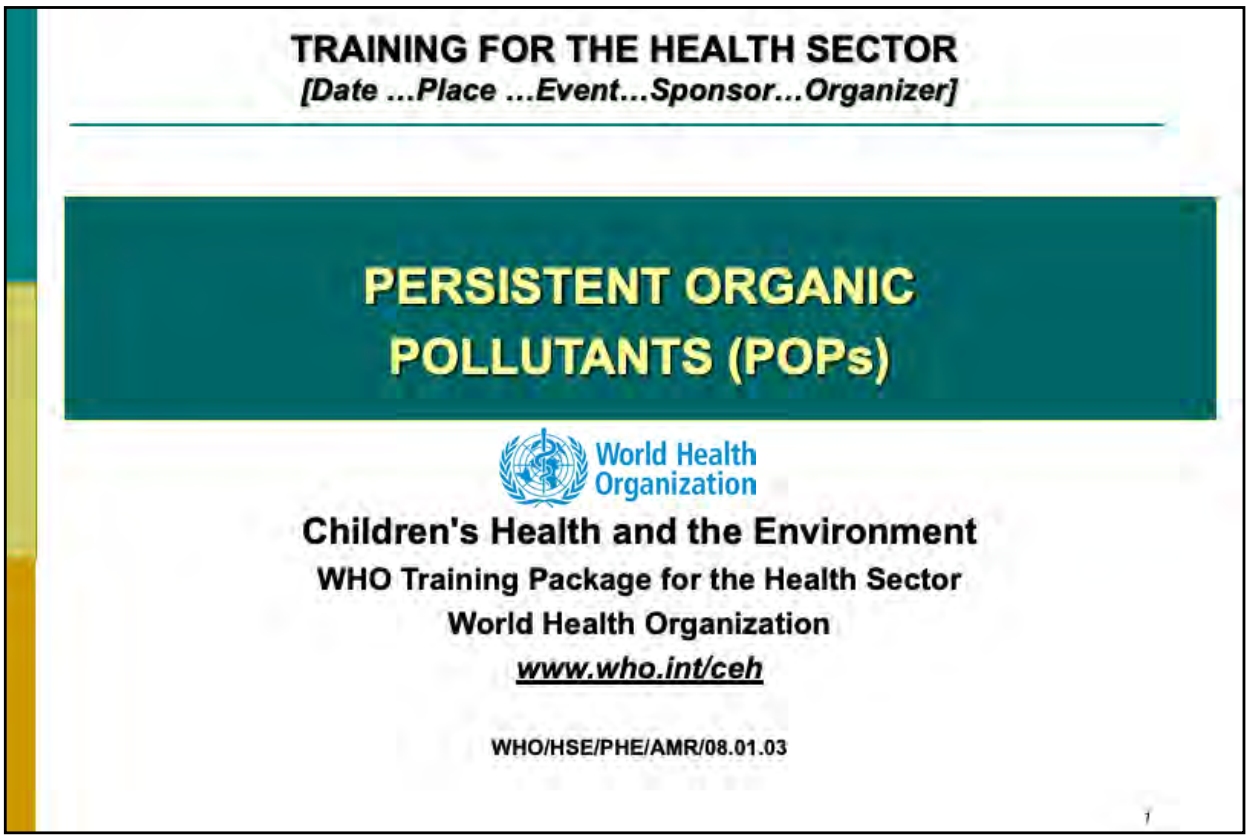
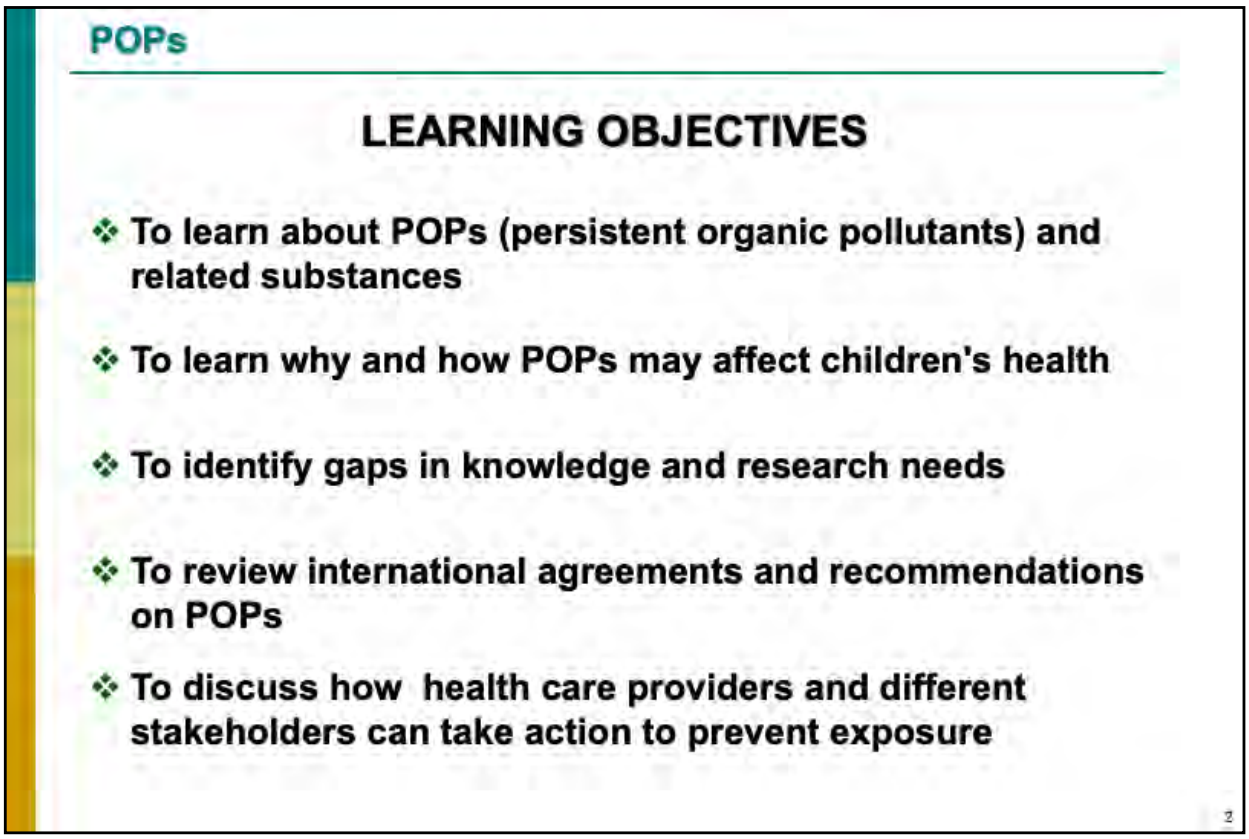


