

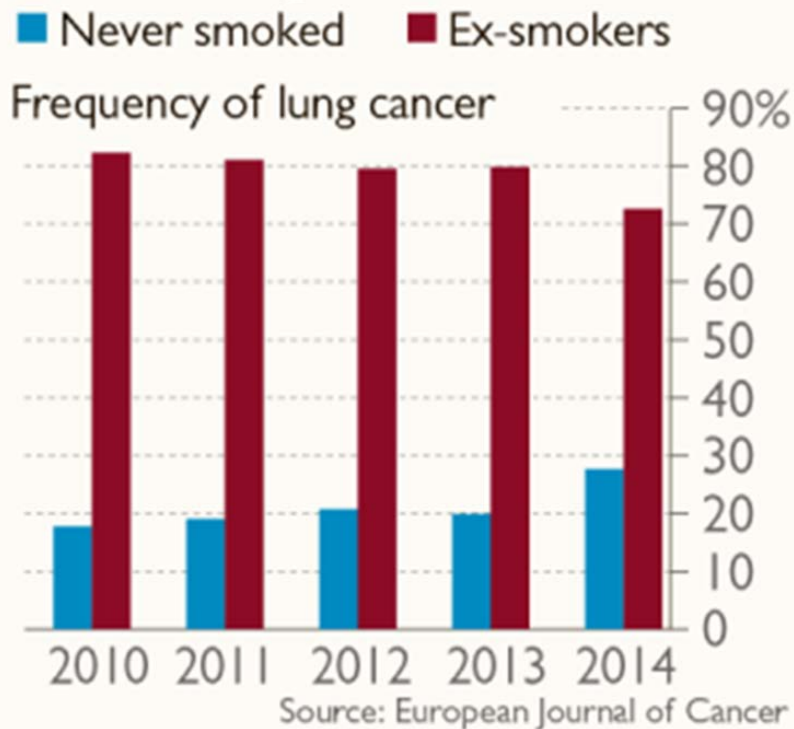
WHEN YOU CAN'T BREATHE, NOTHING ELSE MATTERS!



LUNG CANCER

- Cigarette smoking rates have decreased
- **2/3 lung cancer occurs- never/ ex smokers**

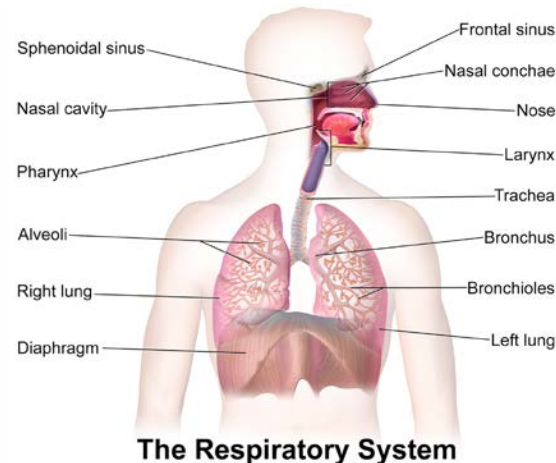
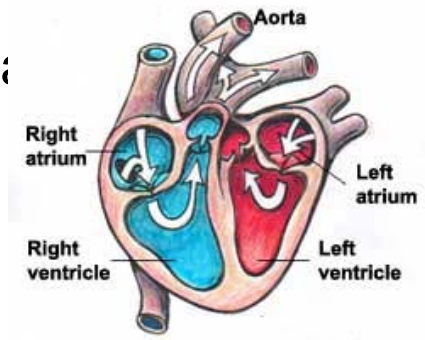
Something in the air



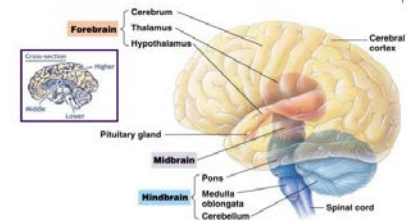
HEALTH EFFECTS OF OZONE

- Pulmonary irritant that affects respiratory mucous membrane and lung tissue
- Coughing and wheezing
- Respiratory disease (asthma, bronchitis, emphysema)
- Bacterial infections
- Worsening of COPD
- Lung sensitivity to histamine, acetylcholine, allergens

- Cardiovascular ha
- CNS Damage
- Premature death
- Low birth rate



Anatomy of the Brain



US EPA, Integrated Science Assessment for Ozone and Related Photochemical Oxidants, 2013

WHAT IS PARTICULATE MATTER?

