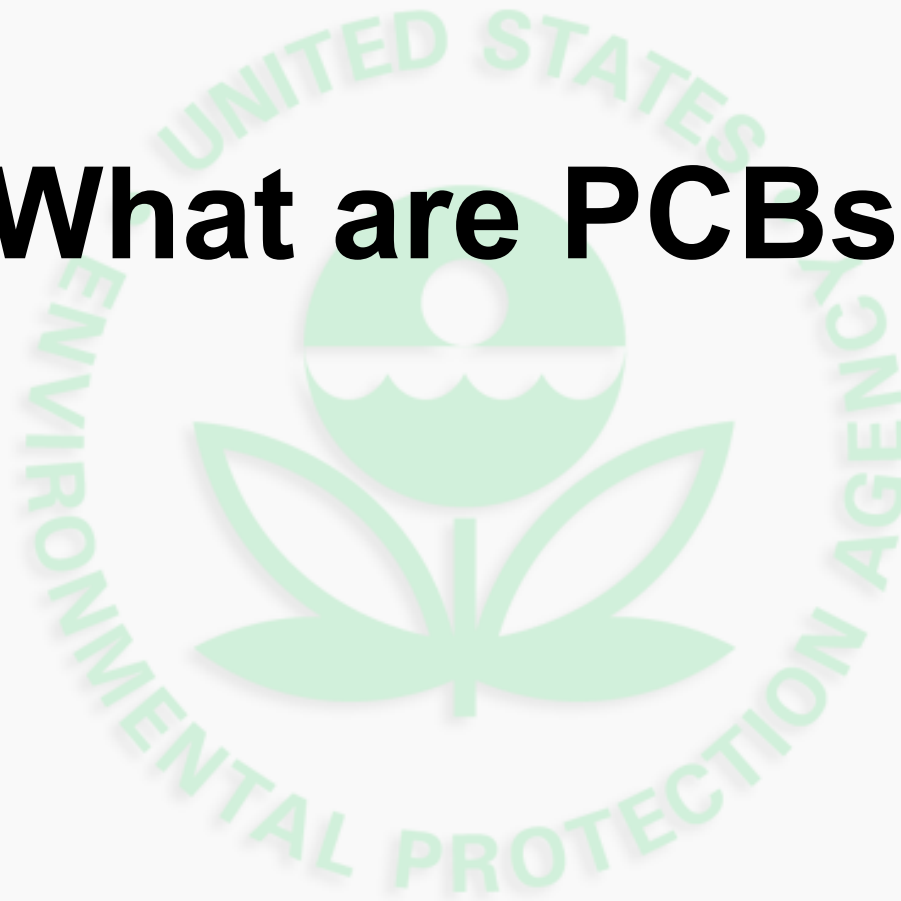
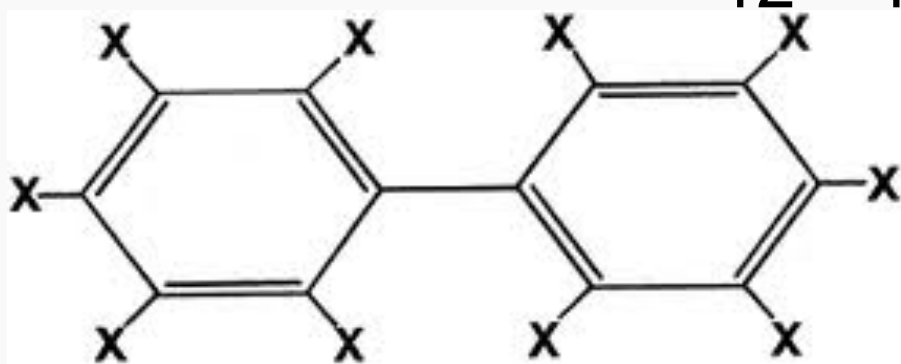
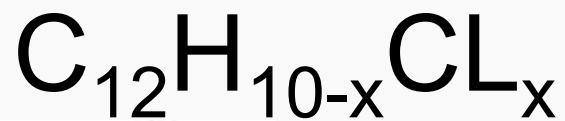
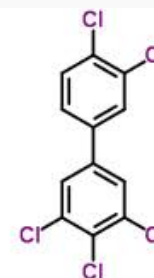
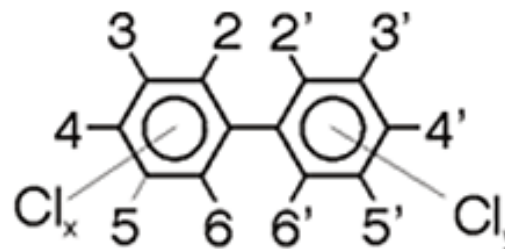
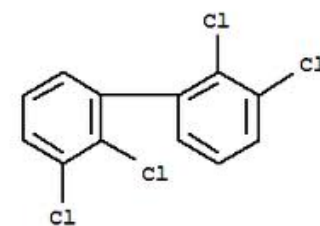