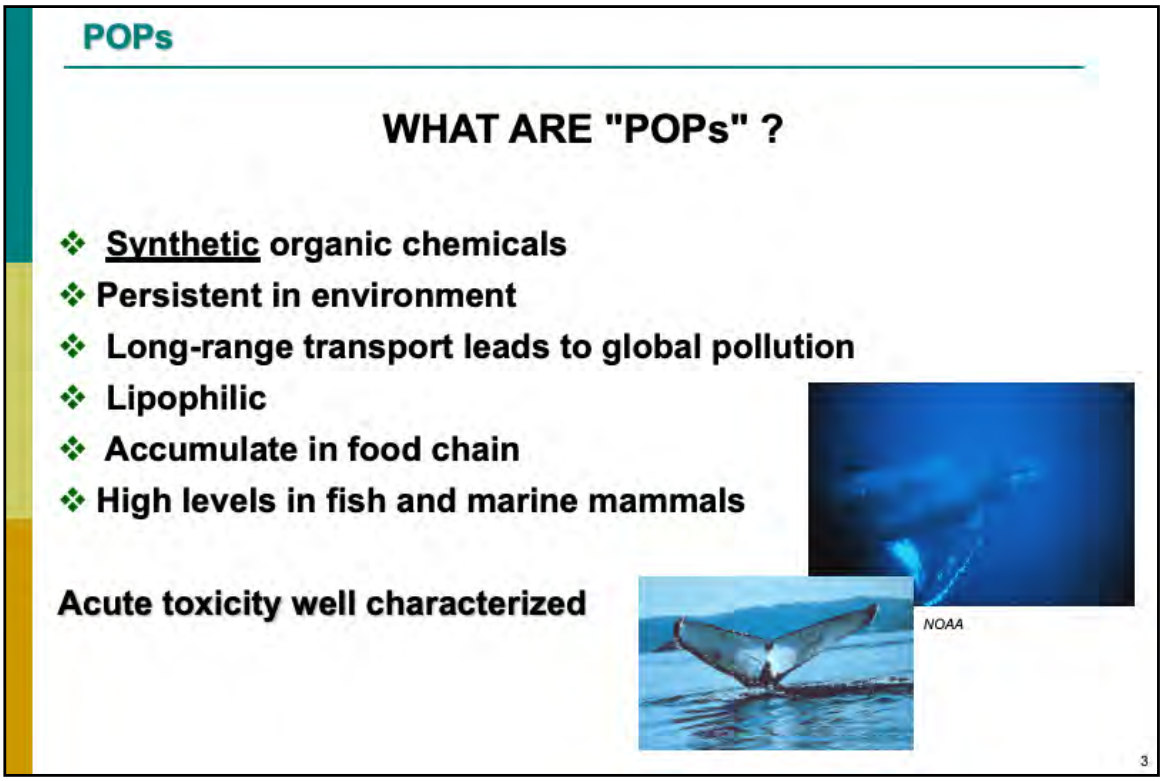
<<NOTE TO USER: Please add details of the date, time, place and sponsorship of the meeting for which you are using this presentation in the space indicated.>>

