Ecology: PESTICIDES AND BIOAMPLIFICATION

*Lesson 13*_ 07 - 09
Text Book Reference: Section 2.2, page 52 - 58

Video: The Love Canal
To explain the interrelationships of matter and energy through the various cycles by the use of pesticides.

To maintain crop success, farmers usually have to spray their crops with pesticides,

(FYI: a "**pest**" is any organism such as weeds, insects, fungi and rodents that people find harmful or inconvenient. "**Pesticide**" is any substance that is used to control a pest, and a **herbicide** is used to prevent destruction of their crops.)

Pesticides include insect sprays, baits, rat poisons, flea and tick sprays and powders, laundry disinfectants, weed killers and swimming pool chemicals.

Pesticides or insecticides are chemicals that tend to remain in the environment for living periods of time; they do not break down easily.

Many pesticides are carcinogenic, or cancer-causing.
Many pesticides are poisonous to organisms other than those they are intended to kill.

Herbivores that consume plants sprayed with pesticides can be harmed, as well as carnivores and omnivores that consume the herbivores.

Unfortunately the organisms, the synthetic chemical pesticides are designed to kill develop resistance to them.
Increasingly widespread applications of pesticides leads to shorter periods of effectiveness before resistance limits their usefulness.

My insecticides, e.g., DDT, [FYI: DDT is dichlorodiphenyltrichloroethane], work by attacking the nervous system of insects.
Herbicides, e.g., 2,4-D, silvex, and Roundup) may work by inhibiting root growth, interfering with photosynthesis, or by acting as growth hormones that cause the plant to grow so quickly that it literally can not sustain itself.

Pesticides can be grouped into four different categories:

Type of Pesticide	Target	Examples	Persistence
Insecticide	insects	DDT, Malathion	High (2-15 years) Moderate (1-2 weeks)
Herbicide	weeds	2, 4-D, Silvex, Roundup	mostly low (days to weeks)
Fungicide	moulds and other fungi	Captan	low (days)
Bactericide	bacteria	penicillin, vancomycin	mostly low

Some of these pesticides decompose fairly rapidly, while others stay in the system for many years. Pesticide chemicals remain inside affected organisms and are passed on to their predators or the decomposers that eat their dead bodies.

Bioamplification

Definition: a process that results in increasing concentrations of toxins that accumulate in the bodies of consumers at each level and became amplified or magnified at each succeeding trophic level as you go up in the food chain.

As an insecticide developed in the 1950's, DDT was particularly effective against populations of insects that carry and transmit disease to humans (e.g. mosquitoes).
However, DDT is not water soluble but accumulates in fat tissues and hence resulting in bioamplification in the fat tissues of the top carnivores.

Thus, DDT exists in the water supply and enters a food web through producers such as plankton, which absorb the insecticide and incorporate it into their structure:

palnkton ⟶ shellfish insects ⟶ fish ⟶ birds ⟶ ducks ⟶ hawks, and finally ⟶ humans.

The higher the organism is in the food chain (or the higher its trophic level), the more concentrated the DDT will be in its body (i.e. bioamplification will result).

Modern Water Soluble Pesticides
Modern insecticides are water soluble and are easily broken down in the body and the soil and thus do not accumulate in fat tissue.

If a pesticide is water soluble, it would be excreted with urine through the kidneys rather than be stored in body tissue.
However, since these new pesticides are water soluble and break down more rapidly, it is therefore, necessary to apply them more frequently; this results in organisms higher up the food chain being subjected to more pesticides because of the greater frequency of application.
Further water soluble, long-acting pesticides can contaminate ground water, and accumulate in streams, rivers and lakes.

Diagram of Bioamplification
Construct a pyramid of numbers with the following organisms and determine how much pesticide would be found in the organisms at each trophic level:

a. 12 grasshoppers each received 1 units of a fat soluble pesticide from the grass, 3 shrews ate an equal amount of grasshoppers and in turn all three shrews were eaten by one owl.

b. In a food chain, 24 grasshoppers each received 2 units of a fat soluble pesticide from the grass, 3 shrews ate an equal amount of grasshoppers and in turn all three shrews were eaten by one hawk.

c. 1000 algae were eaten by 100 small fish, each small fish received an equal amount of the fat soluble pesticide. The small fish were eaten by 10 large fish, each of the large fish eating an equal amount of the small fish. All the 10 fish were eaten by a heron.

d. In an aquatic food chain 5000 plankton each received 5 units of a fat soluble pesticide. 200 krill each ate an equal amount of plankton and in turn were eaten by 10 fish. 2 penguins ate the fish and were eaten by 1 shark.

Homework
1. Read Textbook pages 52 -57
2. Answer questions page 58: Understanding Concepts #1,2,3,8,9
3. Answer questions a –> s, pages 52-57 in article
4. Read Article: DDT: Pesticide or People killer; Answer questions # 1 - 8
5. Read Article: Mercury: Still a Cause for Concern ; Answer question at the end of the Article