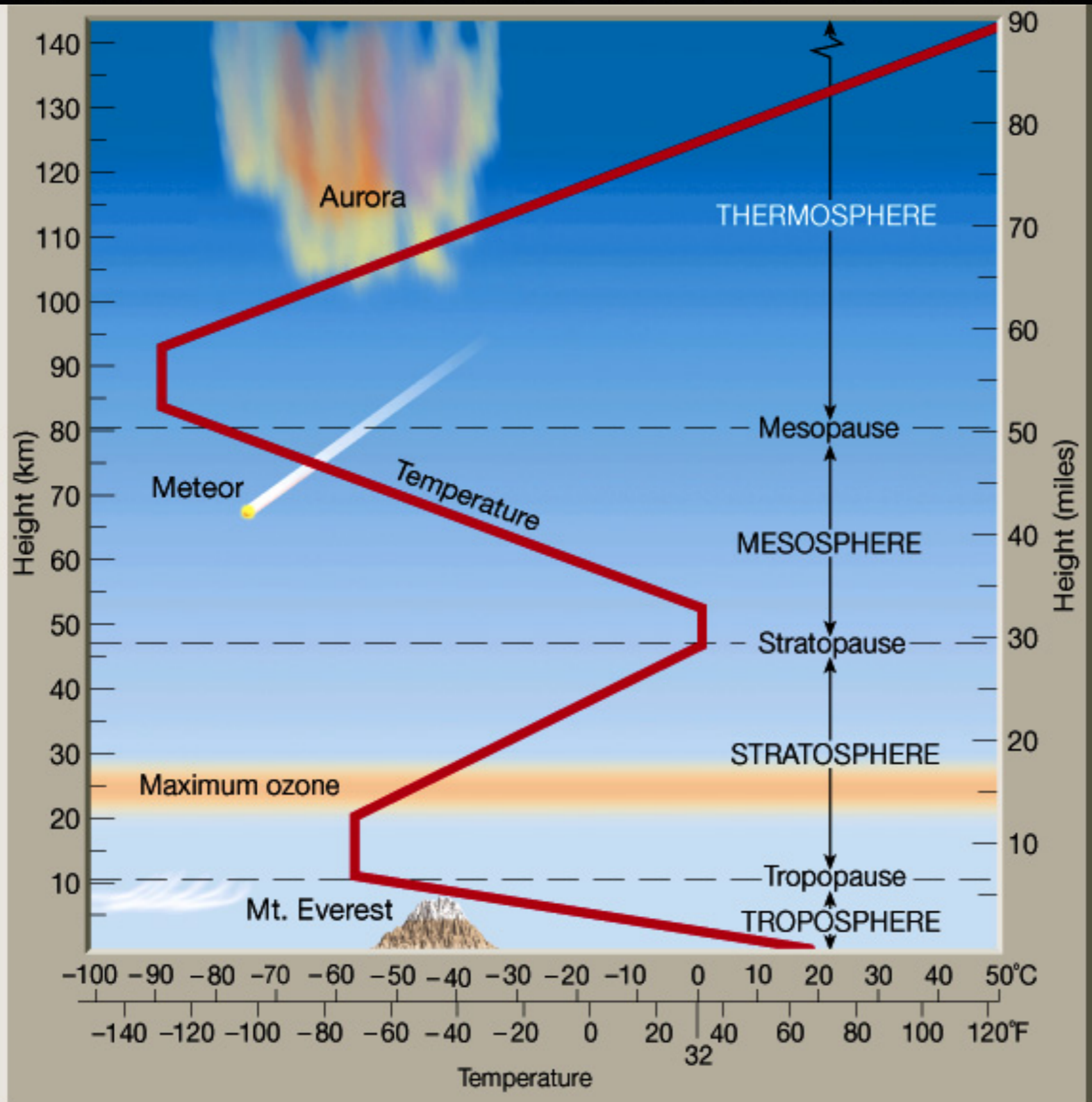


Chapter 18

Air Pollution

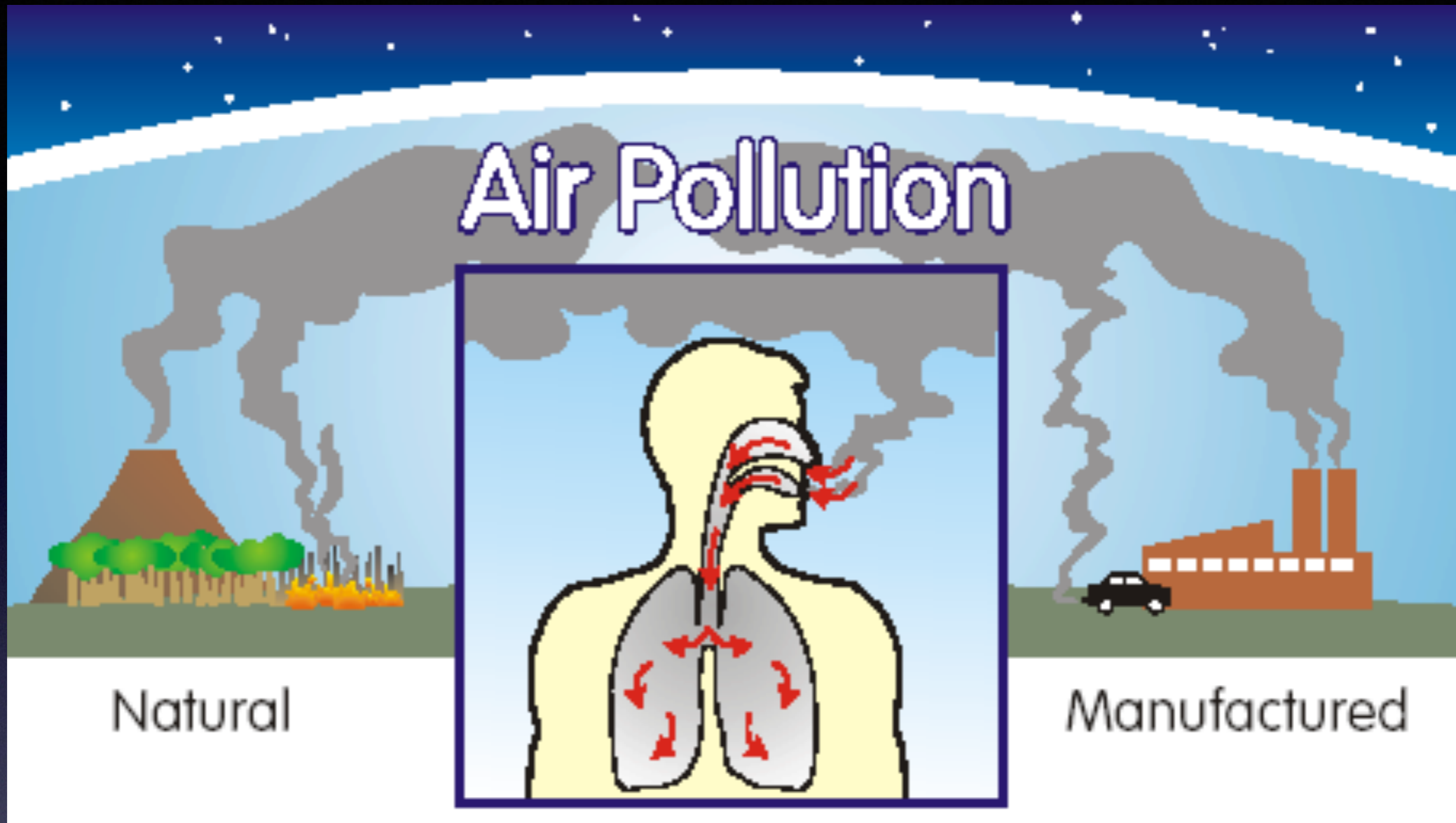




Atmosphere
 78% N
 21% O₂
 1% Ar and
 trace gases

Outdoor Pollution

- Biggest problems are smog and greenhouses gases
- Mostly in industrialized urban areas
- Increasing in industrializing countries but decreasing in industrialized
- Two sources



Volcanoes:
particulates, sulfur
dioxide

Fires: vegetation

Wind: dust

1° pollutants
2° pollutants

Legislation



- 1st Air Pollution control Act 1955
- Clean Air Act 1963 (research \$ for pollution control, emission standards for cars, factories)
