

# Pollution



## Objective 2.2.1

Infer how human activities (including population growth, pollution, global warming, burning of fossil fuels, habitat destruction, and introduction of non-native species) may impact the environment.

# Pollution

Pollution refers any substance introduced into the environment that has harmful or poisonous effects



# Eutrophication

Eutrophication refers to water that have an overload of the nutrients nitrates and phosphates



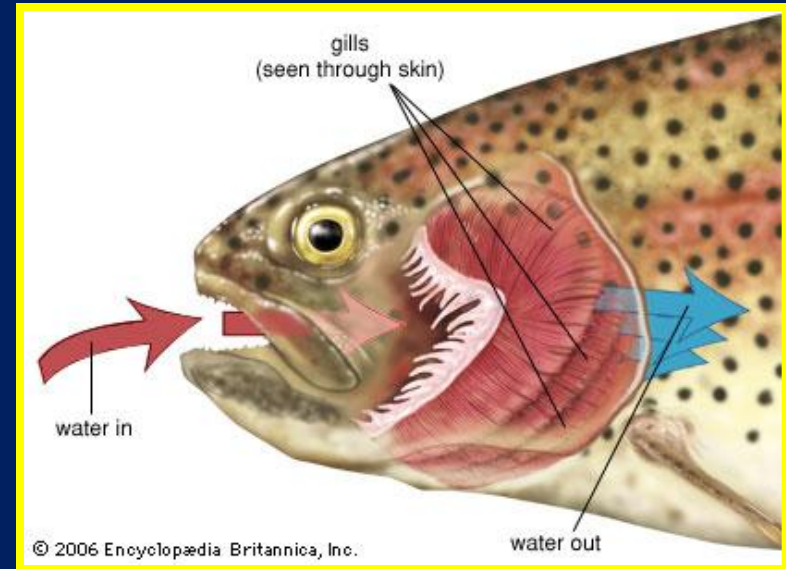
Excess nutrients create an algal bloom.

Algae covers water and blocks sunlight

Lower levels of algae die and are decomposed

# Eutrophication

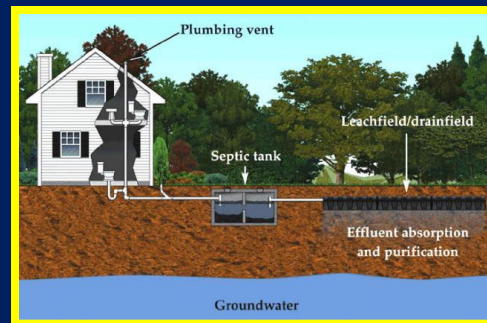
The decomposition of the lower algae decreases the amount of dissolved oxygen in the water



Low levels of dissolved oxygen leads to massive fish kills

# Eutrophication

Sources of excess nitrates and phosphates include: fertilizers; leaky septic tanks; waste treatment plants; and animal wastes from animal farms.



Hog waste is often stored in open-air "lagoons," which can be larger than **7 acres.**

Source: Natural Resources Defense Council

# Pesticides

Wide spread use of pesticides or “weed killers” become pollutants when it is washed into waterways, killing not only natural aquatic insects but can also affect aquatic bird populations.



DDT

# Pesticides

In 1962, Rachel Carson, a wildlife biologist, conducted research and wrote a book called *Silent Spring*, describing the effects DDT was having on the bird population.



**Bald Eagles, Brown Pelicans, Peregrine Falcons, Ospreys, and songbirds.**

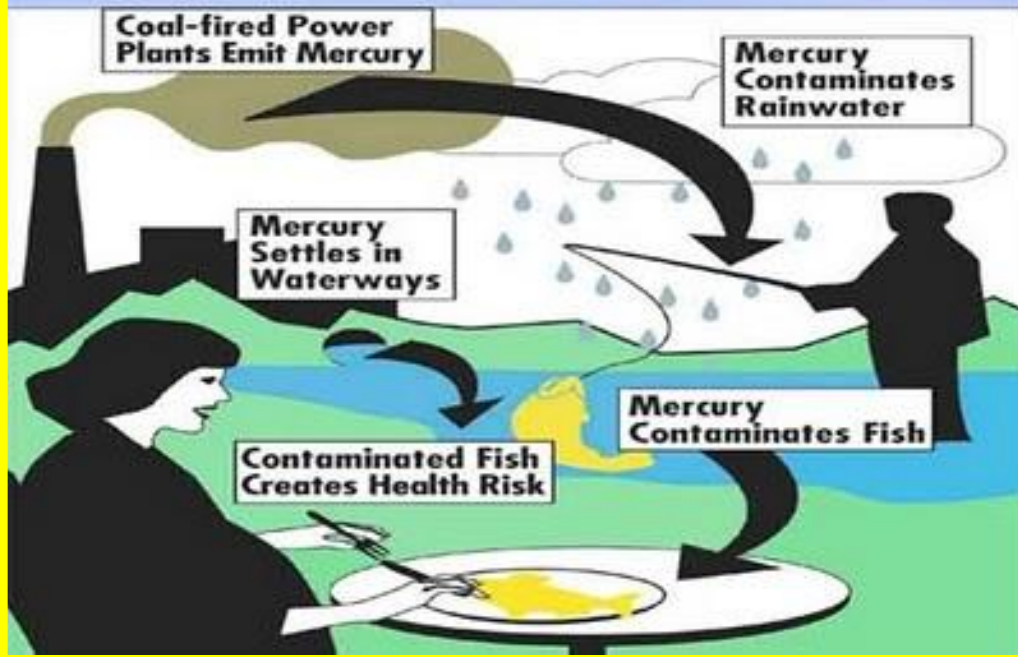


Ingestion of DDT, as it traveled up the food chain, resulted in extremely weak egg shells that usually broke before hatching could occur.

