

Bioaccumulation



S2-1-03 Describe bioaccumulation and explain its potential impact on consumers.

Examples: bioaccumulations of DDT, lead, dioxins, PCBs, mercury

Bioaccumulation...

In an ecosystem undisturbed by man, organisms are born, live, reproduce and die. Materials needed for life are CYCLED through the ecosystem.

When humans appear in an ecosystem, CHEMICALS produced by human activity in HOUSEHOLDS and INDUSTRIES are released into the environment. Humans even spread chemicals deliberately to kill certain organisms that they call pests.

These POISONS were NOT part of the ecosystem initially. There is often no way for the ecosystem to RID ITSELF of the poisons

If there is NO CYCLE to do this, what happens to the poisons and how is the ecosystem affected by them?



Biodegradable???

Biodegradable Substances

- Substances that are **BROKEN DOWN NATURALLY** in the environment.
- Examples of **BIODEGRADABLE** substances include:
 - **SEWAGE**
 - **FOOD SCRAPS**
 - **DEAD ORGANISMS**



Non-Biodegradable Substances

- substances that are broken down very **SLOWLY** or **NOT BROKEN DOWN AT ALL** by natural processes.
- Once these pollutants enter an ecosystem, they will remain there **FOREVER**.
- Examples of **NON-BIODEGRADABLE** substances include:
 - **DDT** (a pesticide)
 - **MERCURY**
 - **GLASS**
 - certain types of **PLASTICS**



A **POLLUTANT** becomes a **TOXIN** when it adversely affects living organisms. Examples of toxins include **DDT** and **MERCURY**.

Bioaccumulation...

What happens when non-biodegradable substances enter ecosystems?

- When producers like PLANTS and ALGAE take in WATER for PHOTOSYNTHESIS, they can also ABSORB small AMOUNTS of non-biodegradable substances.
- Because these substances CANNOT be USED nor BROKEN DOWN, they are STORED and ACCUMULATE in the plant.
- When HERBIVORES eat the plants containing the non-biodegradable substances, they too begin to STORE the TOXINS in their FAT.
- Because MANY PRODUCERS must be EATEN to keep one herbivore alive, the AMOUNT of TOXIN inside one HERBIVORE is much HIGHER than that of the INDIVIDUAL PRODUCERS it CONSUMED.
- The STORED TOXINS continue to be PASSED UP the food chain, with the the amount of TOXIN inside the organisms INCREASING as you get higher on the food chain (because each PREDATOR eats MANY PREY)

This process is known as BIOACCUMULATION or BIOAMPLIFICATION.

Bioaccumulation...

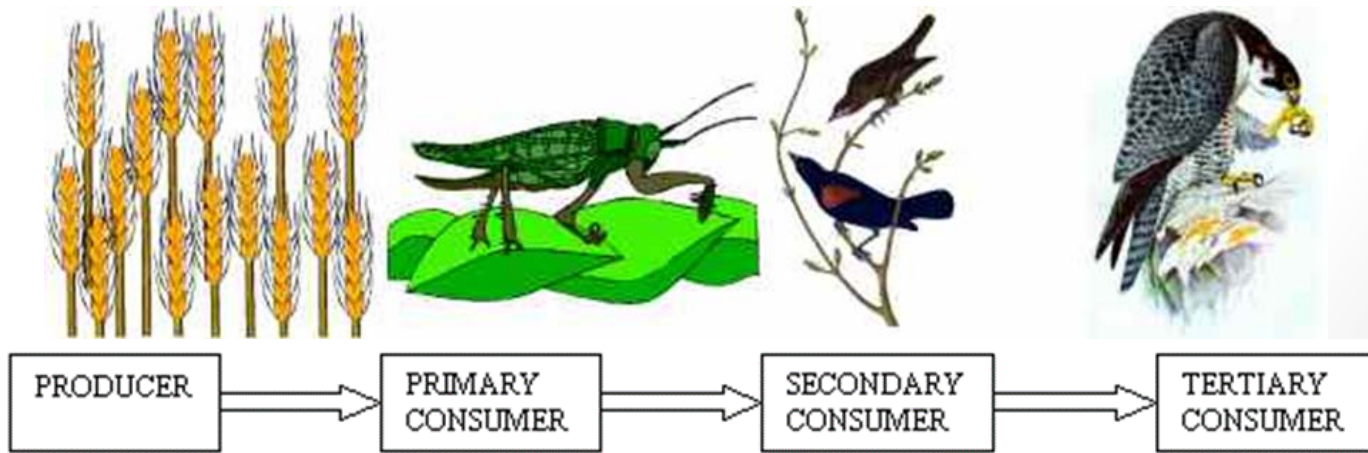
Eventually the LEVELS of the TOXIN become HIGH ENOUGH inside the SECONDARY or TERTIARY CONSUMERS that their HEALTH is AFFECTED. They may be POISONED and DIE, or WEAKENED and more susceptible to DISEASE or PREDATORS.