- Clean Air Act 1970
- Clean Air Act 1990 emissions cap and trade program
- Each time strengthening regulations, increasing standards for air quality
- EPA monitors 188 substances

Criteria Pollutants

Carbon monoxide

- Colorless
- Odorless
- Source- fuel exhaust, burning wood residentially, industrial
- Prevents hemoglobin from binding

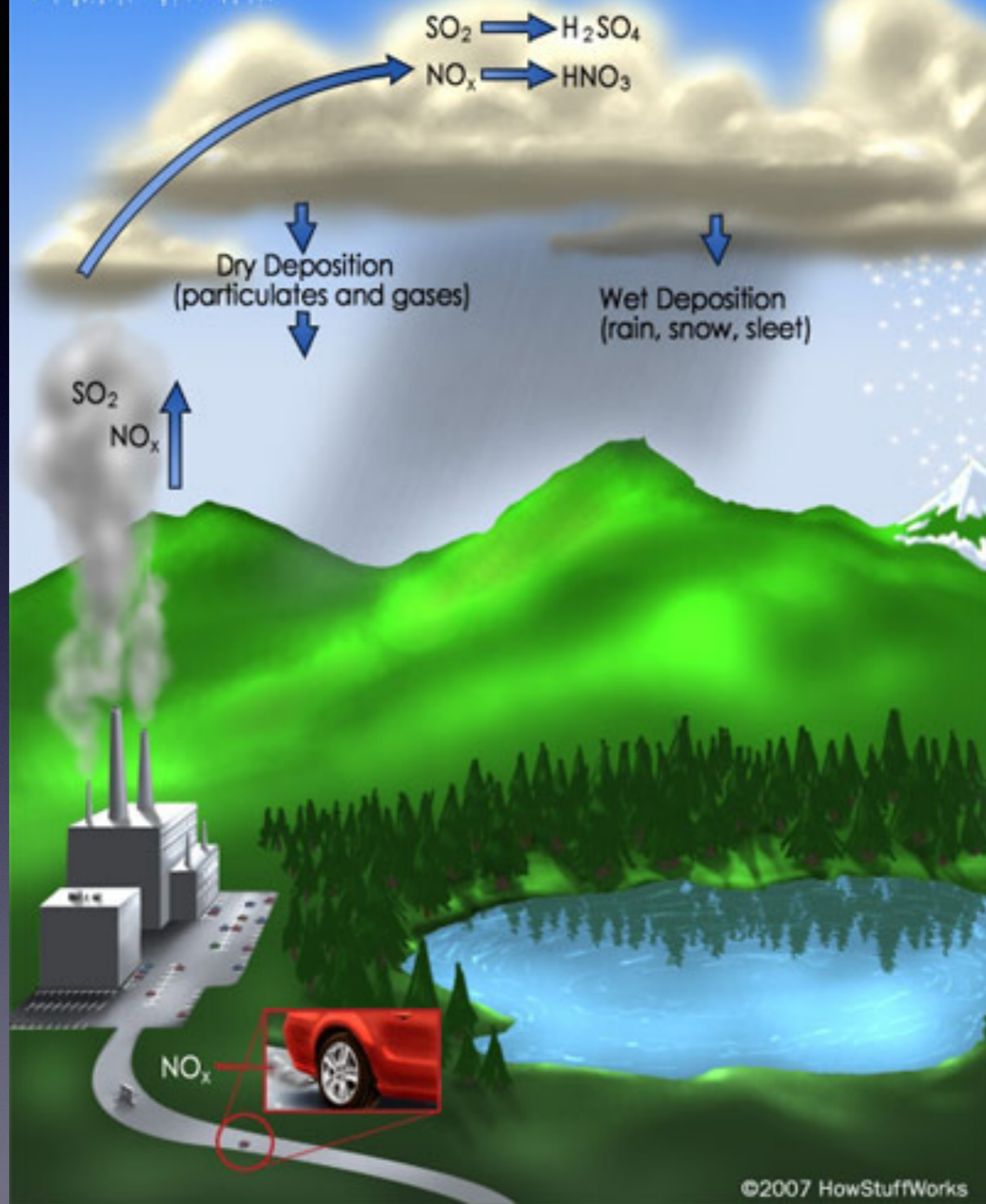
Sulfur Dioxide

- Colorless
- Smells bad
- Most from coal combustion
- S in coal reacts with oxygen
- SO₂ can form SO₃ and H₂SO₄
- Respiratory problems and acid deposition