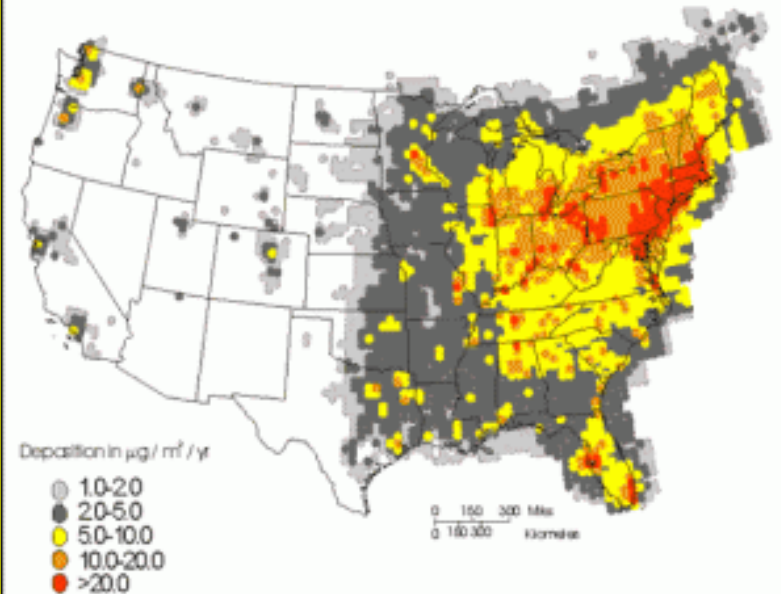
# Mercury

Mercury is a heavy metal that usually enters the waterways in the form of mercury-polluted rain near coal burning plants.

## The Mercury Cycle



## National Atmospheric Hg Deposition



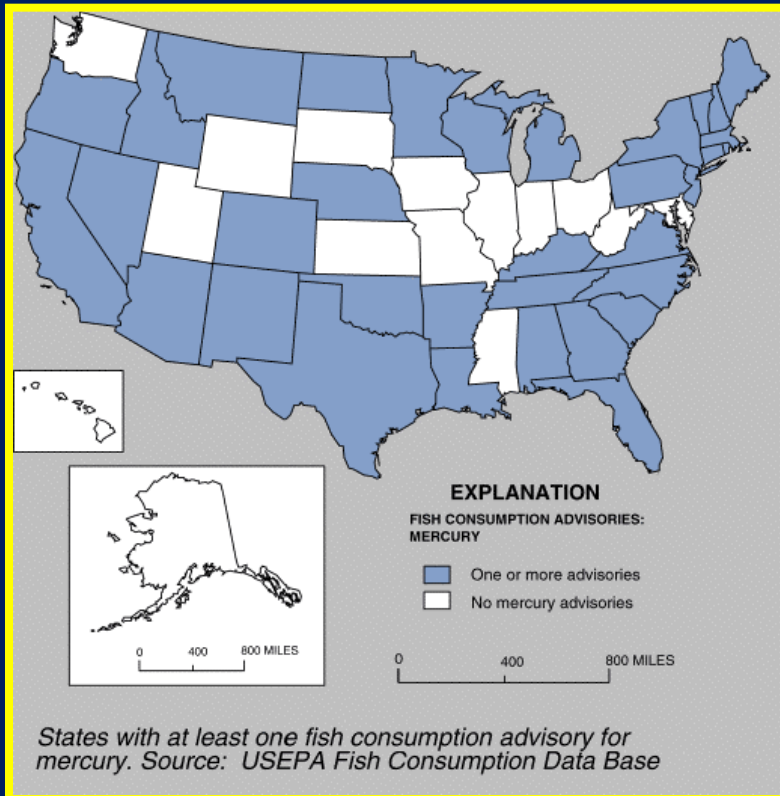
Source: US EPA, 1998, Mercury Report to Congress

USGS



# Mercury

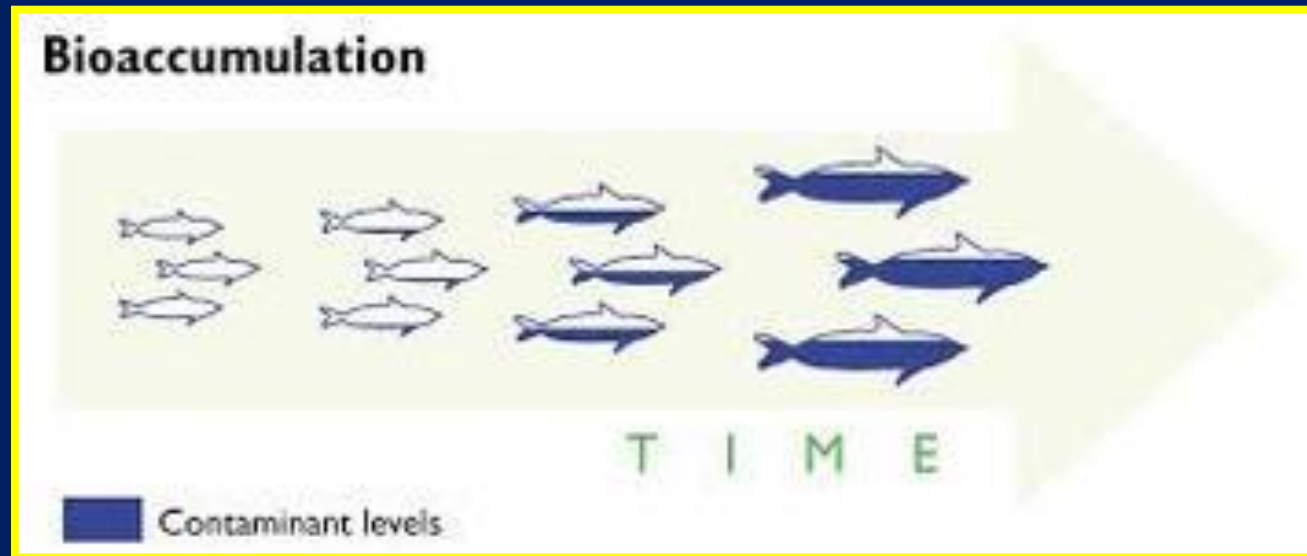
Consuming fish with high levels of mercury can cause kidney and liver damage, as well as interfere with brain development in children under the age of six and in developing fetuses.