Example:

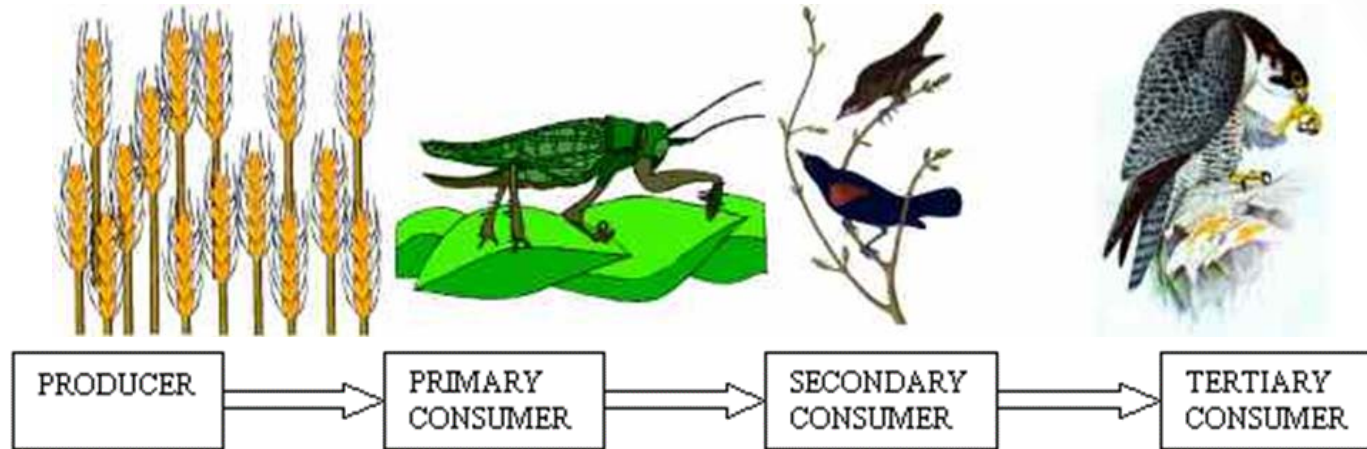
Bioaccumulation of DDT

- Starting in the 1940's this chemical was sprayed to control insects. In the 1950's and 1960's the number of BIRDS OF PREY such as peregrine FALCON, HAWKS and EAGLES began to decline rapidly.

Examine the food chain in the diagram below.