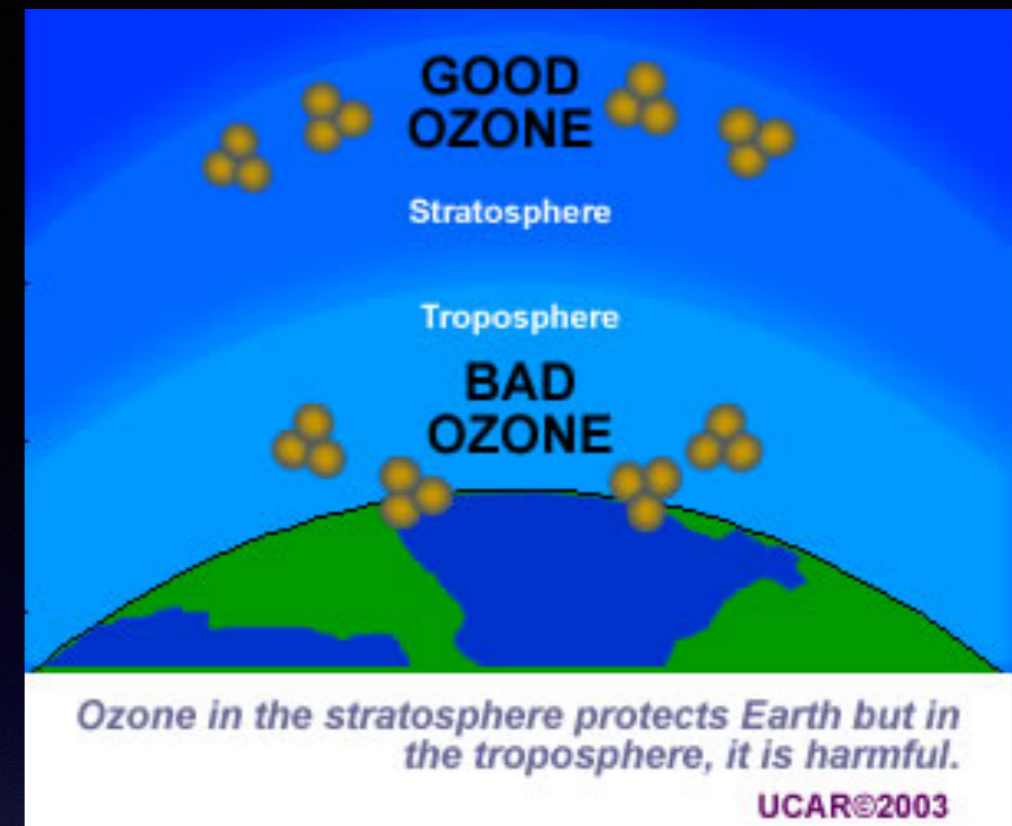
Nitrogen Dioxide

- Highly reactive
- Smells bad
- Reddish brown
- Smog and acid deposition
- Most from combustion engines

ACID RAIN



Troposphere Ozone



- Respiratory problems
- Often exceeds EPA standards
- From interaction of sunlight, heat, nitrogen oxides and VOCs

Particulate Matter

- Solid or liquid
- 1° pollutants - dust, soot
- 2° pollutants nitrates and sulfates
- 10 micrometers and smaller of most concern (can enter lungs)
- Damage respiratory tissues

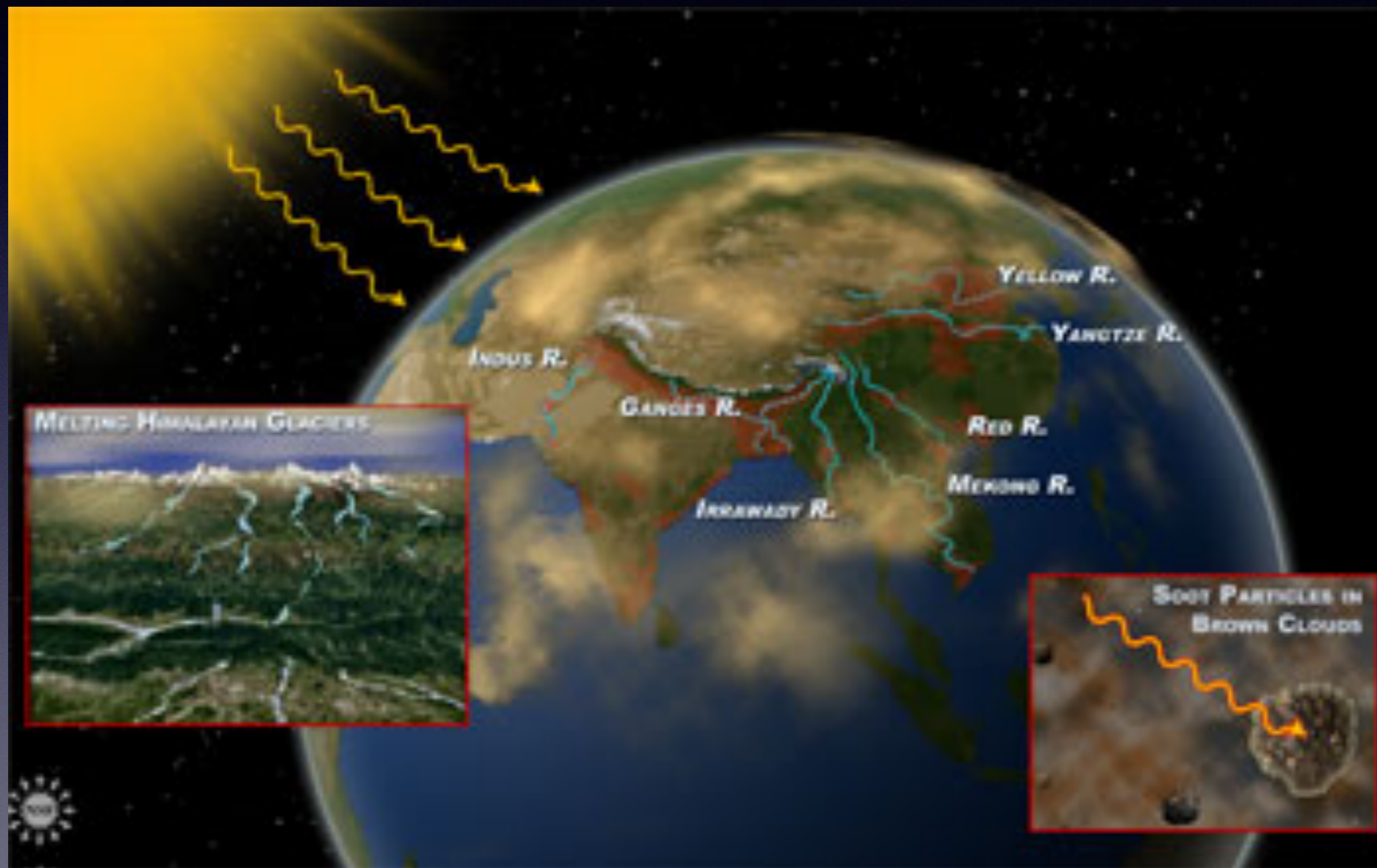
Lead

- Heavy metal
- Gasoline - improves engine performance
- Main source today is industrial metal smelting, some airplanes
- Neurotoxin