LEAST MERCURY	MODERATE MERCURY	HIGH MERCURY	HIGHEST MERCURY
Enjoy these fish	Eat six servings or less per month	Eat three servings or less per month	Avoid eating
Anchovies	Bass)	Croaker	Bluefish
Catfish	Codfish	Halibut	Grouper
Flounder	Tuna (Chuck Light)	Mackerel	Mackerel (King)
Trout	Snapper	Perch (Ocean)	Marlin
Shad	Carp	Albacore Tuna	Swordfish

# Bioaccumulation

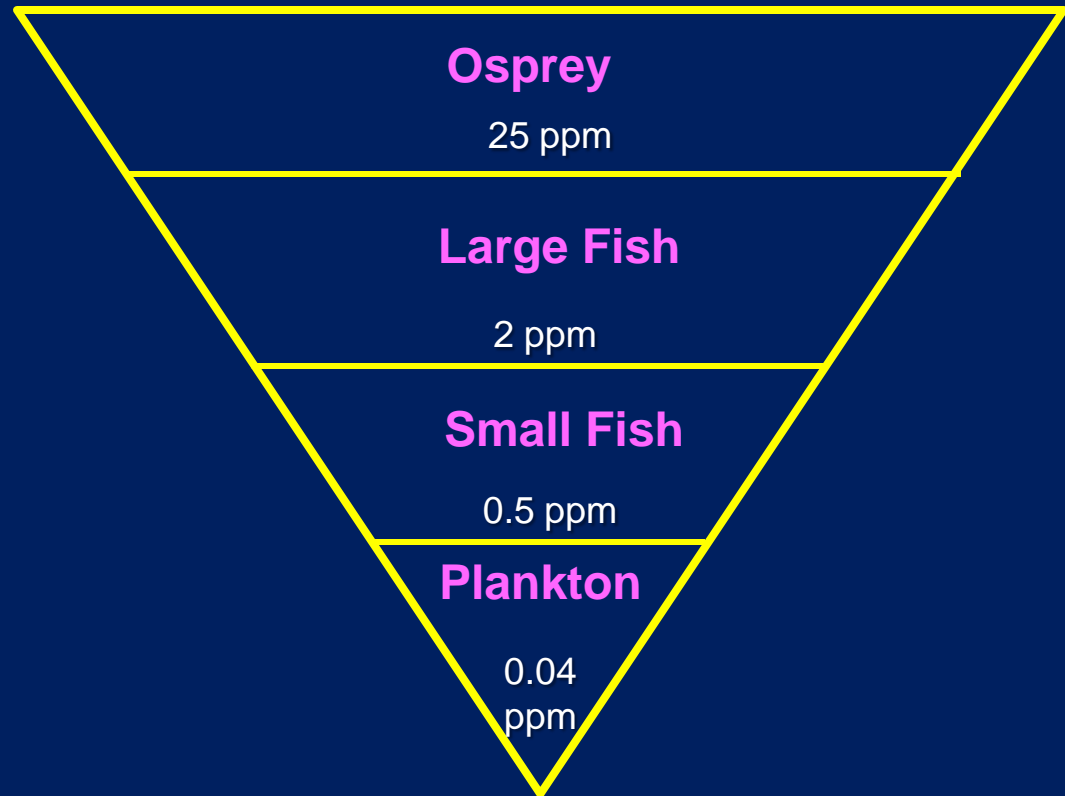
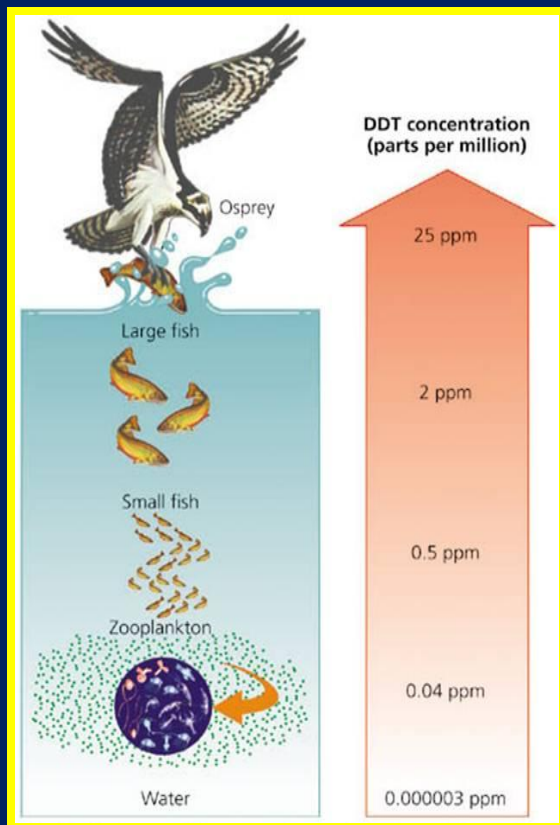
Bioaccumulation is the process by which toxins are stored and increase in concentration within the body of an organism



Both DDT and mercury bioaccumulate in the fatty tissues of organisms.