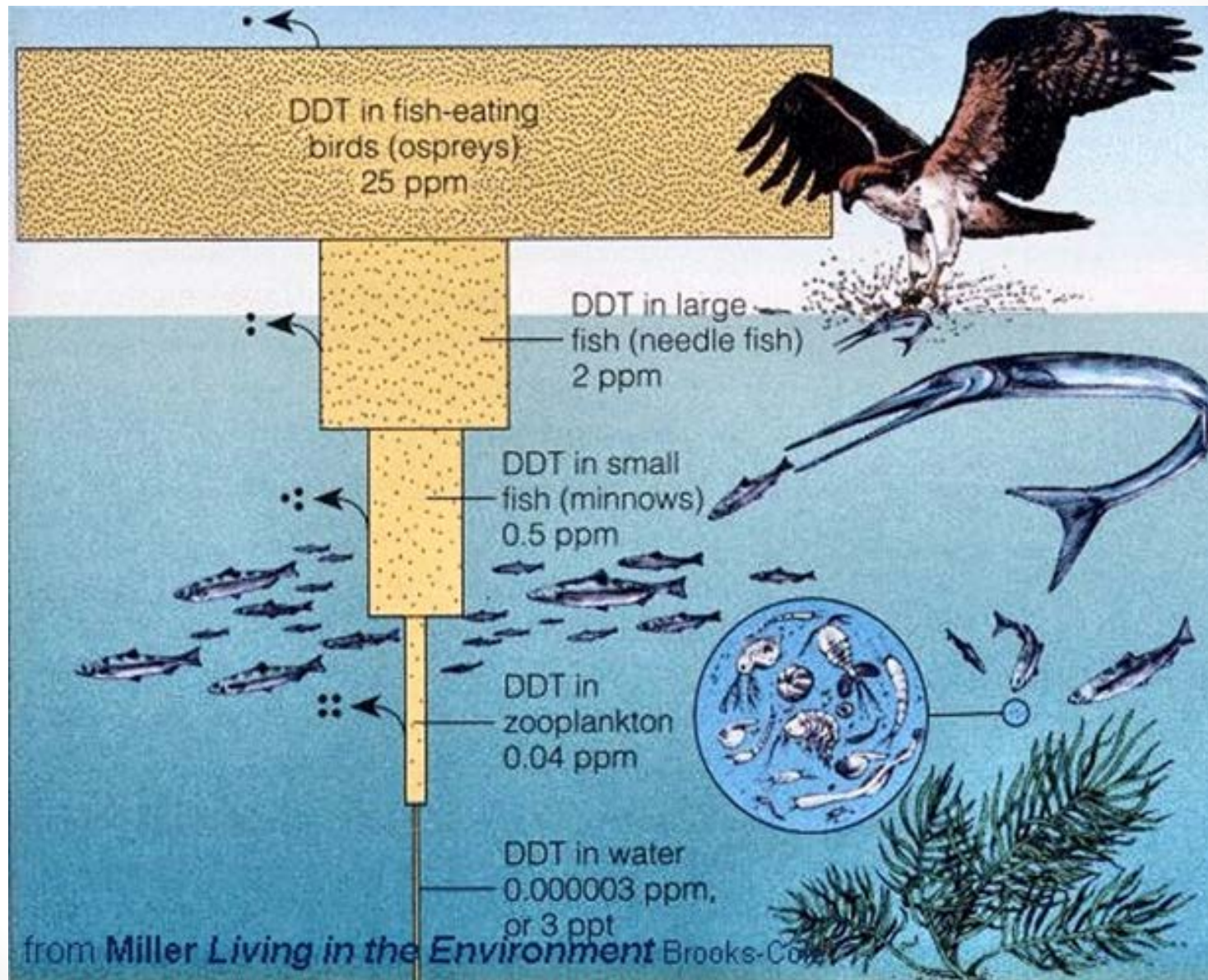


Bioaccumulation of DDT



- WHEAT was sprayed with DDT to kill insects that fed on it.
- When GRASSHOPPERS ate the wheat many died, but some survived.
 - The DDT was passed from the PRODUCER trophic level (wheat) to the PRIMARY CONSUMER trophic level (grasshopper).
- The DDT continued to move up the food chain and its concentration INCREASED in the tissues of the SECONDARY CONSUMERS (red-wing blackbirds) and TERTIARY CONSUMERS (peregrine falcons).