Lead Pollution from Lead Smelters



Asian Brown Cloud



- Persistent
- 2 miles thick
- Reduces sunlight by 10-20%
- Decreases agriculture productivity
- Increases glacial melting

Smog

- Most common air problem
- **Industrial smog** - "gray smog" - burning coal, oil, CO, soot, mercury, sulfur
- **Photochemical smog** - "brown air smog" - sunlight drives chemical reactions between 1° pollutants (NO₂) and normal atmospheric compounds; hot, windless, sunny conditions

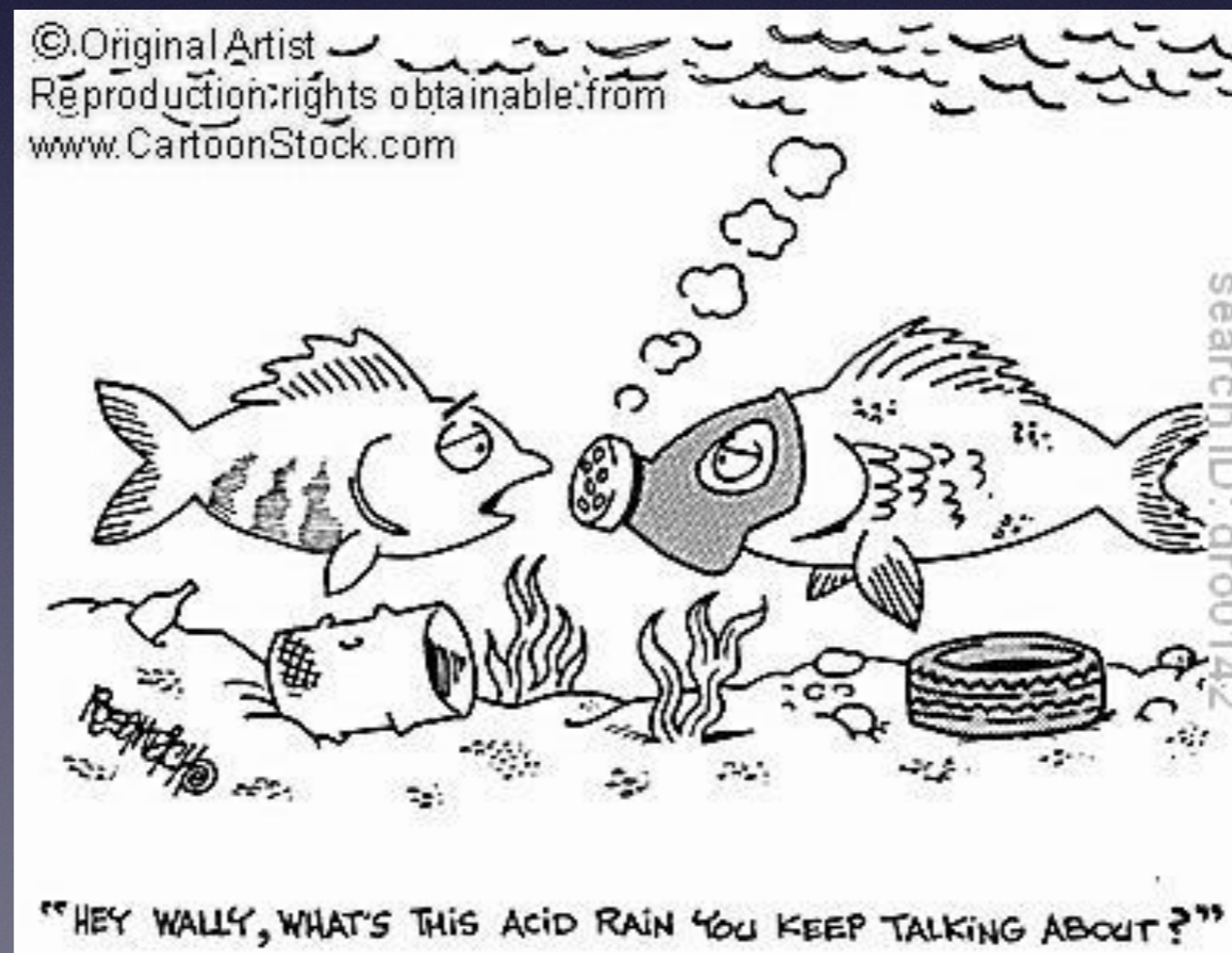
Smog Busters!!

- drive every other day
- vehicle inspections
- subsidized drivers for newer cars
- remove lead from gas
- remove sulfur from diesel fuel
- electronic pollution indicator boards around cities
- lower gas subsidies