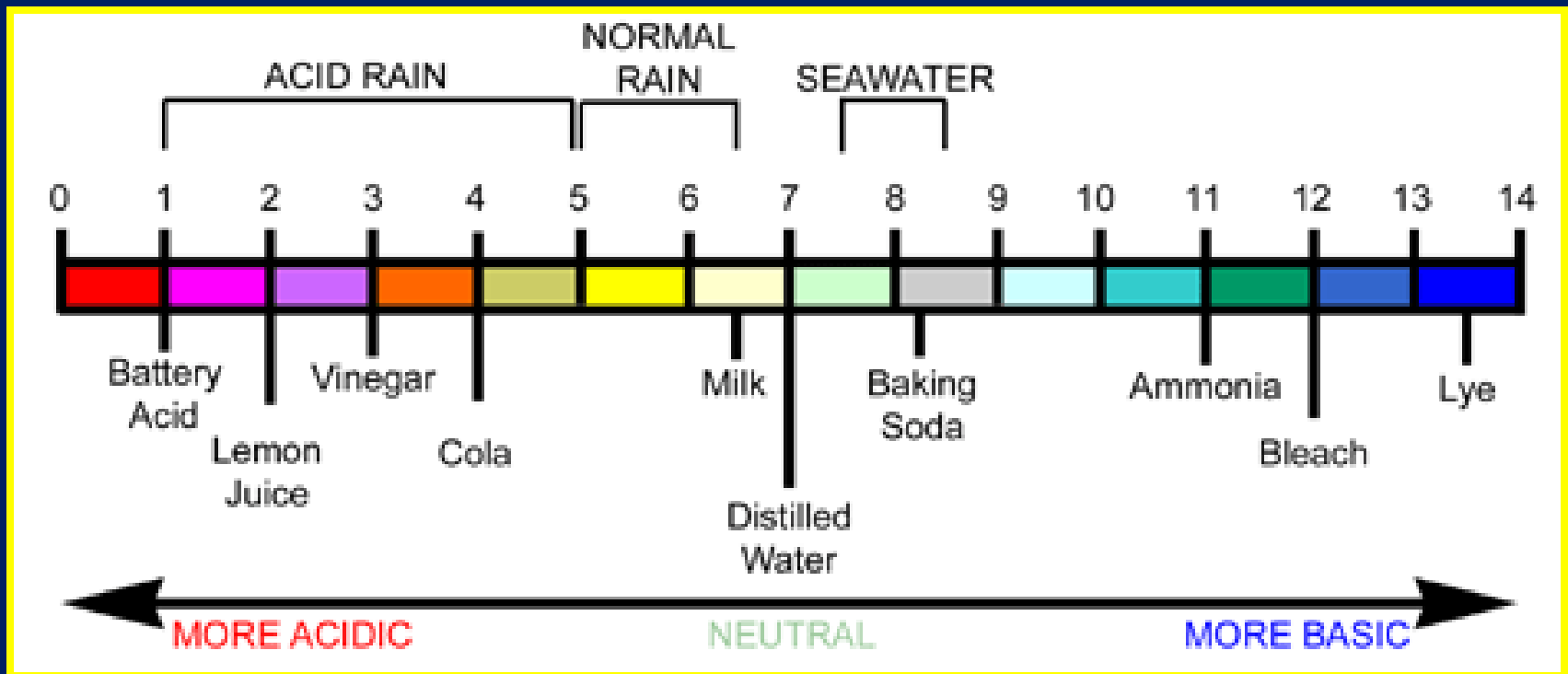
# Biomagnification

Biomagnification is the process by which toxins increase in strength and concentration as they travel up the food chain