# What are PCBs?





X = H or Cl





- 209 possible combinations, or “congeners”
- Congeners are PCBs with the same structural base but differing by the number or position of chlorine atoms
- About 130 congeners have been used
- Over 98% of the PCBs mf'd by Monsanto were of 7 congeners



- Estimated 1.5 million tons produced, >600,000 tons in US from 1930 to 1977
- Domestic production banned in 1979



## What are PCBs?

- Strictly man-made
- Rights owned by Monsanto since around 1930
- Other companies mf'd under license
- Monsanto brand name "Aroclor"
  - Aroclor naming convention – Aroclor 1248 means 12 carbon atoms, 48% chlorine by weight
  - The more chlorine, the more viscous and tar-like



## Other brand names:

- Apirilio
- Asbestol
- Askarel
- Bakola
- Chlorextol
- Clophen
- Delor
- Diaclor
- Dykanol
- Elemex
- Halowax
- Hydol
- Interteen
- Noflamol
- Phenclor
- Pyralene
- Pyranol
- Pyroclor
- Saft-Kuhl
- Sovol
- Solvol
- And others



# Properties-

- Colorless
- Odorless
- Liquid or solid
- Electrically resistive
- Low vapor pressure
- High boiling point
- Thermally stable below 1000°C
- Flame retardant
- Fat soluble



## Uses -

High-temp electrical equipment

Hydraulic equipment

Heat transfer fluids

Plasticizers

Adhesives

Wax extender

Carbonless copy paper

Lubricants, oils, greases

Paints

Inks

Cable insulation

Cutting oils

Dust control

Caulk

Gaskets

- PCBs made many products more durable





## Fun Facts!

*“Non-drying”* – even in thin films, no noticeable oxidation or hardening will occur

*“Non-flammable”* – will not combust even at 350°C

*“Adhesiveness”* – adhere strongly to smooth surfaces

*“Thermoplasticity”* – undergo no condensation or hardening upon repeated melting and cooling



- Not affected by boiling with sodium hydroxide
- Prolonged stirring with concentrated sulfuric acid had negligible effect
- Resistant to prolonged heating
- Resistant to electricity – high resistivity and dielectric strength, low power factor
- Readily penetrates skin, latex, rubber