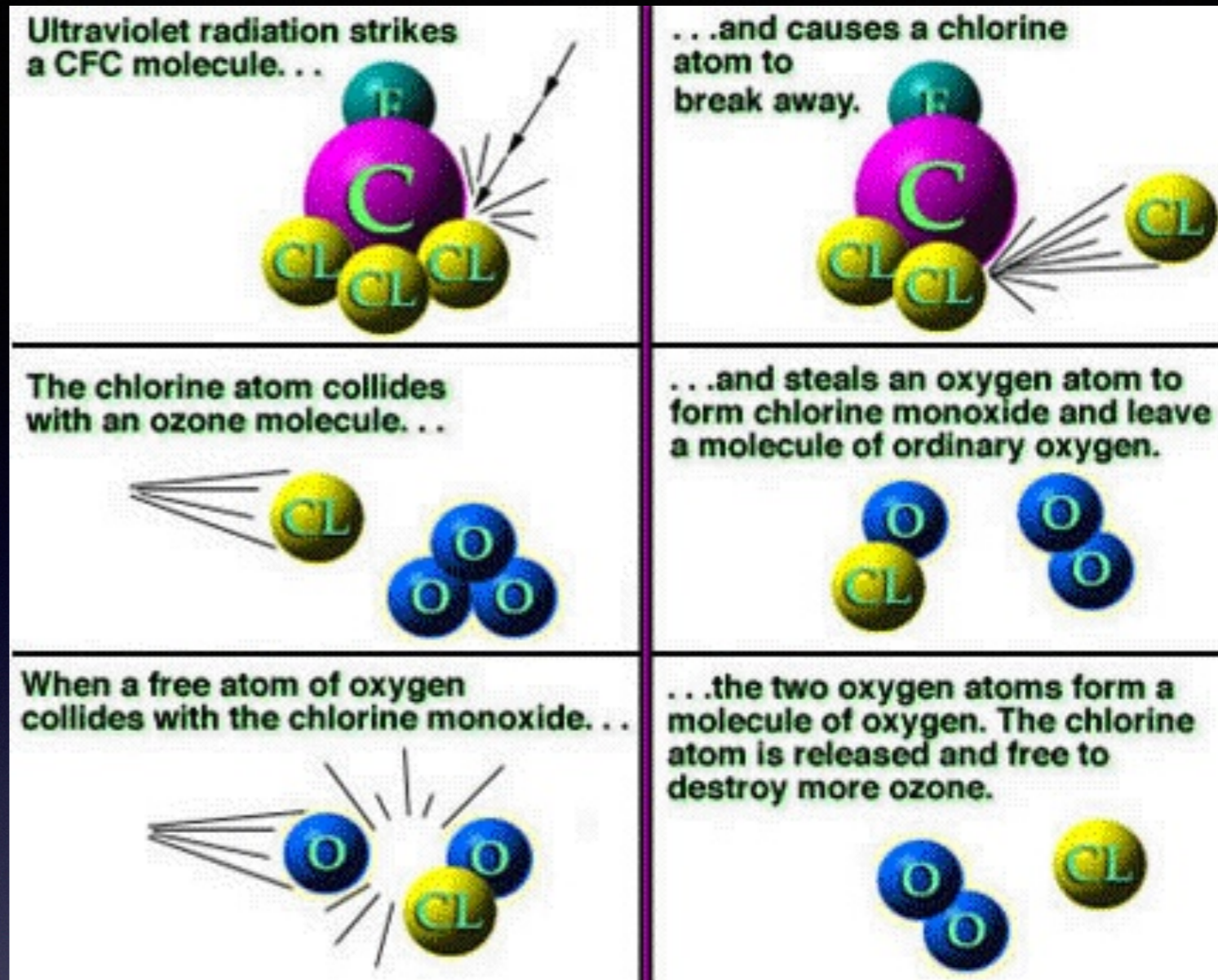
Acid Deposition

- Rain, snow, hail, fog, gases, or dry particles
- Mostly sulfur dioxides and nitrogen oxides (fossil fuel combustion)



Ozone depletion

- Halocarbons - hydrocarbons where a C is replaced by a halogen (Cl, Br, FI)
- In particular - **CFCs**

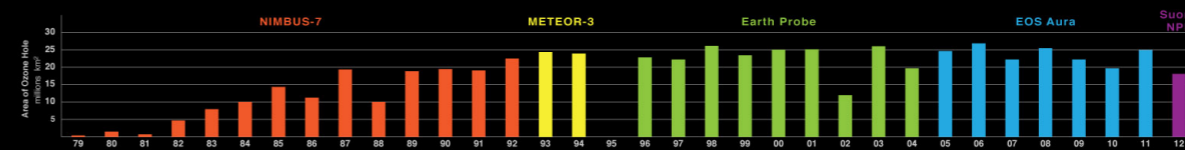
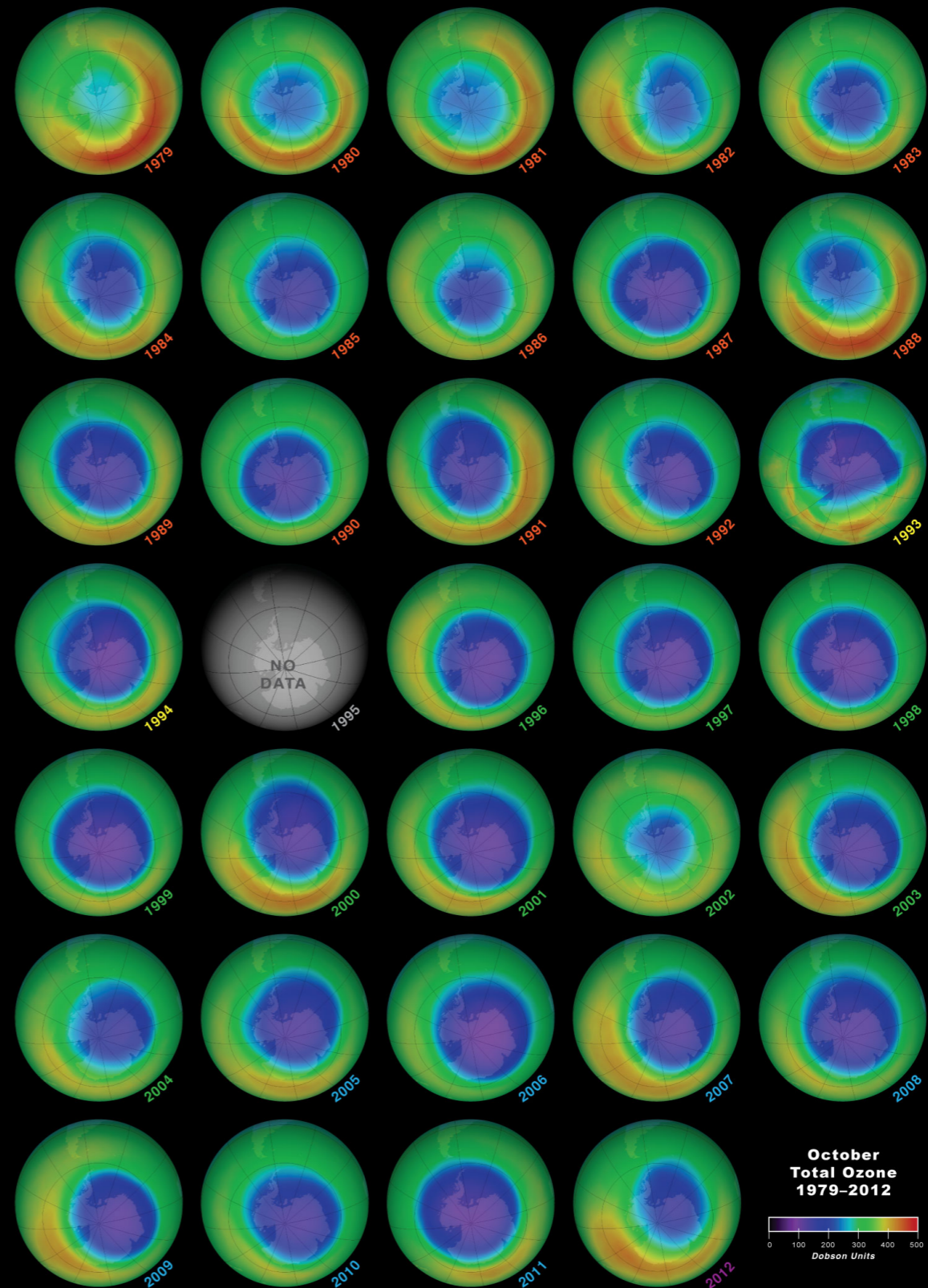