<<NOTE TO USER: This is a large set of slides from which the presenter should select the most relevant ones to use in a specific presentation. These slides cover many facets of the problem. Present only those slides that apply most directly to the local situation in the region.>>



<<READ SLIDE.>>

<<NOTE TO USER: Please add other objectives, if relevant, and refer to the situation of the country concerning the ratification of the Stockholm Convention and national implementation plans (NIPs).>>



The POPs are:

❖**Synthetic (man-made) organic chemicals** – they are all synthetic chemicals, either intentionally or non-intentionally produced/released. Some are pesticides, others are industrial products or unintended by-products resulting from industrial processes or combustions (see next slide).

❖**Persistent in the environment** – their persistence in the environment is remarkable – it may take them decennia or centuries to be degraded.

❖**Long-range transport leads to global pollution** – Some POPs will almost always be found if tested for in tissues or environmental samples from different parts of the world. As is the case with many environmental pollutants, it is most difficult to establish that illness or disease are directly attributable to exposure to a specific persistent organic pollutant or to a group of POPs. This difficulty is further underscored by (a) the fact that POPs rarely occur as a single compound, and (b) that individual field studies are insufficient to provide compelling evidence of cause and effect in their own right.

❖**Lipophilic** – they have a tendency to remain in fat-rich tissues. This affinity for the adipose tissues means that POPs are likely to accumulate, persist and bioconcentrate and could, eventually, achieve toxicologically relevant concentrations – even though exposure episodes may appear limited.

❖**Accumulate in food chain** – POPs enter into a cycle in nature, accumulating in the bigger animals as they eat the smaller ones.

❖**Highest levels found in marine mammals** – immune dysfunction is considered as a plausible cause for increased mortality among marine mammals. It is postulated that the consumption by seals of fish contaminated with POPs may lead to vitamin and thyroid deficiencies and cause increased susceptibility to microbial infections and reproductive disorders.

❖**Acute, high-level toxicity is well characterized** – acute effects after high-level exposure have been described for some of the organochlorine pesticides (e.g. aldrin, dieldrin and toxaphene). PCBs have caused well-documented episodes of mass poisoning called "Yusho" and "Yu Cheng", that occurred in China, Province of Taiwan, and in Japan. Pregnant women exposed had no or minor symptomatology, but their children presented adverse effects and developmental disorders. Some are potential endocrine

