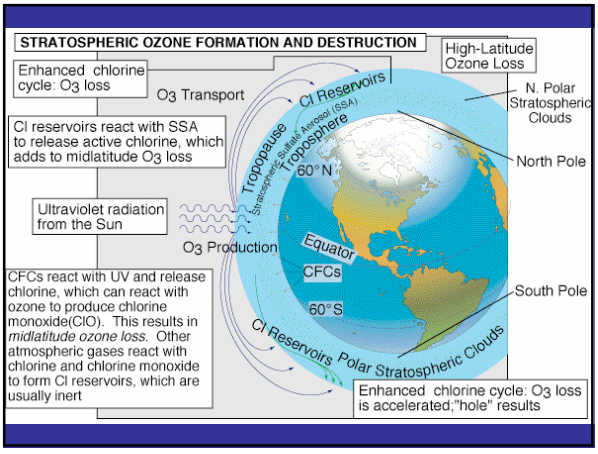
How do CFCs deplete ozone?

- CFCs stable, move from troposphere to stratosphere
- UV breaks off chlorine molecule (Cl) from CFC
- Cl acts as a catalyst to break down ozone (O_3)
  - catalyst – promotes a chemical reaction without itself being used up in the reaction
  - shifts equilibrium of oxygen / ozone reaction:

$O_2 \longleftrightarrow O_3$



CLICK FOR ANIMATION

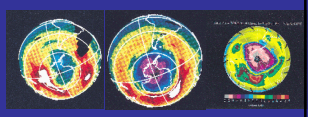


Other O.D.C.s

Br Compounds	Cl Compounds

Antarctic Seasonal Thinning

- Not conventional wisdom
- 40-50% loss of ozone over Antarctica during their spring and early summer (Sept. – Dec)
- The process?



1. Winter – polar vortex forms
   - Winds blow circularly around pole
   - Isolated from rest of atmosphere
2. Water forms ice crystals in vortex
3. Crystals collect CFCs on surface
   - Also speeds up release of Cl & ClO
4. ClOs combine → Cl_2O_2
   - Not reactive … no sun
5. Accumulates in vortex
6. In spring, more sunlight… breaks up stored Cl_2O_2 releasing lots of Cl atoms
7. Cl atoms deplete the ozone!

Other side effects…

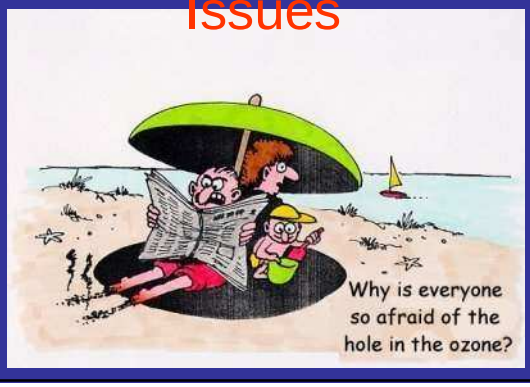
Vortex breaks up in spring

Ozone depleted air flows northward

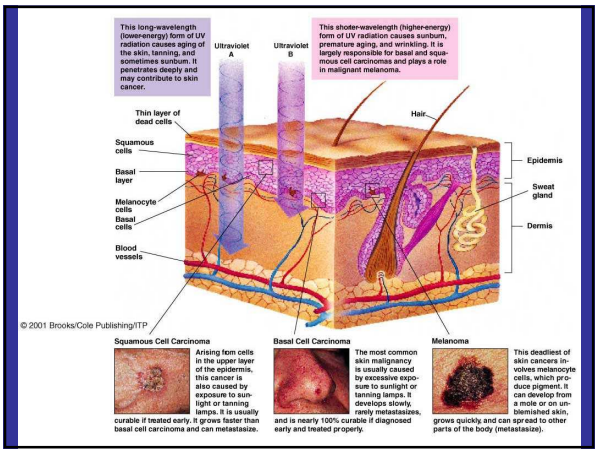
Lingers over Australia, New Zealand, S. America, S. Africa

Heightened risk of sun/UV damage

U.V. Exposure Issues



1. Skin Cancer
2. Immune system suppression
3. ⇑ smog & acid deposition
4. ⇓ crop yields
5. ⇓ forest productivity (trees UV-B sensitive)
6. ⇑ materials deterioration
7. ⇓ phytoplankton productivity
8. General ecosystem damage



Solutions

- CFC substitutes (p. 525)
- **Montreal Protocol**
  - 1987
  - 36 nation treaty
  - Cut CFC emissions 35% by 2000
  - Continued to meet ('90,'92,'97) to discuss other ODCs
  - Hopeful, but not all nations enforced

http://www.epa.gov/ozone/