- Small solid particles and liquid droplets
- Effect is directly related to size and composition
- Natural & man-made
- Natural PM is larger (generally removed by respiratory system)
- **Man-made PM - small & imbeds deep in lung**
- **Smaller PM – hard for removal at industrial processes**
- PM 10 – PM 2.5 micron

RISKS FROM PARTICULATE MATTER

- **Health effects**
 - ✓ **Bronchioles/alveoli/blood**
 - ✓ **Lung & heart**
- Asthma attacks
- Heart attacks, strokes
- Worsening of lung & cardiovascular diseases
- Causes lung cancer
- May cause lower birth weight & infant mortality

EPA, Integrated Science Assessment, 2009, WHO 2013

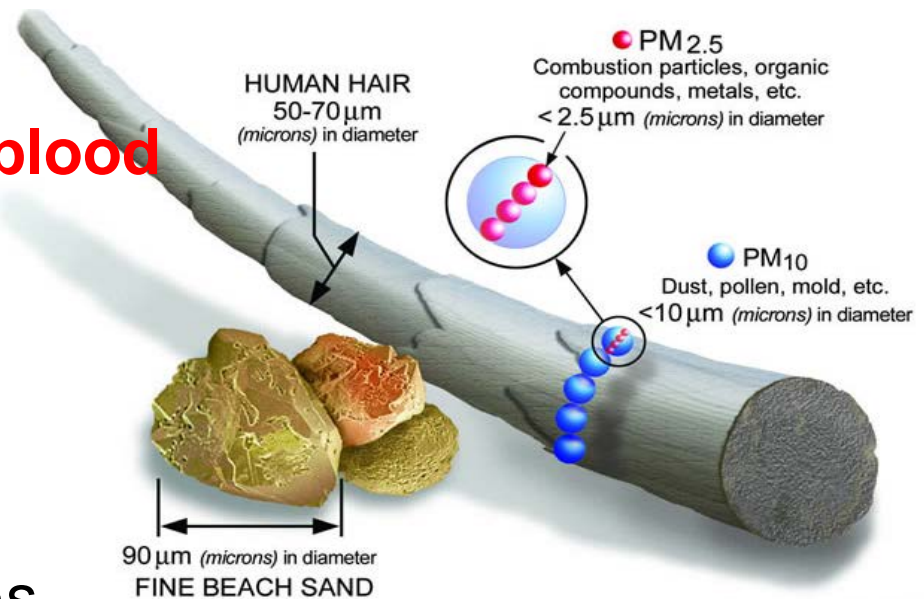
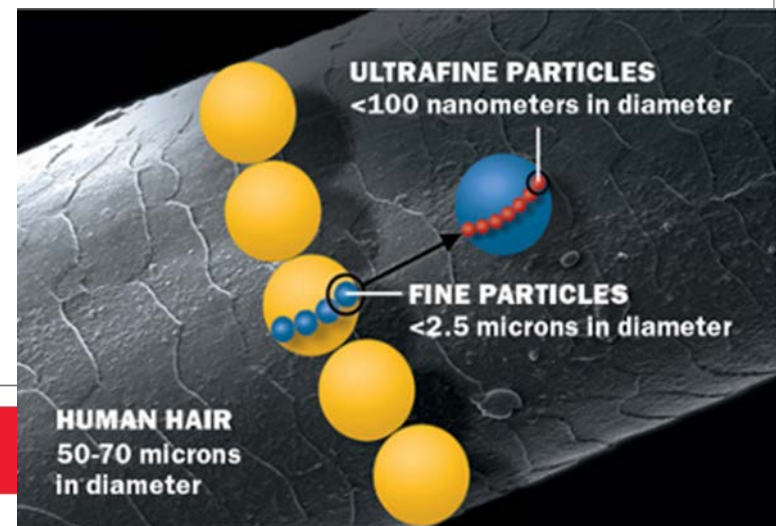
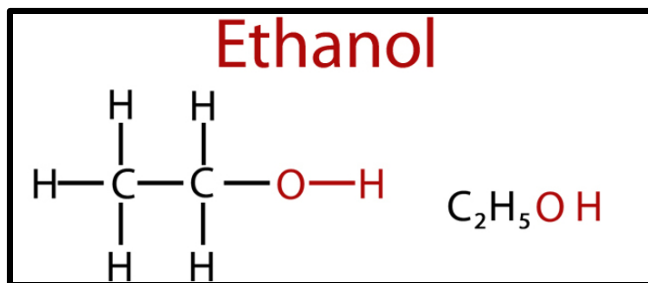