Chemical stability of PCBs =  
persistent organic pollutant

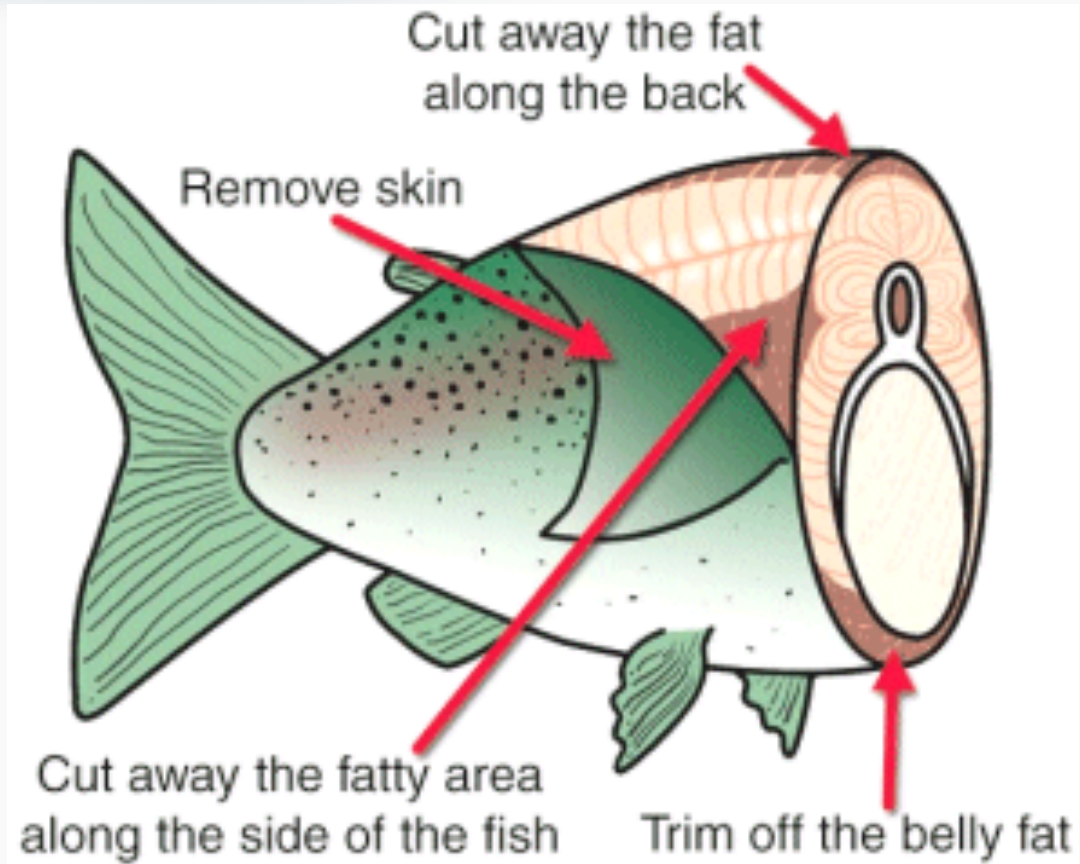


- Persistent, bioaccumulative, biomagnifying
  - The types of PCBs most likely to bioaccumulate in fish and bind to sediments are also the most carcinogenic
  - Bioaccumulation selectively concentrates the most toxic PCB congeners
- Poisonous and ecotoxic
  - *Every* commercial formulation tested on rats caused cancer
- Widespread fish consumption advisories (Kaw)
- Incomplete combustion forms dibenzodioxins and dibenzofurans, even more toxic by-products



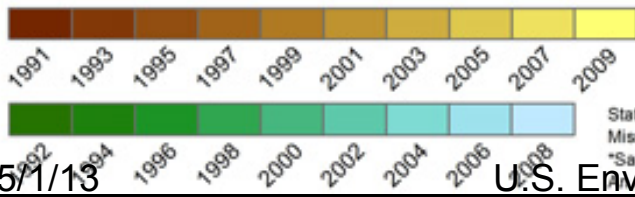
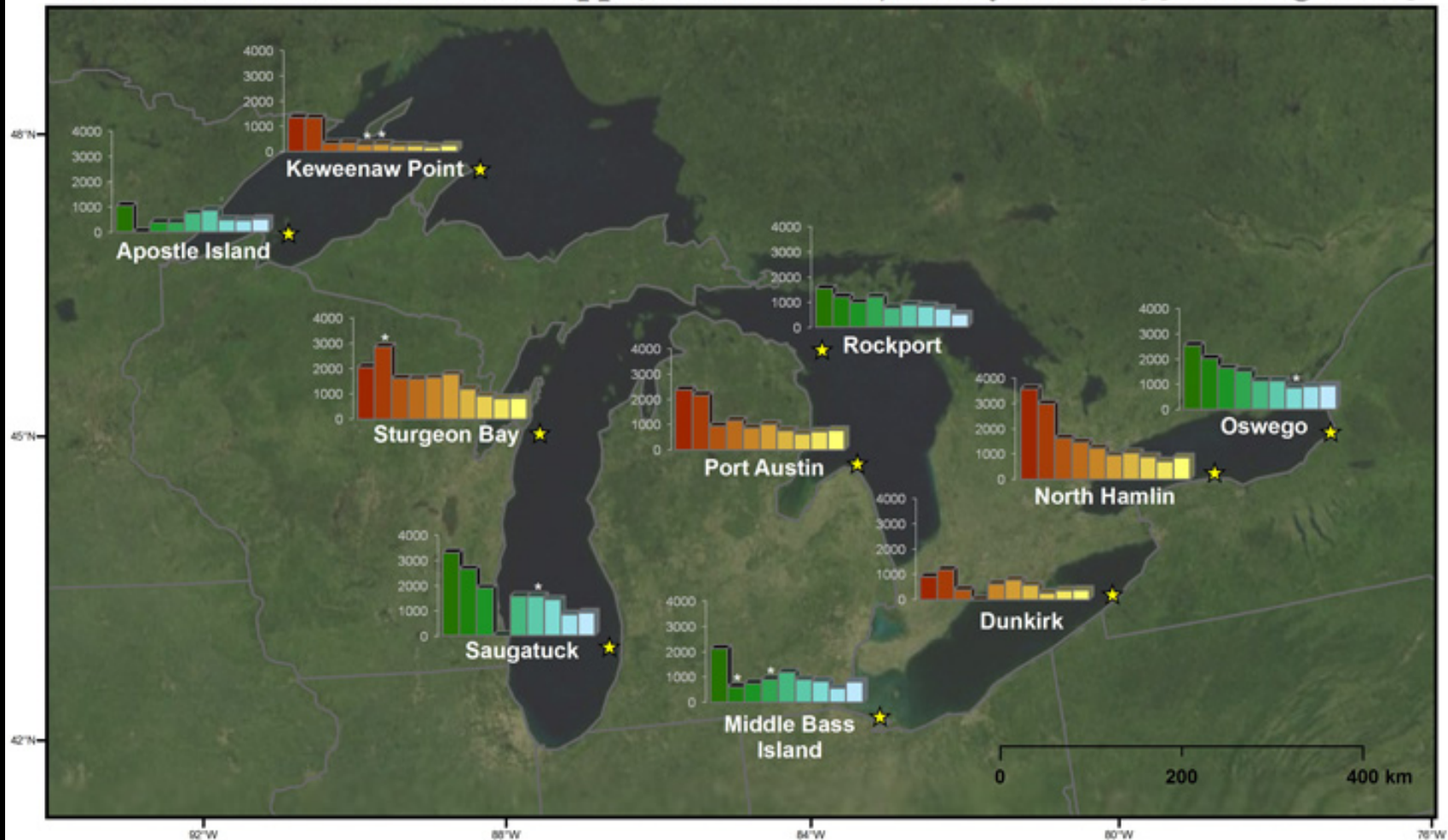
Fish and shellfish usually contain the highest PCB levels of any food, especially fish that:

