Organic Chemicals in the Environment

Why we are producing these dangerous chemicals intentionally?

- Humans always have had to contend with pests
- The Black Death, which killed millions of people in the Middle Ages, was transmitted to humans by fleas (insects) on rats carrying bubonic plague
- The failure of the potato crop in Ireland in 1845, which caused widespread starvation and mass emigration to the United States, was caused by a potato blight (fungus)

Organic Chemicals in the Environment

Why we are producing these dangerous chemicals intentionally?

- Malaria, spread by the Anopheles mosquito, still kills millions of people annually in less developed countries
- Swarms of locusts continue to devastate crops in many areas of the world

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New generation of locusts may attack crops in UP after monsoon

A new generation of swarms may attack crops in Uttar Pradesh and Rajasthan after the monsoon even as the toxic chemicals sprayed to kill them may have adverse environmental and health consequences

Organic Chemicals in the Environment

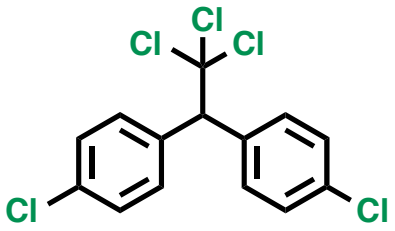
Why we are producing these dangerous chemicals intentionally?

- Humans depends on plants for food
- Plants that produce food grains are under constant attack from insects, fungi, bacteria, viruses, and other microorganisms
- Before 1940, only a few pesticides were available and most of the insect poisons are naturally extracted from plants

Ex. 1. Pyrethrins obtained from the pyrethrum flower
2. Nicotine sulfate obtained from tobacco
3. Garlic oil

United States uses approximately 500,000 metric tons of pesticides annually to control pests

Organic Chemicals in the Environment



DDT (Dichlorodiphenyltrichloroethane)

- The introduction of DDT at the end of WW-II (late 1940s) escalated the use of pesticides and the development of several other pesticides

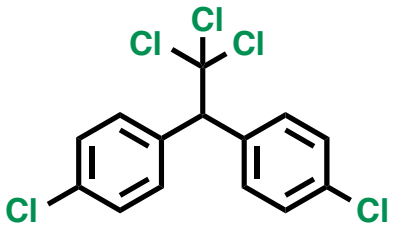
Advantages

- Inexpensive
- Nontoxic to humans and other mammals
- Stable
- Continued to kill insects for a long period after application

Disadvantages

- Harmful to fish-eating birds such as bald eagles, peregrine falcons, and brown pelicans

Organic Chemicals in the Environment

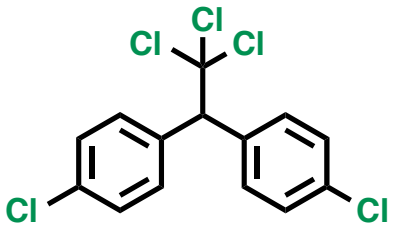


DDT (Dichlorodiphenyltrichloroethane)

Disadvantages

- Harmful to fish-eating birds such as bald eagles, peregrine falcons, and brown pelicans
- Water gets contaminated with DDT from aerial spraying and runoff from treated land
- With time, insects also became increasingly resistant to DDT and larger amounts had to be applied to achieve the desired results
- DDT interferes with calcium metabolism in birds and it causes eggshells to become thin and break when parent birds attempt to incubate the eggs

Organic Chemicals in the Environment

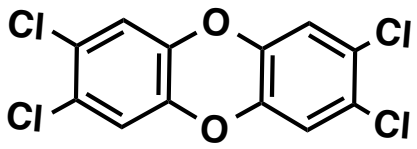


DDT (Dichlorodiphenyltrichloroethane)

- The first person to draw public attention to the dangers of pesticides was biologist **Rachel Carson** and she a played key role for the establishment of Environmental Protection Agency (EPA) in 1970
- In 1973, the use of DDT was banned in the United States and fish-eating birds population restored shortly
- Still DDT is partially banned in several countries such as India
- DDT is banned for agriculture but allowed for fumigation to kill mosquitoes to prevent malaria

Organic Chemicals in the Environment

Dioxins

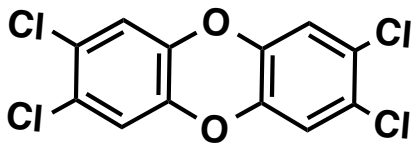


2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD)