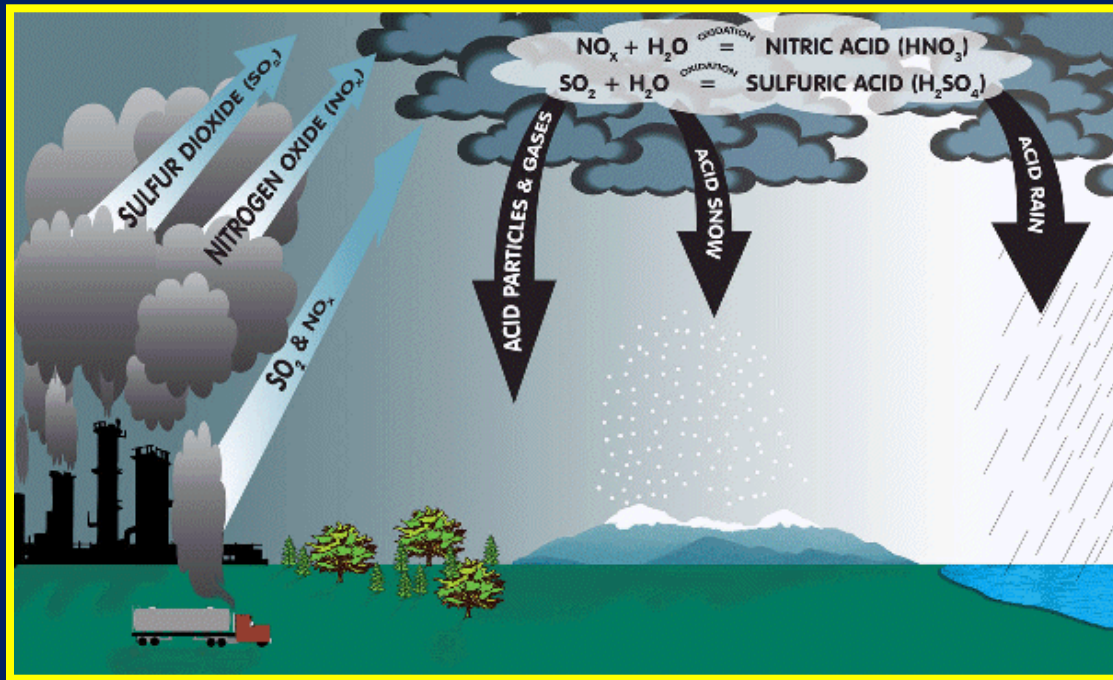
# Acid Precipitation

Acid precipitation refers to rain, snow, sleet, mist, and fog that has a pH lower than 5.



# Acid Precipitation

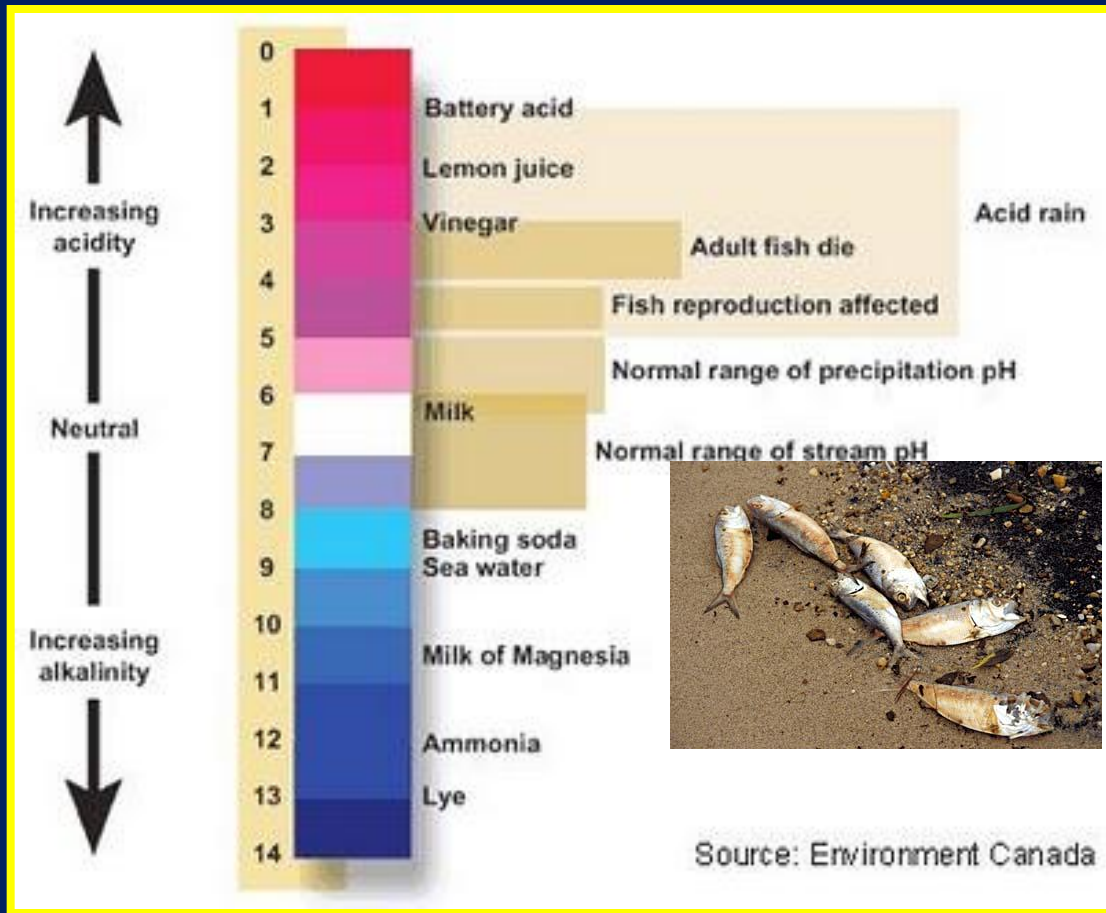
When coal and other fossil fuels are burned, sulfur dioxides and nitrogen dioxides are released into the atmosphere.



Sulfur dioxide (SO<sub>2</sub>) and nitrogen dioxides (NO<sub>2</sub>) mix with water to form sulfuric acid and nitric acid.

# Acid Precipitation

When acid precipitation enters waterways, the pH of the water is lowered.



Most fish eggs cannot hatch with a pH less than 5.

Adult fish die when the pH falls below 4.

# Acid Precipitation

Acid precipitation can also damage forests, especially those at higher elevations.



Soils at high elevations tend to be thin so they have less buffering effect.

# Acid Precipitation

Acid precipitation causes soils to release aluminum which then blocks a tree's ability to take up water.