Image courtesy of the U.S. EPA

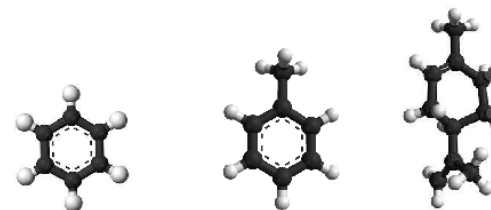


RISKS FROM TOXIC COMPONENTS

- Mixture of over 200 Chemicals - mixture varies depending upon raw material & refinery process
- **BENZENE Group A: "Human Carcinogen"**
Sufficient evidence from epidemiologic studies to support a causal association between exposure to the agents and cancer."
- Toxic at low concentrations
- Persistent, Bioaccumulative, Toxic (PBT)
- Travels in groundwater (causes groundwater contamination)
- Oil exploration/refining/spills (massive, tremendous impact)



Gasoline



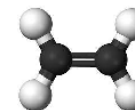
20-50% Aromatics (Benzene, Toluene, Xylene)



Paraffins (Alkanes)



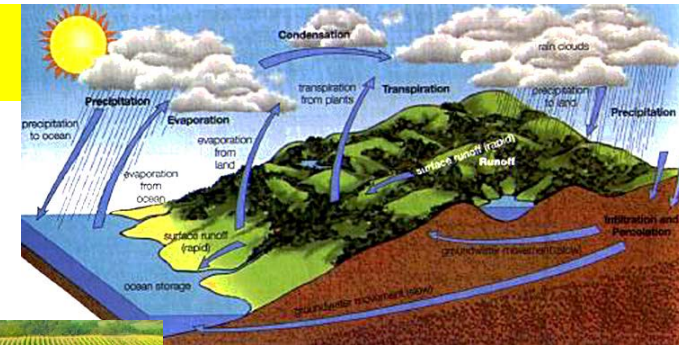
Cycloalkanes (Naphthenes)



Olefins (Alkenes)

OTHER ENVIRONMENTAL EFFECTS

- Haze & smog
- Cloud formation & precipitation
- Water acidity
- Damage to crops
- Effects on ecosystems
- Corrosion and damage to materials/buildings
- Injury to vegetation
- Accelerates aging of rubber materials, dye fading and paint erosion (at low levels long duration)