Bioaccumulation of DDT



Bioaccumulation of DDT

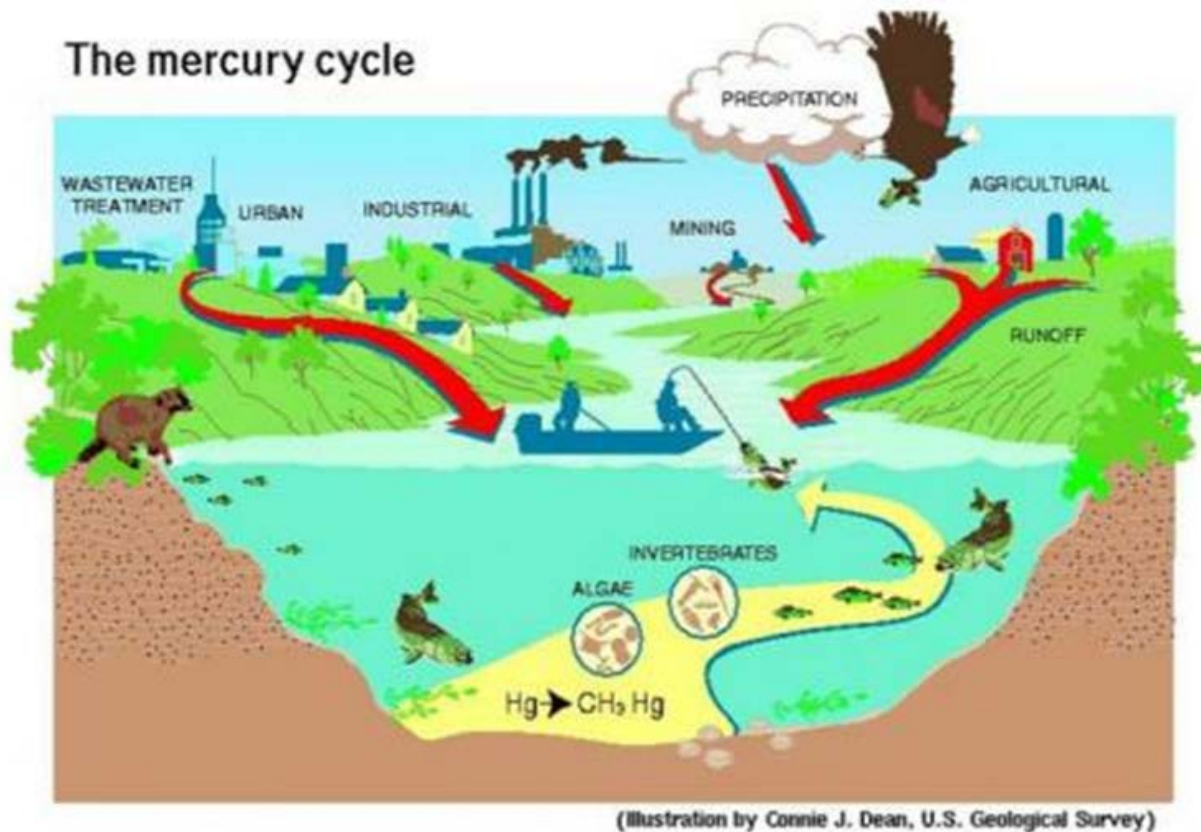
By the 1970's the peregrine **FALCON** and **BALD EAGLE** populations in North America was almost **WIPED** out. The high concentrations of DDT in the birds had caused their **EGGSHELLS** to become **THIN** and **BREAK**, reducing the numbers of chicks that hatched. The DDT also **AFFECTED** the bird's **BEHAVIOUR** causing them to abandon their nests and chicks.

The use of DDT has been restricted in Canada since 1969. Unfortunately, DDT is non-biodegradable, and has continued to persist in the environment. It is **STILL FOUND** in the **TISSUES** of higher-level consumers to this day, but the amounts are declining. As a result, these birds are making slow recovery in Canada.