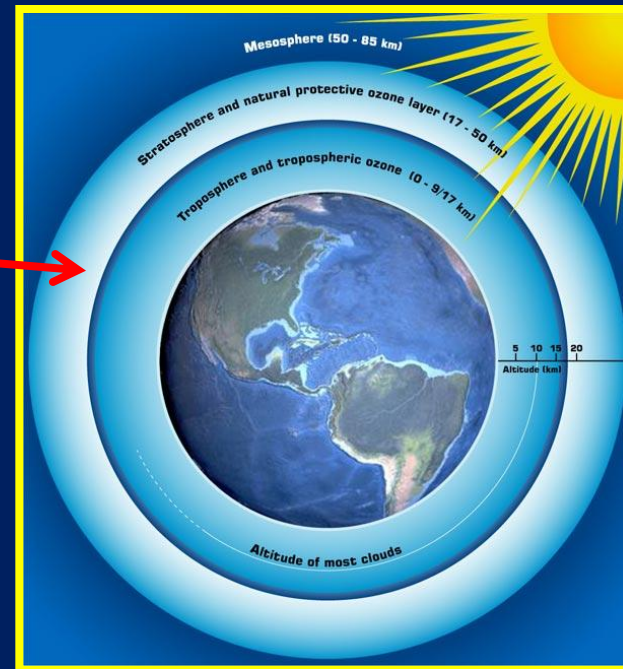
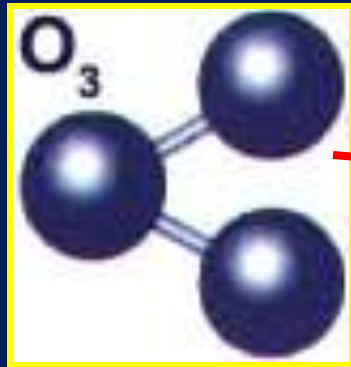
Acid precipitation also dissolves minerals and nutrients in the soil, washing them away before plants can use them.

Forest trees undergoing stress from acid precipitation are less able to withstand cold temperatures, insects, and disease.



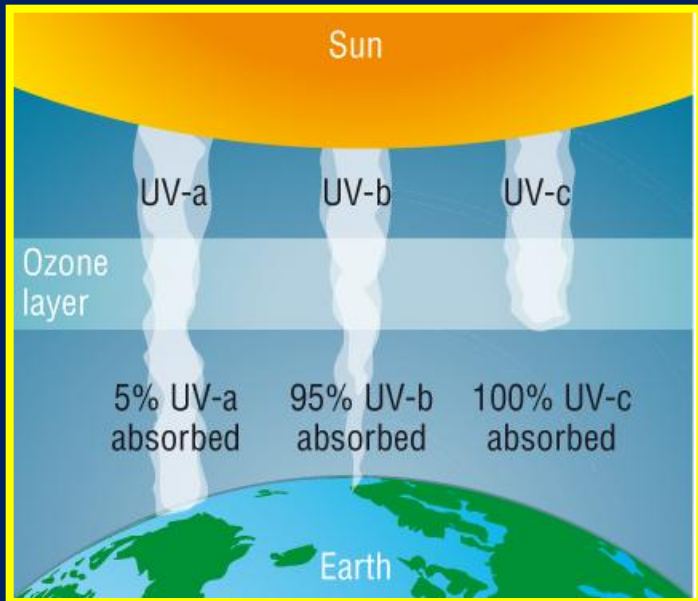
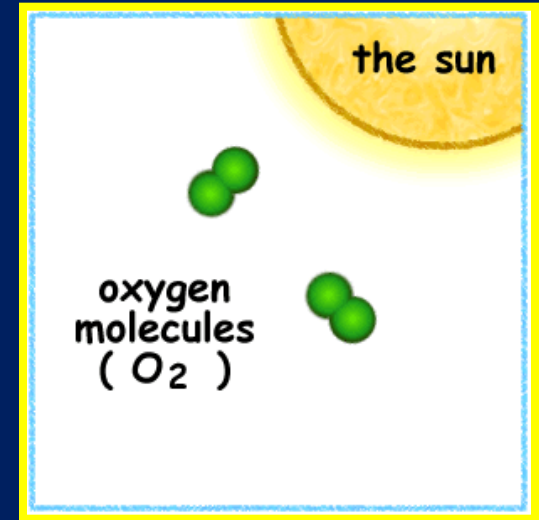
# Hole in the Ozone Layer

Ozone, O<sub>3</sub>, is a naturally occurring gas that collects in the stratosphere and shields the Earth from harmful ultraviolet radiation released from the Sun.



# Hole in Ozone Layer

In the stratosphere, ozone, oxygen molecules,  $O_2$ , combine with free oxygen atoms,  $O$ , to form ozone molecules,  $O_3$ .



Ozone then absorbs most of the more harmful ultraviolet radiation, preventing the rays from reaching Earth.

# Hole in Ozone Layer

In the early 1930's, a “miracle” compound called Freon, containing chemicals called chlorofluorocarbons, CFCs, were invented to use as propellants in aerosols and refrigeration units.