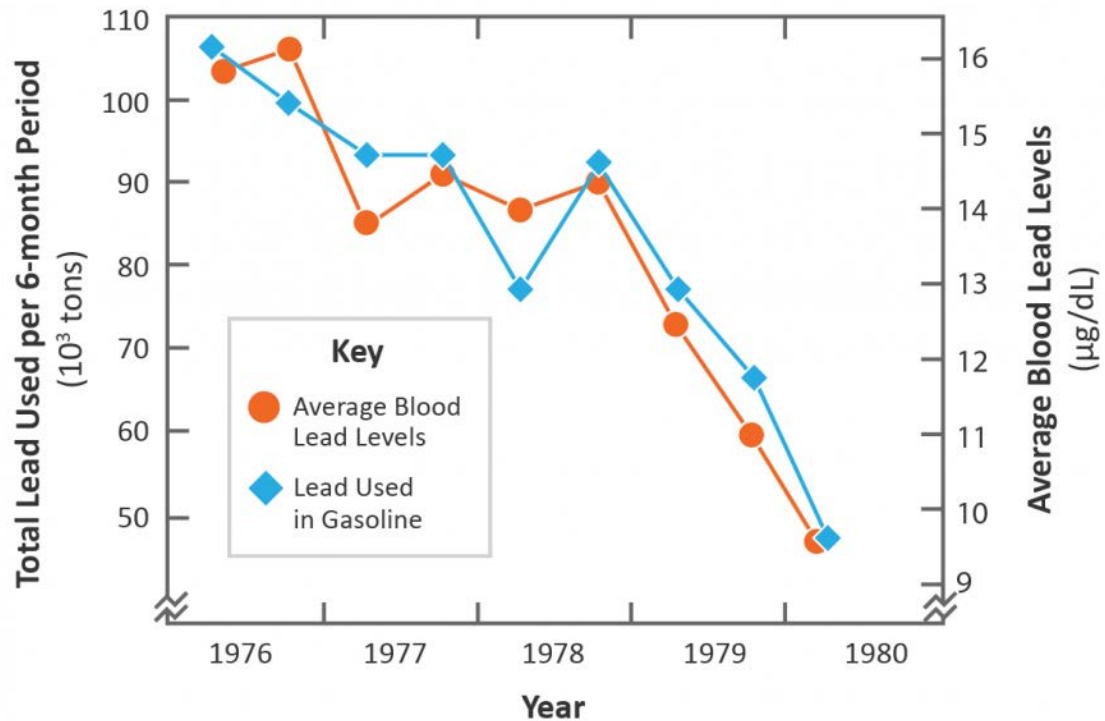
WHAT IS THE SOURCE OF LEAD (PB)?

- Leaded gasoline
- 1975 – 90% reduction due to removal of PB from gasoline
- Ingestion and inhalation
- Into bloodstream
- Bio-accumulates in body
- 6000 lead studies in children
- Neurological and kidney damage



1974 REMOVAL OF LEAD FROM GASOLINE

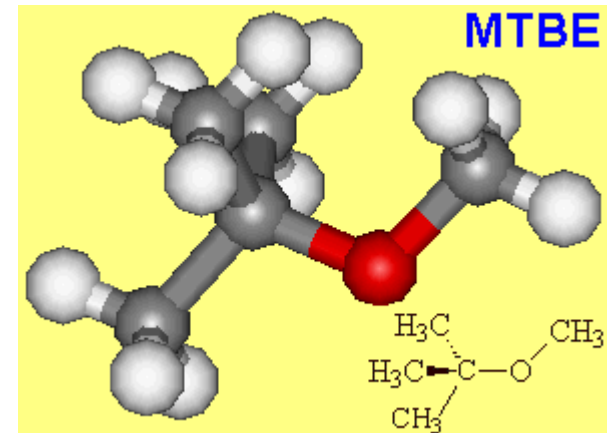
Lead Content in Gasoline and Average Blood Lead Levels



EPA standards led to parallel decreases in lead content of gasoline and blood lead level of the average American.

WHAT IS MTBE?

- Oxygenate similar to ethanol as an octane booster in auto fuel, used in USA 1990 to 2005
- Not naturally occurring, **not biodegradable**
- Very hard to clean up when spills reach groundwater – unlike ethanol
- **Disagreeable taste** at low concentrations (0.053 ppm) in drinking water – compare to ethanol taste threshold of 49 ppm – MTBE a thousand times lower
- **Now banned in the USA.**



FUEL COMPONENT PROGRAM

Pollutant	Overview	Pollutants Addressed
Lead (1970 - 1990)	Total ban of the use of Lead	Lead
Reformulated Gas (1995)	<ul style="list-style-type: none"> • Further refinement of gasoline • Requires oxygenate (E10, MTBE) • Reduces toxics (43%) • 98 % gasoline is E10 	Ozone and toxics
MTBE	Total ban of the use of MTBE	MTBE