The Ozone Hole

Over 30 Years of Satellite Observations

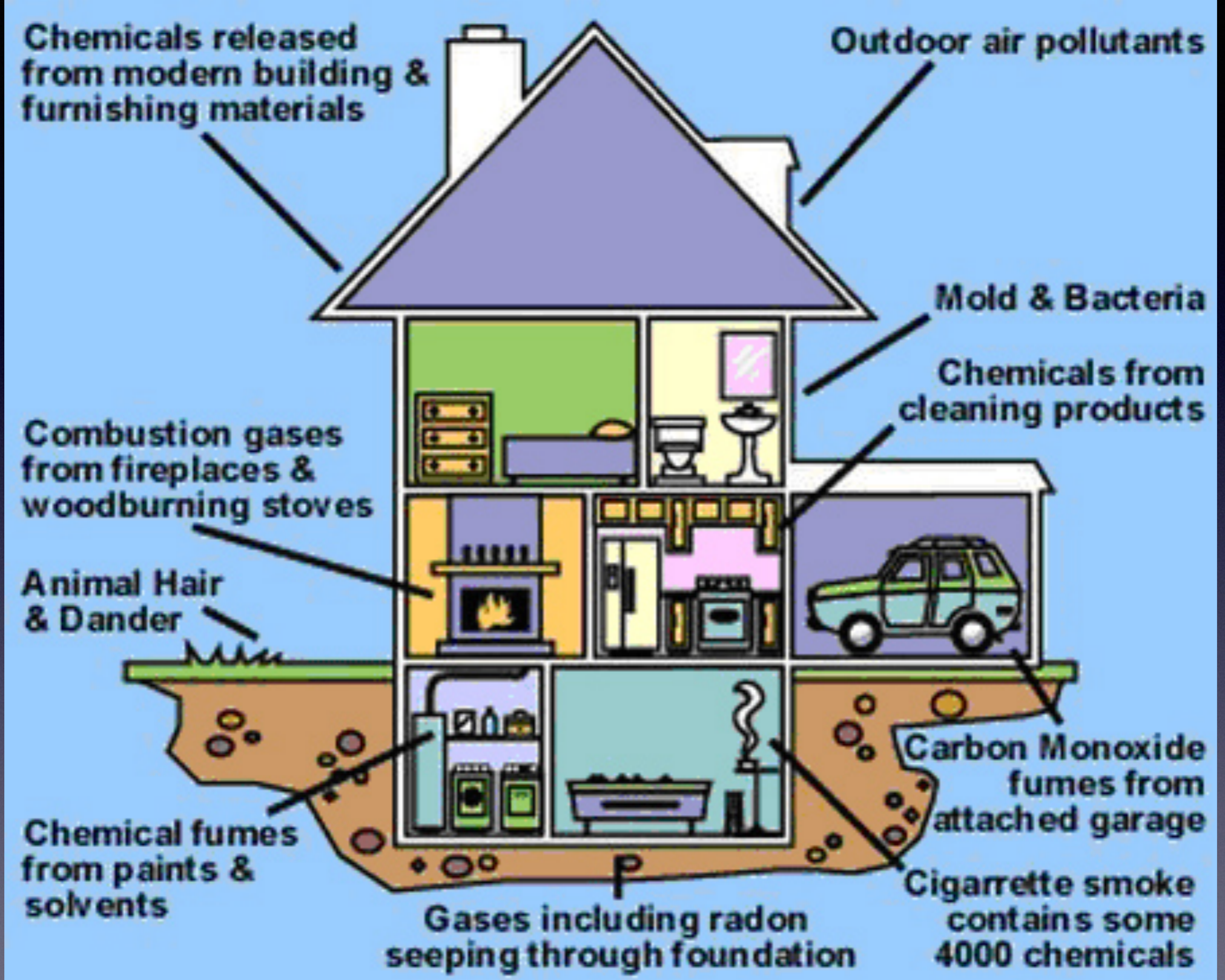
Montreal Protocol ... *a success story*

- Treaty addressed ozone depletion
- Agreement to cut CFC production by half by 1998