- TCDD persists in the environment for a very long time and bioaccumulates within the food chain
- TCDD is extraordinarily toxic to guinea pigs and is a known carcinogen for many animals
- During Vietnam war, USA used **Agent Orange** (defoliant) in which TCDD present as an impurity
- EPA concluded that exposure to dioxin, increase the risk of cancer, may disrupt some reproductive mechanisms and suppress the immune system

Organic Chemicals in the Environment

Dioxins



2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD)

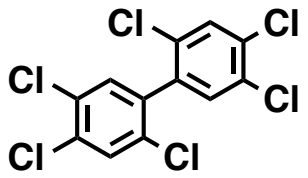
Major sources for TCDD

- Burning of chlorine-containing medical and municipal wastes
- Paper mills that use chlorine to bleach paper pulp
- During the manufacture of Trichlorophenol a precursor for herbicides

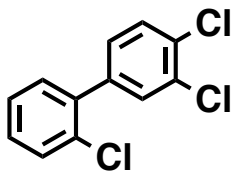
Currently, proper solutions were found for above three problems

Organic Chemicals in the Environment

PCBs (Polychlorobiphenyls)



PCB_1



PCB_2

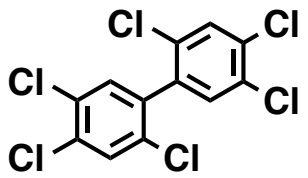
- PCBs are not water soluble but readily soluble in fat
- PCBs are chemically and thermally stable, fire and electricity resistant and persist in the environment for many years

Uses of PCBs

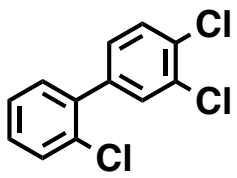
- Heat exchange fluid in transformers,
- Paints and plastic additive (platicizer)

Organic Chemicals in the Environment

PCBs (Polychlorobiphenyls)



PCB_1

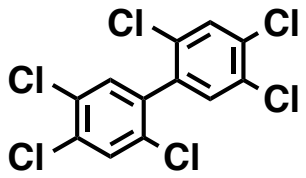


PCB_2

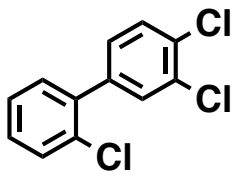
- When plastic wastes and other PCB-containing materials are burned, PCB vapors condense on airborne particles, which then fall directly onto water or reach water in runoff from the land
- PCBs present in water in a negligible concentration but can become more than 1 million times concentrated in fish
- PCBs cause eggshell thinning and neurologic damage in birds and impair reproduction of aquatic species
- In humans, they cause, chloracne, liver damage, reproductive disorders, birth defects, and cancer

Organic Chemicals in the Environment

PCBs (Polychlorobiphenyls)



PCB_1



PCB_2

- In 1977, production of PCBs in the United States was halted, and disposal of PCB-containing products is now strictly regulated