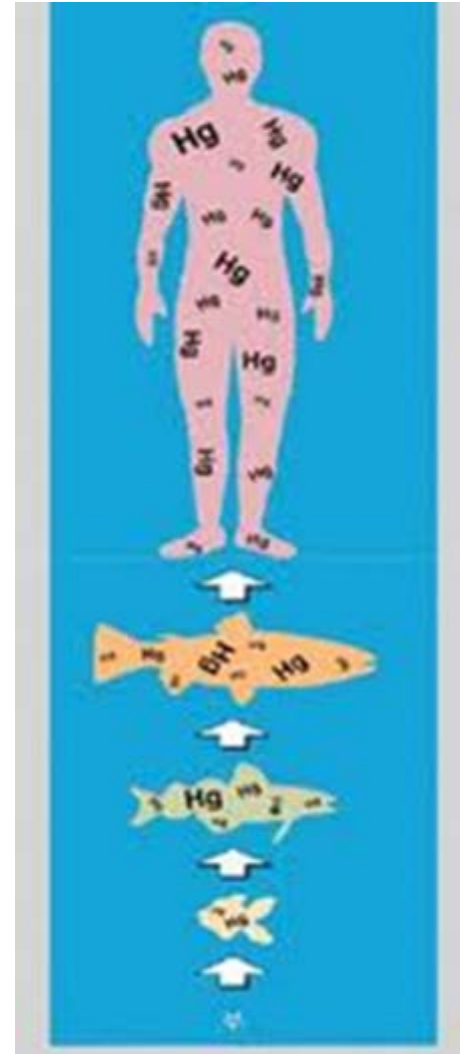
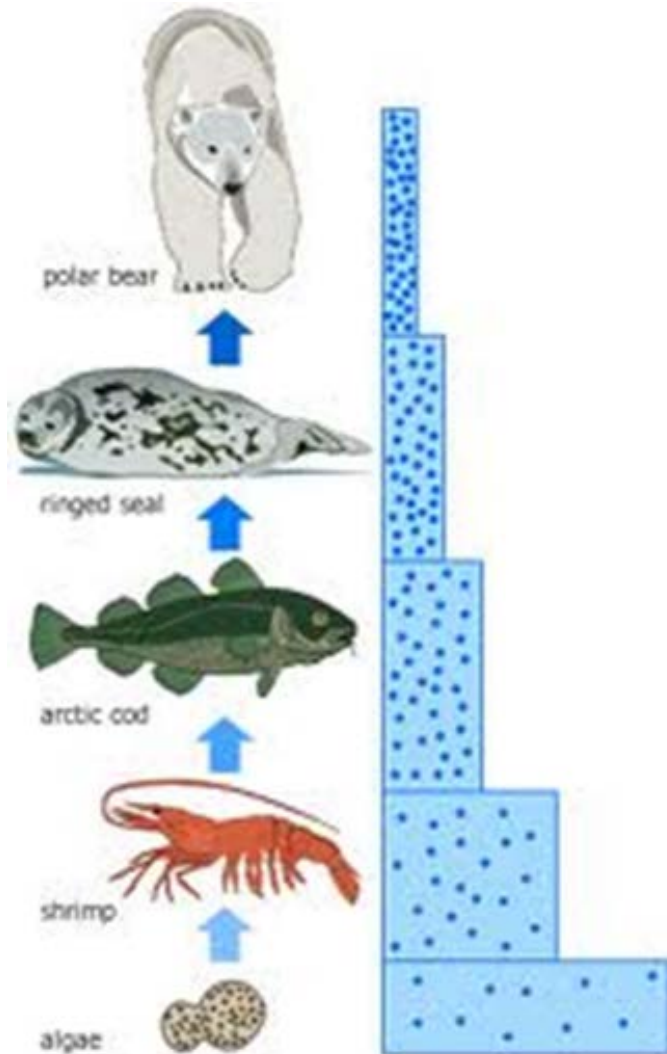


Bioaccumulation of Toxic Metals

- Some heavy metals (LEAD, MERCURY) are highly toxic.
- They are LIPOPHILIC (FAT-LOVING) or HYDROPHOBIC (WATER-HATING), which means they get STORED in FAT CELLS rather than PASSING through the body.



Bioaccumulation of Toxic Metals



Tale of the Mad Hatter

- In the 1800's HATTERS used MERCURY solutions to turn FUR into FELT
- Workers breathed in FUMES that contained the highly toxic metal
- The result was MERCURY POISONING leaving the worker with symptoms that include SHAKES, memory LOSS, lack of COORDINATION, slurred SPEECH, ANXIETY, and DEPRESSION