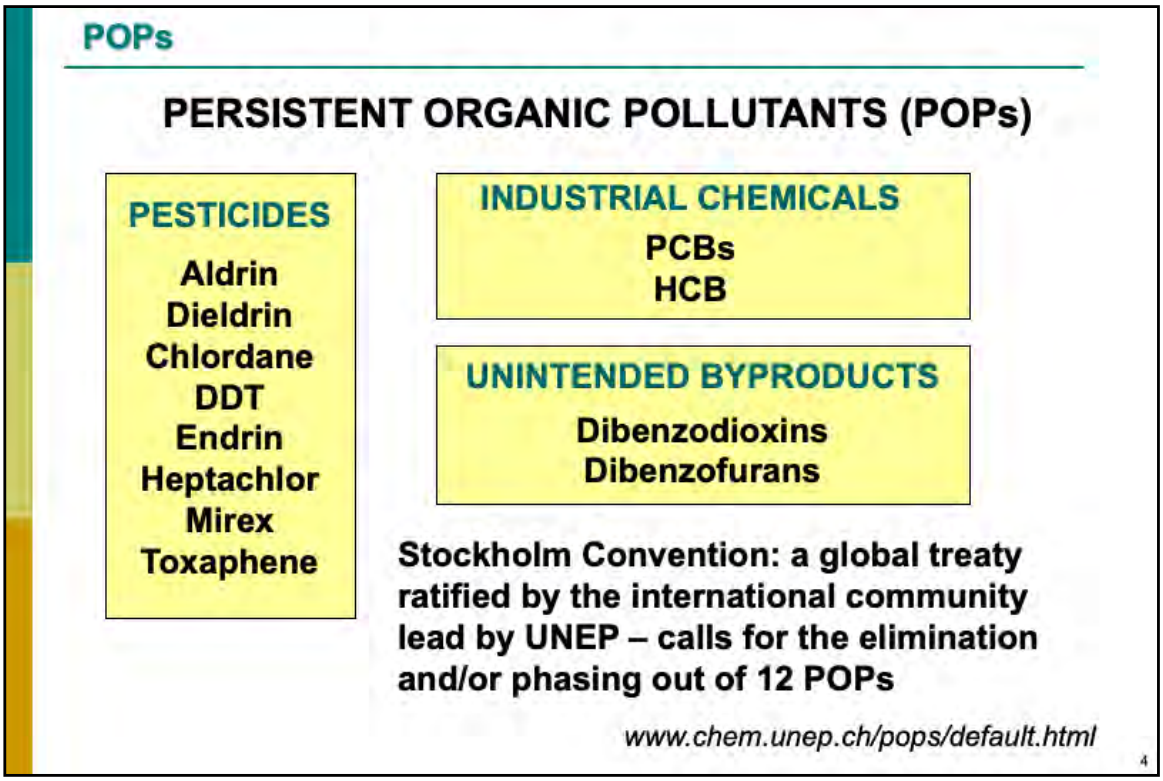
disrupters – this will be addressed later in the presentation.

Ref:

•www.pops.int/documents/background/assessreport/en/ritteren.pdf

Picture above: NOAA, NURP, Wicklund. Humpback whales cruising beneath a diver. www.photolib.noaa.gov/nurp/nur02001.htm

Picture below: NOAA, Captain Budd Christman. Humpback whale. www.photolib.noaa.gov/animals/anim0800.htm



These are the persistent organic pollutants – grouped according to their use and origin:

-8 pesticides – Introduced in 1940-1950, banned later on but still in use in some countries.

-2 industrial chemicals – One of these, HCB, was used as a fungicide in the past.

-2 unintended industrial by-products.