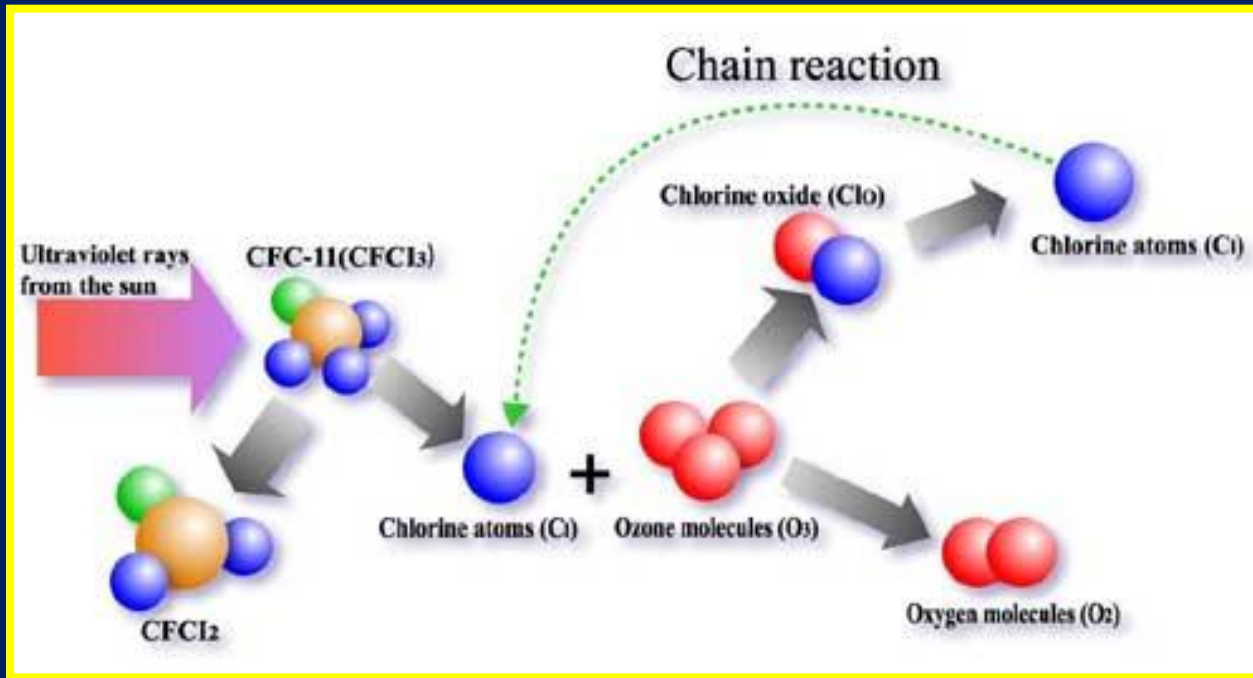
Freon replaced chemicals that were directly harmful and fatal to human health.



Chlorofluorocarbons, CFCs, contain carbon, fluorine, and chlorine atoms.

# Hole in Ozone Layer

Radiation, from the Sun, causes the chlorine atom to break free from the CFC molecule.

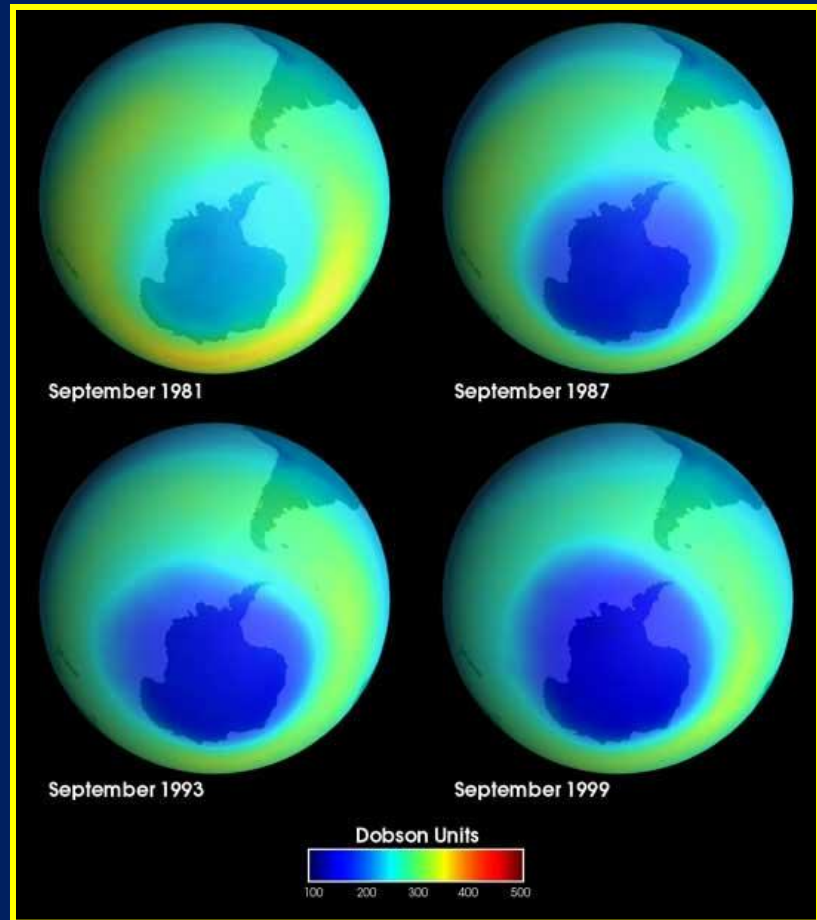
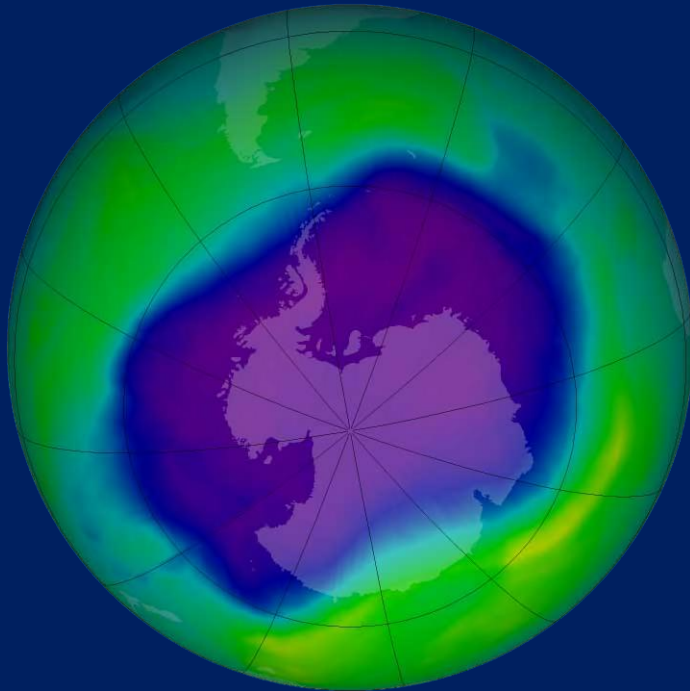


The free chlorine atom then interact with and breakdown ozone atoms.