Indoor Pollution





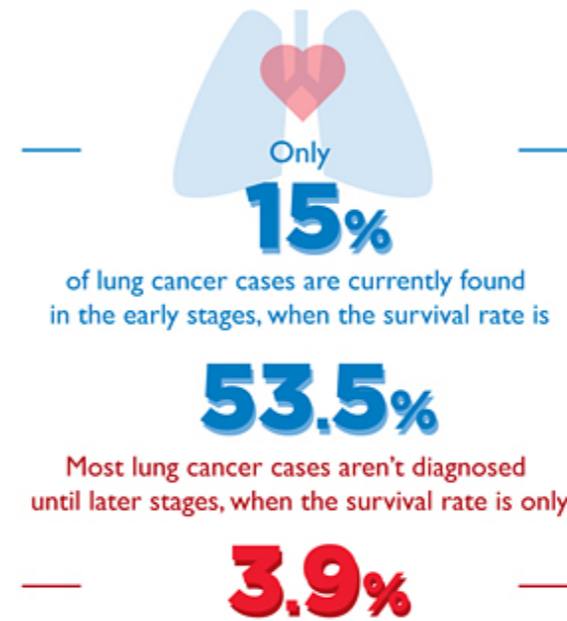
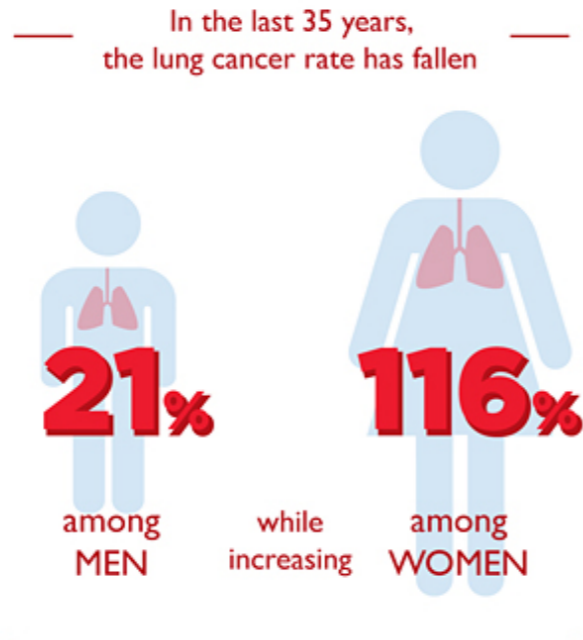
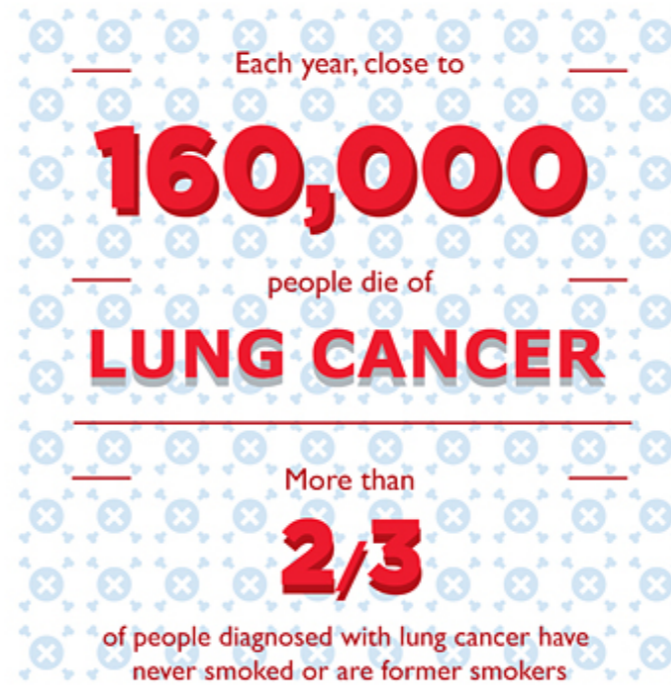


LUNG CANCER FACTS

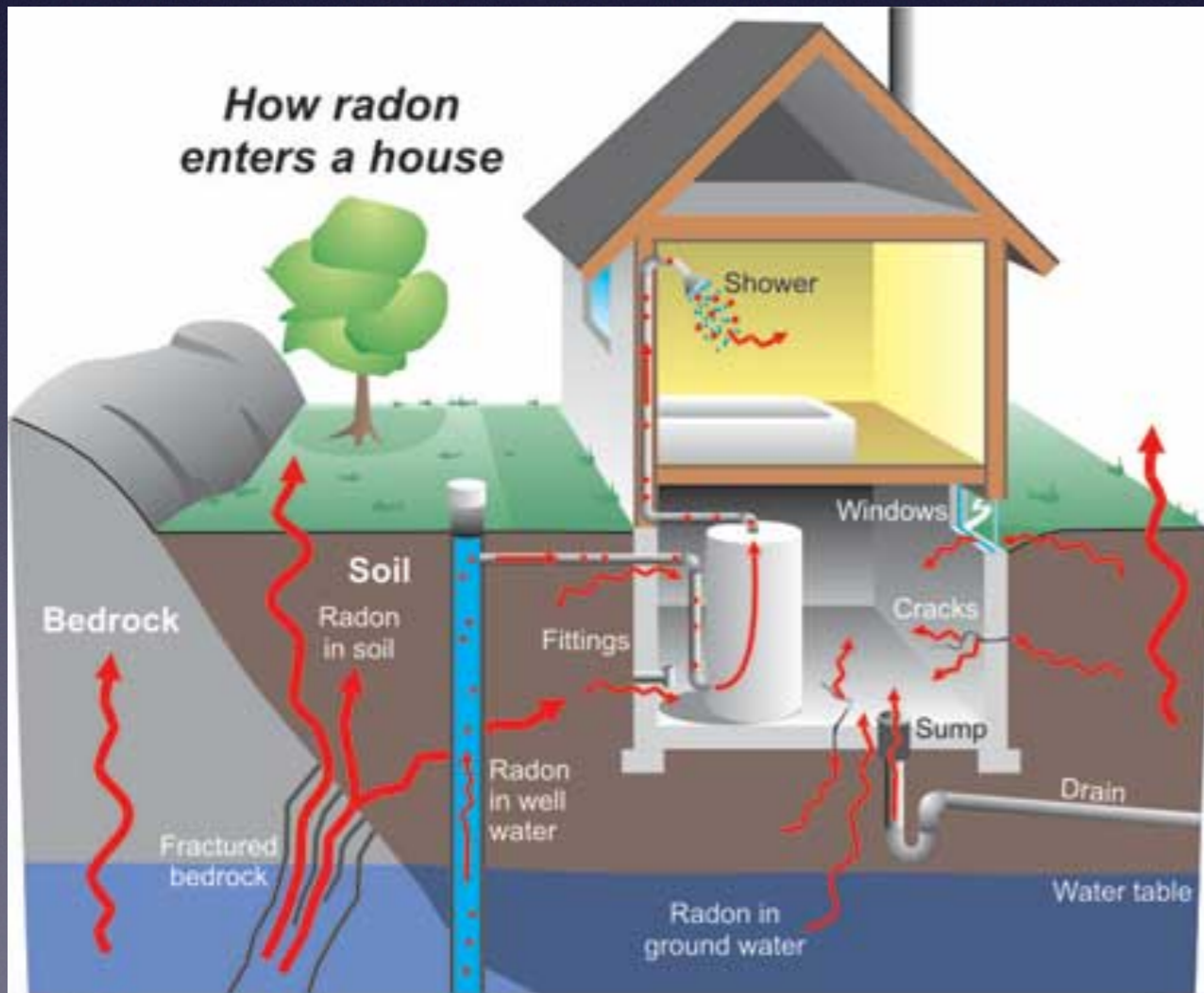
For more information about lung cancer or other lung disease, visit Lung.org or call the American Lung Association Lung HelpLine at **1.800.LUNG.USA**



killing more people than breast, colon, pancreas & prostate cancers combined.