<<READ SLIDE.>>

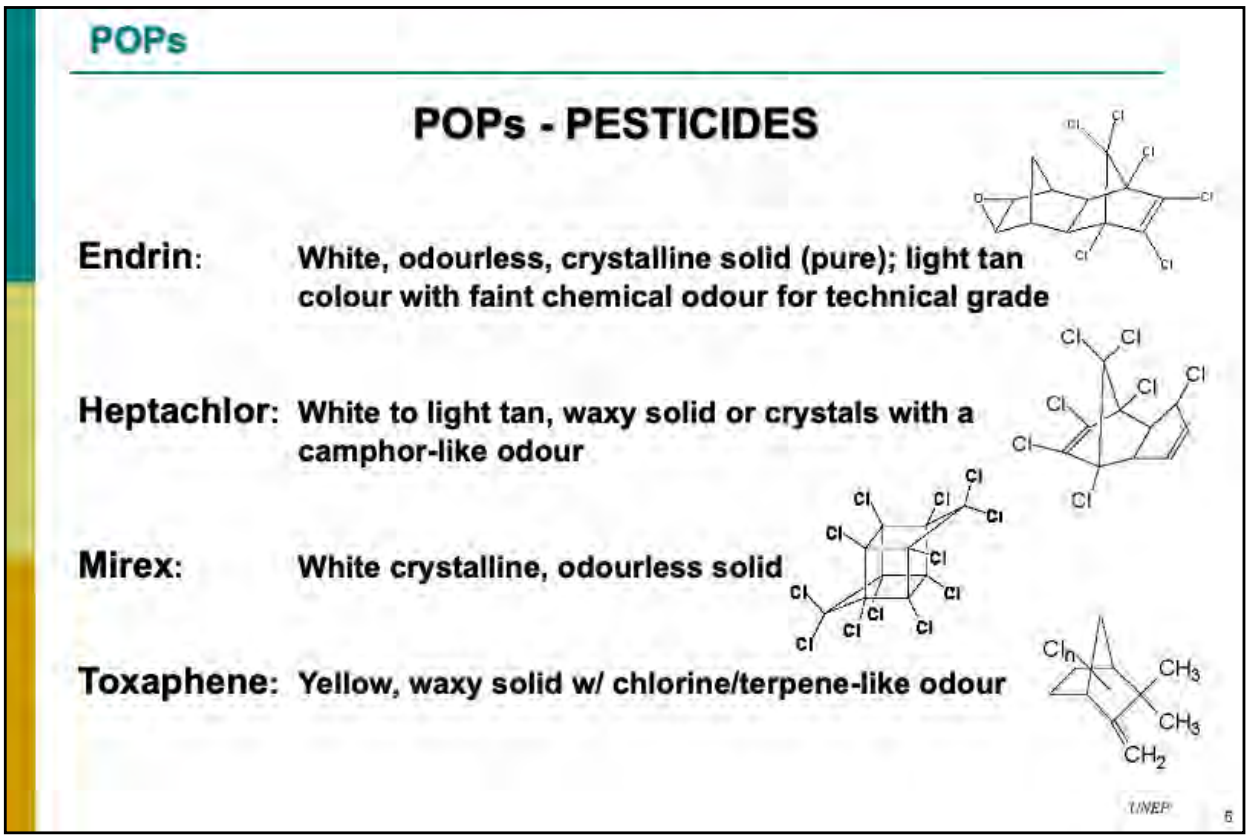
PCBs: polychlorinated biphenyls

HCB: hexachlorocyclohexane

DDT: dichlorodiphenyl trichloroethane.

The Stockholm Convention is a global treaty ratified by the international community and led by the United Nations Environment Programme (UNEP) that calls for the elimination and/or phasing out of 12 POPs, called the *"dirty dozen"*.

More information is available at: www.chem.unep.ch/pops/default.html



•Endrin is a foliar insecticide used mainly on field crops such as cotton and grains. It has also been used as a rodenticide to control mice and voles. It is rapidly metabolized by animals and does not accumulate in fat to the same extent as other compounds with similar structures. It can enter the atmosphere by volatilization, and can contaminate surface water from soil run-off. The half-life of endrin in soil may be up to 12 years, depending on local conditions. This persistence, combined with a high partition coefficient (log KOW = 3.21–5.340), provides the necessary conditions for endrin to bioconcentrate in organisms. The chemical properties of endrin (low water solubility, high stability in the environment, and semi-volatility) favour its long-range transport, and it has been detected in arctic fresh water. The main source of endrin exposure to the general population is residues in food however, contemporary intake is generally below the acceptable daily intake of 0.0002 mg/kg body weight recommended by the Joint FAO/WHO Meeting on Pesticide Residues (JMPR).