- Fish in many lakes still contain significant levels of contaminants

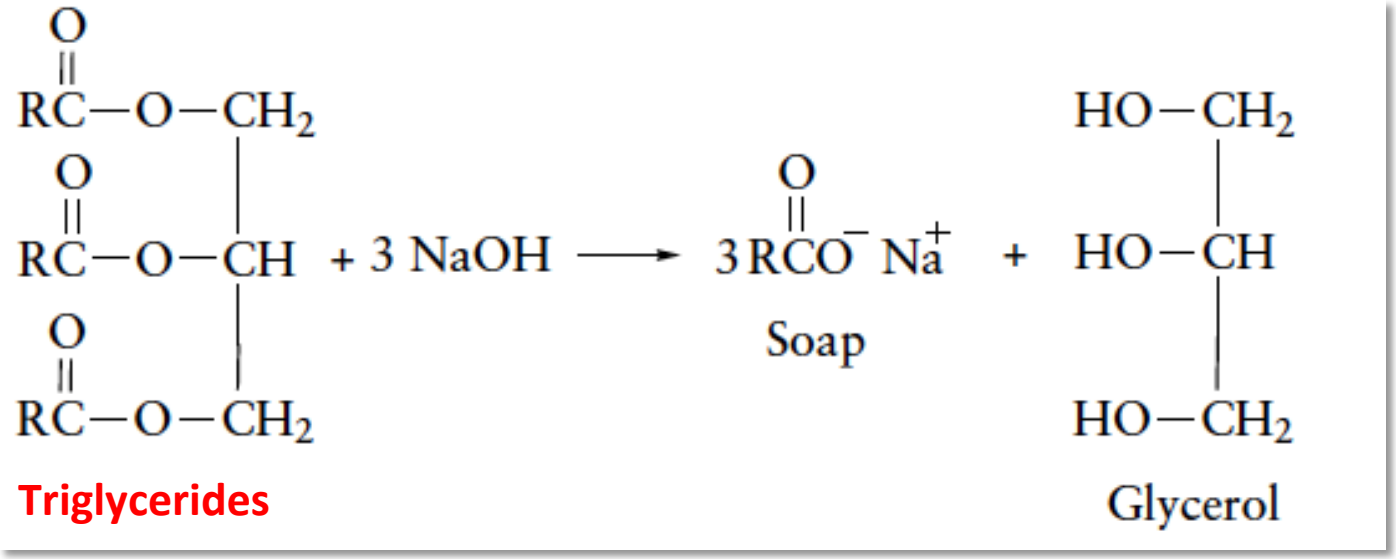
- Unfortunately, PCBs are still produced in Russia and many developed countries

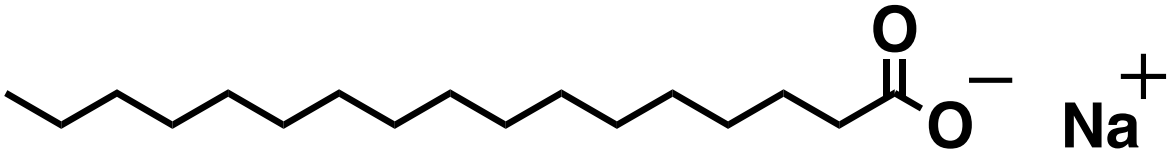
Organic Chemicals in the Environment

Soaps and Synthetic Surfactants

Soap: Sodium salts of fatty acids

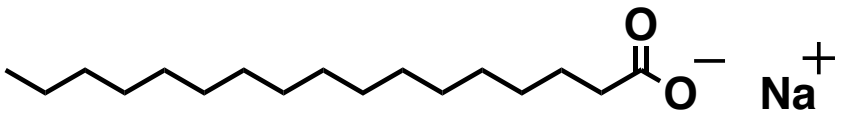
Prepared by the saponification (base hydrolysis) of animal or vegetable fats

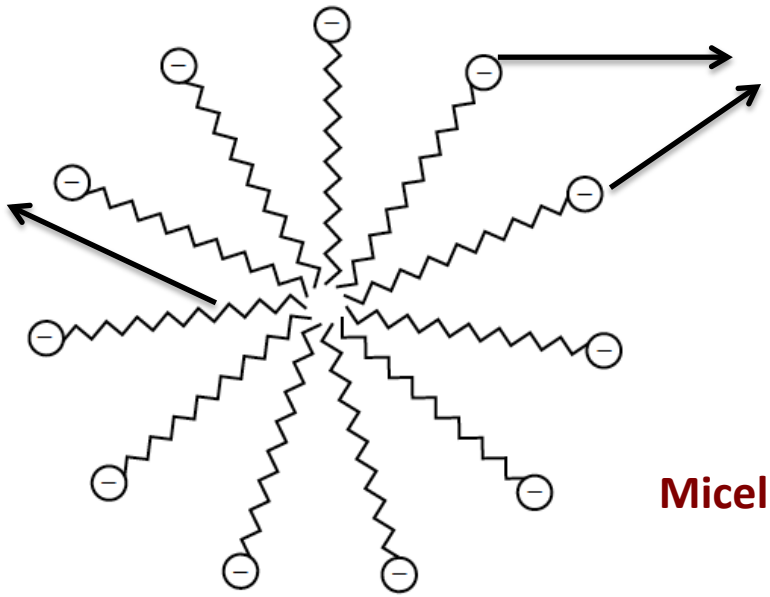




Organic Chemicals in the Environment

Soaps and Synthetic Surfactants





Hydrophilic region

Hydrophobic region

Micelle