- are fatty
- eat many other fish
- are caught near industrial areas



# Great Lakes Fish Monitoring and Surveillance Program

## Mean Total PCB Concentration (ppb) in Lake Trout/Walleye from 1991 through 2009



★ GLFMSP Station

Stations are not representative of entire lake.  
 Missing bars represent a missing value for that period.  
 \*Sampling period is typically comprised of 10 composites but varies between 3 and 11.



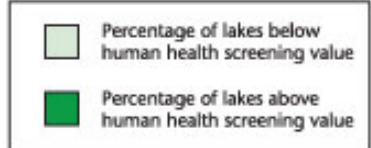
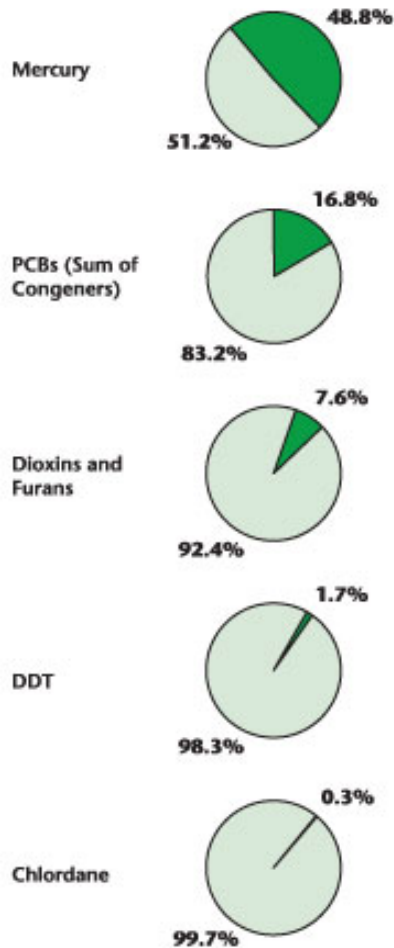
Projected in Albers Equal Area  
 April 2012  
 Created by CSC 15

5/1/13

U.S. Environmental Protection Agency

**Percentage of Lakes Above or Below Human Health Screening Values**

*(Predator Results:  
Sampled Population = 76,559 Lakes)*



From USEPA National Lake Fish Tissue Study: 16.8% of the sampled population of lakes had total PCB tissue concentrations that exceeded the 12 ppb human health screening value, representing a total of **12,886 lakes.**







# Likely Human Health Effects

Immune system

Reproductive system

Nervous system

Endocrine system



## Likely Human Health Effects

- ***Toxic*** - Chloracne, rashes, fatigue, headaches, coughs, anemia, liver damage, immunosuppression
- ***Developmental*** - Low birth weight, premature birth, poor cognitive development, motor skill problems, poor memory
- ***Carcinogenic*** - Liver cancer, biliary cancer, non-Hodgkins lymphoma, malignant melanoma



"Yusho" incident in Japan, 1968 – contaminated rice bran oil

400,000 chickens killed by feed

14,000 persons affected by consumption

-skin and eye lesions, irregular menstruation, lowered immune response, fatigue, headache, cough, sores, poor cognitive development

"Yu-Cheng" incident in Taiwan, 1979

2008 Irish pork crisis – estimated 20% of population will experience up to 5 years reduced life expectancy



“...to protect against unreasonable risks from PCBs by providing cost-effective and environmentally protective disposal options that will reduce exposure to PCBs by encouraging their removal from the environment, thereby reducing the potential risk to human health and the environment from PCBs.”