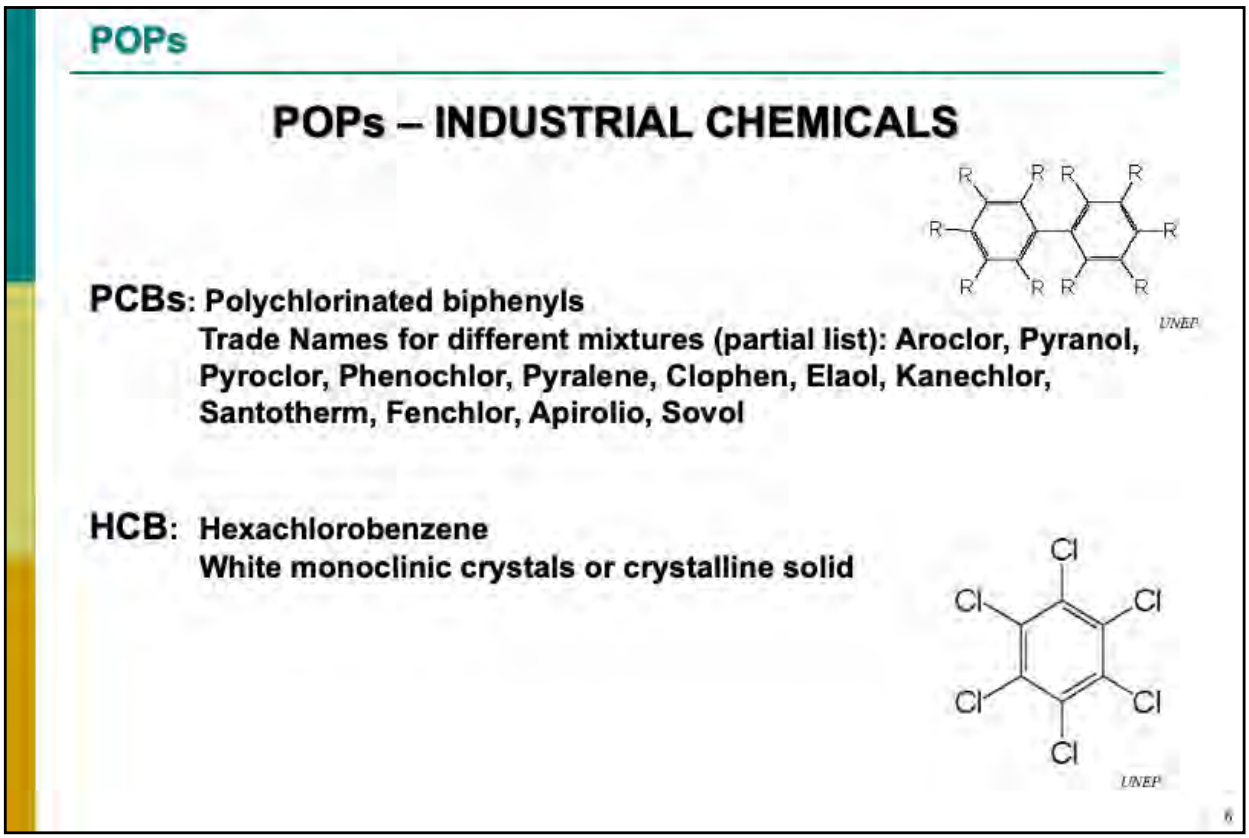
•Heptachlor is a non-systemic stomach and contact insecticide, used primarily against soil insects and termites. It has also been used against cotton insects, grasshoppers, some crop pests and to combat malaria. Heptachlor is highly insoluble in water, and is soluble in organic solvents. It is quite volatile and can be expected to partition into the atmosphere as a result. It binds readily to aquatic sediments and bioconcentrates in the fat of living organisms. The half-life of heptachlor in temperate soil is up to 2 years. This persistence, combined with a high partition coefficient (KOW = 4.4–5.5), provides the necessary conditions for heptachlor to bioconcentrate in organisms. The chemical properties of heptachlor (low water solubility, high stability, and semi-volatility) favour its long range transport, and heptachlor and its epoxide have been detected in arctic air, water and organisms. WHO suggests that food is the major source of exposure of heptachlor to the general population. Heptachlor has been detected in the blood of cattle from both Australia and the USA. In both instances, heptachlor was among the most frequently detected organochlorine.