One CFC can destroy 100,000 ozone molecules.

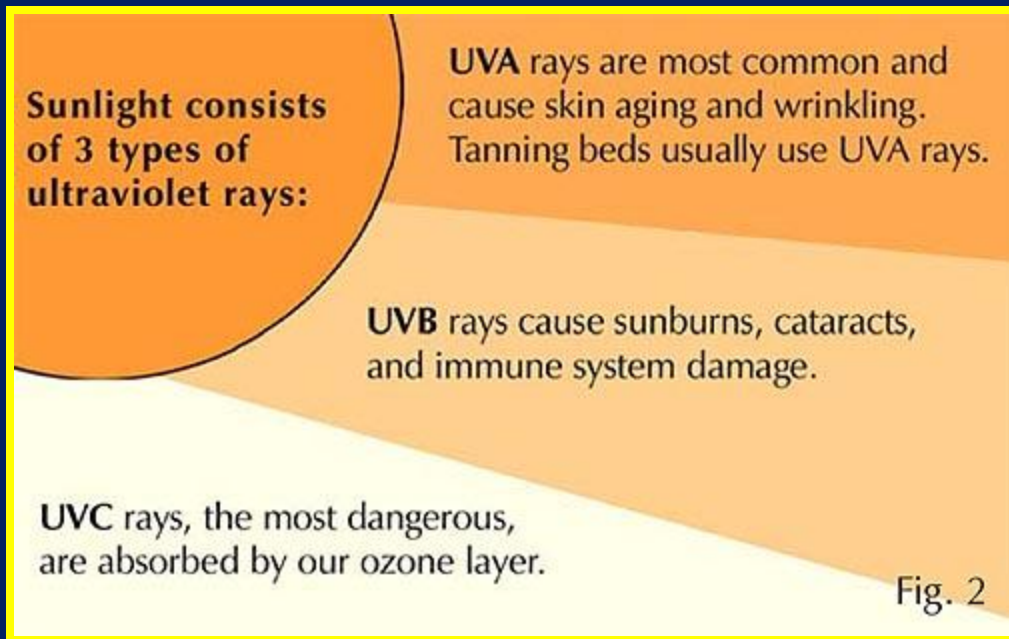
# Hole in Ozone Layer

In the 1970's, scientists began to notice that the layer of ozone was thinning, most noticeably above Antarctica.



# Hole in Ozone Layer

With a thinner ozone layer, more ultra-violet radiation reached the surface of Earth resulting in increased cases of skin cancer.

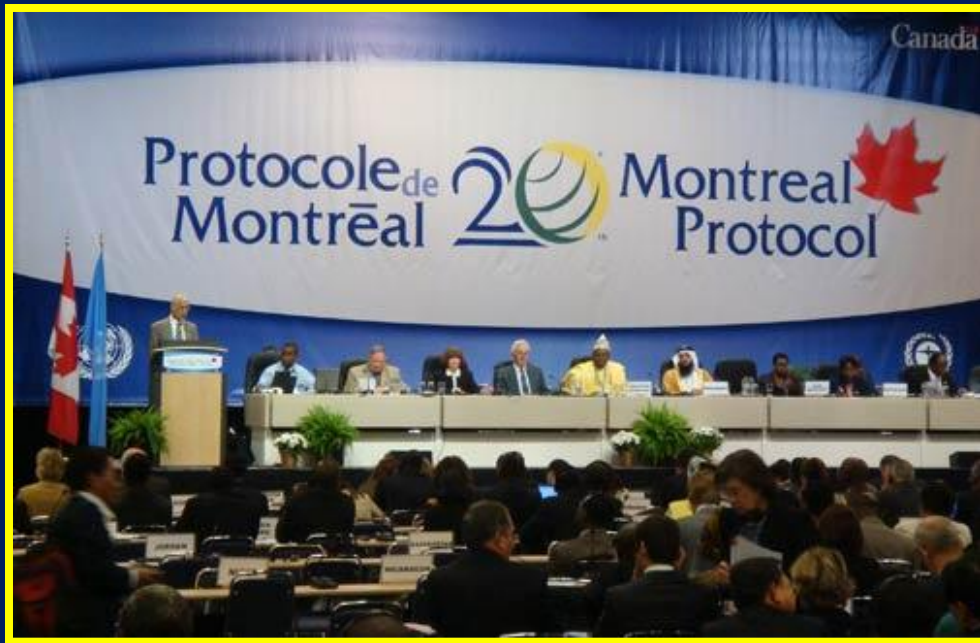


## Skin Cancer

- Most common cancer in the US
- 90% increase in cases since 1970
- 1 in 5 people will develop skin cancer
- UVB radiation has accumulative effect

# Hole in Ozone Layer

In 1989, an international agreement, called the Montreal Protocol, was made among national leaders to reduce and phase out the use of chemicals that break down ozone in the stratosphere.



However, since CFCs have a residence time between 20 to 100 years, it may take until the late part of the 21<sup>st</sup> century for the ozone layer to be fully repaired.