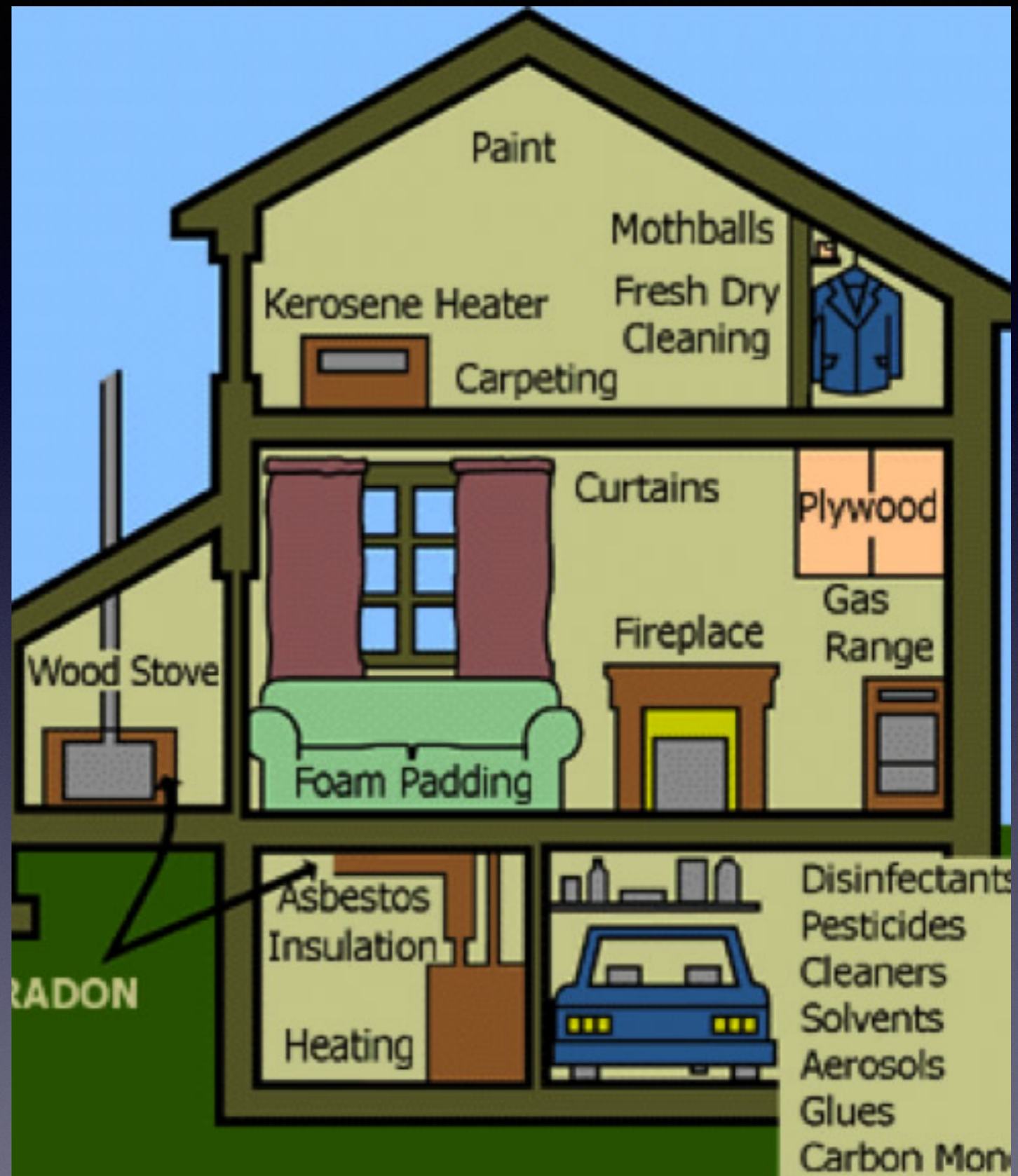


Worst indoor pollutants: tobacco smoke and radon

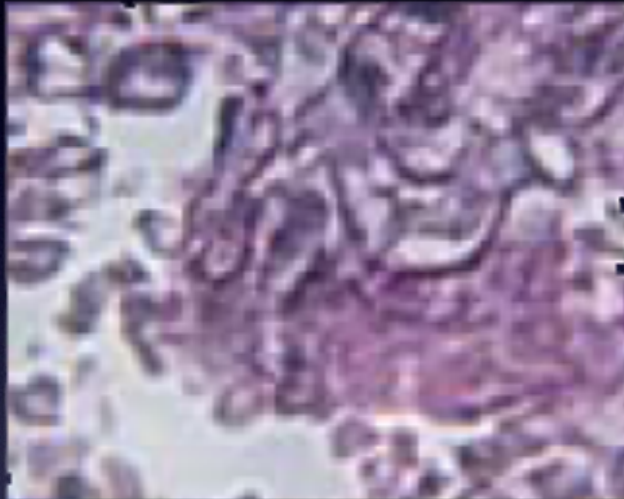


VOCs

- 1/2 are from anthropogenic source; rest are natural (plants)
- Used and emitted by cars, solvents, industrial processes, household chemicals, inks, dry cleaning
- Evaporate quickly
- Contribute to Ozone



Living organisms



VIRUSES



POLLEN



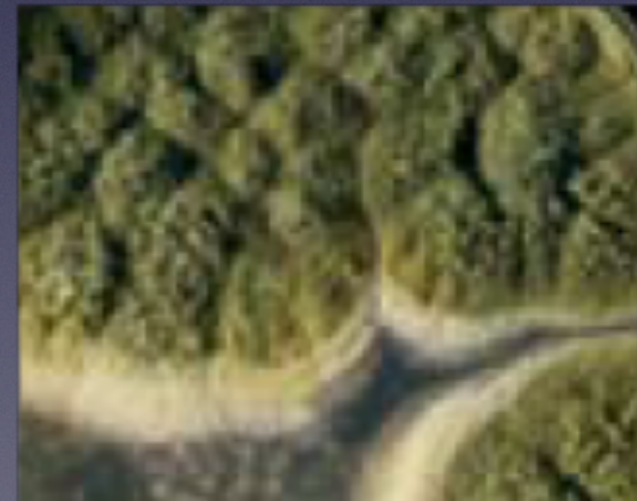
PET DANDER



DUST MITES



BACTERIA



MOLD/FUNGI