•Mirex is a stomach insecticide with little contact activity. Its main use was against fire ants in the southeastern United States, but it has also been used to combat leaf cutters in South America, harvester termites in South Africa, Western harvester ants in the USA, mealybug of pineapple in Hawaii and has been investigated for possible use against yellow jacket wasps in the USA. It has also been used as a fire retardant in plastics, rubber, paint paper and electrical goods. Mirex is very resistant to breakdown, is very insoluble in water and has been shown to bioaccumulate and biomagnify. Due to its insolubility, mirex binds strongly to aquatic sediments. Mirex is considered to be one of the most stable and persistent pesticides, with a half-life of up to 10 years. This persistence, combined with lipophilicity, provides the conditions necessary for mirex to bioconcentrate in organisms. The chemical properties of mirex (low water solubility, high lipid solubility, high stability, and semi-volatility) favour its long-range transport, and mirex has been detected in arctic fresh water and terrestrial organisms. The main route of exposure of mirex to the general population is through food, especially meat, fish and wild game, and intake is generally below established residue tolerances.

•Toxaphene is a nonsystemic and contact insecticide that was used primarily on cotton, cereal grains, fruits, nuts and vegetables. It has also been used to control ticks and mites in livestock. Toxaphene has been in use since 1949 and was the most widely used insecticide in the USA in 1975. Toxaphene is highly insoluble in water, and has a half-life in soil of up to 12 years. It has been shown to bioconcentrate in aquatic organisms and is known to undergo atmospheric transport. The half-life of toxaphene in soil ranges from 100 days up to 12 years, depending on the soil type and climate. This persistence, combined with a high partition coefficient (log KOW = 3.23–5.50) suggests that toxaphene is likely to bioconcentrate. The chemical properties of toxaphene (low water solubility, high stability and semi-volatility) favour its long-range transport, and toxaphene has been detected in arctic air. Exposure of the general population is most likely through food, however levels detected are generally below maximum residue limits.

These pesticides are banned and restricted in many countries, please see UNEP website for more information.

Notes and pictures taken from UNEP website: www.chem.unep.ch/pops/alts02.html
<<NOTE TO USER: The other POPs are addressed more in detail further on in the module.>>



•Polychlorinated biphenyls (PCBs) are mixtures of chlorinated hydrocarbons that have been used extensively since 1930 in a variety of industrial uses, including as dielectrics in transformers and large capacitors, as heat exchange fluids, as paint additives, in carbonless copy paper and in plastics. There are 209 possible PCBs. PCBs in the environment may be expected to associate with the organic components of soils, sediments and biological tissues, or with dissolved organic carbon in aquatic systems, rather than being in solution in water. Association between elevated exposure to PCB mixtures and alterations in liver enzymes, hepatomegaly, and dermatological effects such as rashes and acne has been reported. Adverse effects are predominantly associated with higher blood concentrations. Contamination of rice oil by PCBs in Japan (1968) and China, Province of Taiwan (1979) has resulted in the exposure of a large number of people to PCBs and their contaminants PCDFs. Signs and symptoms of exposure from these incidents include enlargement and hyper secretion of the Meibomian glands of the eyes, swelling of the eyelids, and pigmentation of the nails and mucous membranes, occasionally associated with fatigue, nausea and vomiting. This was followed by hyperkeratosis and darkening of the skin with follicular enlargement and acneform eruptions, often with a secondary staphylococcal infection. Children born up to 7 years after maternal exposure in the Taiwan incident had hyperpigmentation, deformed nails and natal teeth, intrauterine growth delay, poorer cognitive development up to 7 years of age, behavioural problems and higher activity levels. The affected children appeared to "catch up" with controls at 12 years of age. Children born 7–12 years after maternal exposure experienced mildly delayed development, but no differences in behaviour. Effects observed in these children are probably a result of the persistence of PCBs in the human body, resulting in prenatal exposure long after the exposure took place. These effects are consistent with the observations of poorer short-term memory functioning in early childhood, in children exposed prenatally by mothers who had high consumption of Lake Michigan sports fish containing PCBs, amongst other POPs. People exposed in the Yucheng incident had low resistance, and suffered from a variety of infections. Examination during the first year revealed decreased concentrations of IgM and IgA, decreased percentages of total T-cells, active T-cells and helper T-cells, but normal percentages of B-cells and suppressor T-cells; suppression of delayed type response to recalling antigens; enhancement of spontaneous proliferation