

SNC1D BIOLOGY

SUSTAINABLE ECOSYSTEMS

☛ Pests & Poisons (P.79-80)

☛ Pests & Poisons

Humans are in competition with many other organisms. Some of them eat the same foods as we do. Others compete with the plants we grow. Still other organisms, such as mosquitoes and lice, actually feed on us! How do we control these organisms?



August 6, 2014

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*Recall that a **pest** is a living thing that causes illness or harm to another living thing, or is simply a nuisance to humans. However, the term "pest" refers only to how humans see the relationship. It is important to remember that there are no pests in nature. There are simply producers, consumers, and decomposers.*

PEST

- ❖ any plant/animal that causes illness, harm, or annoyance to humans
- ❖ there are no pests in nature


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Monocultures


When farmers plant a **monoculture** (i.e. a single crop), they often create the ideal environment for pests. For example, a known pest in Canada is the European corn borer. When a population of these insects finds a field of corn, they begin to feed and reproduce rapidly. In a natural food web, predators help to control the insect population. But on a farm, the natural food web that includes corn borers has been changed. There may be fewer of the corn borers' natural predators. As a result, the population of corn borers can grow, take over, and easily destroy the entire crop.



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Pesticides


One of the most common ways to control or eliminate pests is to use a substance called a **pesticide**. There are different names for pesticides, depending on their target – herbicides kill plants, insecticides kill insects, and fungicides kill fungi. And once applied, pesticides vary greatly in how long they remain active in the environment (some last for years while others only last a few days). Regardless, compared to killing pests by hand, using pesticides requires less labour. Therefore, pesticides are considered to be an effective way to maintain a crop or protect a forest.



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How Pesticides Work

Pesticides work by causing physical or biological harm to the pest organism. Diatomaceous earth, for example, is made up of the fossilized remains of tiny algae called diatoms. The substance is ground into a fine, abrasive powder that scratches the waxy outer coating of insects and causes them to dry out and die. Other pesticides interfere with biological processes, such as photosynthesis, or cause damage to vital organs.




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How Pesticides Work

PESTICIDE


- ❖ substance used to control/eliminate a pest
- ❖ cheap and easy to use
- ❖ cause physical/biological harm to the pest
- ❖ 3 different types:
 - herbicide (plants)
 - pesticide (insects)
 - fungicide (fungi/mold)



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Problems with Pesticides


Although pesticides are helpful to farmers and other people, the use of pesticides has many drawbacks. When pesticides are sprayed, some of the poison never reaches the intended pest. Instead, winds carry it away to other areas. The pesticide may then cause air, soil, or water pollution which can then damage essential food webs. If a pesticide contaminates the groundwater, people might drink the contaminated water and get sick.



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Non-Target Species

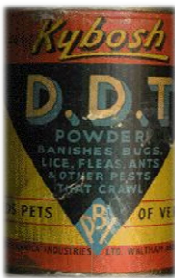
*Pesticides can also harm organisms that are not the intended target – known as **non-target species**. For example, spraying pesticides at the wrong time of the year may kill honeybees, which are vital for pollinating flowers and fruit crops. As a result, less fruit will be produced. Pesticides may also kill the pest's natural predator which creates a situation in which farmers become more dependent on pesticides.*



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Non-Target Species


The consequences of killing these non-target species can be surprising and serious. Consider the dramatic set of events that took place on the island of Borneo. In 1955, the World Health Organization began a DDT spraying program to control mosquitoes that were responsible for spreading malaria. The spraying initially reduced the spread of malaria, but it also caused an unexpected chain reaction. In addition to killing mosquitoes, the DDT killed the wasps that preyed on thatch-eating caterpillars. Without the wasps, the caterpillars ravaged the thatched homes of the villagers.



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Non-Target Species

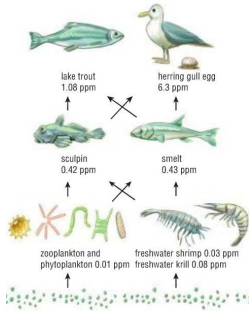
DDT also killed the cockroaches that were then consumed by lizards. The DDT in the cockroaches damaged the nervous systems of the lizards making them easy prey for cats. Many cats died from consuming the poisoned lizards. And in a final twist, the villagers were threatened by a new disease. When the cats disappeared, the rat population in the villages increased dramatically. The fleas on the rats carried the plague – a potentially devastating disease. To prevent an epidemic, large numbers of healthy replacement cats had to be brought to Borneo to control the rats.



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Bioaccumulation

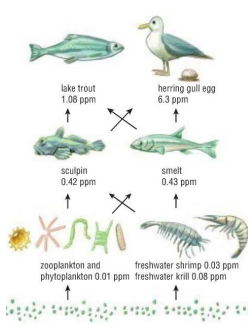
Some pesticides build up in the bodies of individual organisms. The organism may not be able to break down the chemicals, or eliminate them with other wastes. As a result, the pesticide collects, or accumulates, in the tissues or organs. This is known as **bioaccumulation**. Bioaccumulation occurs when a pesticide cannot dissolve in water, but does dissolve in fats and oils. Animals use their fats and oils to store energy, build tissues, and in many other important processes.



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Bioamplification

When pesticides build up in the tissues of an organism, they can also affect other organisms. At high concentrations, a pesticide can harm or kill the organism. Pesticides become more concentrated as they move up the food chain. This is because the toxins stored in an organism at one trophic level are passed on to the organisms at the next trophic level. The process is called **bioamplification** or **biomagnification**. Other fat-soluble toxins, such as mercury and polychlorinated biphenyl (PCB), also bioamplify in the food web.



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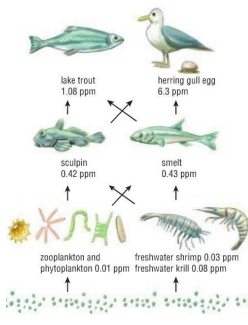
Bioaccumulation & Bioamplification

BIOACCUMULATION

- the concentration of a toxin in the body of an organism

BIOAMPLIFICATION


- also known as biomagnification
- the increase in concentration of a toxin as it moves higher up the food chain/web



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Resistance to Pesticides

When a pesticide is used for a long period of time, some species may become resistant to it (sometimes called "superbugs"). The pesticide can no longer control the pest. Since the individuals that resist the pesticide survive longer, they can produce offspring. They pass their resistance on to their offspring.



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Resistance to Pesticides

Over time, the population may become highly resistant to the pesticide. This means that the farmer needs to apply more pesticide or a stronger pesticide to control the pests.

Year	Insects and mites	Weeds
1910	~10	~5
1920	~15	~10
1930	~20	~15
1940	~25	~20
1950	~30	~25
1960	~100	~50
1970	~250	~100
1980	~450	~180
1990	~550	~220
1998	~580	~250

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Benefits & Risks of Pesticides

There is little doubt that pesticides have dramatically increased global food production. By reducing competition and other pests, crops grow faster and have higher yields. The benefits of using pesticides must, however, be weighed against the risks of pollution, harm to non-target species, bioamplification, and pesticide-resistance species.

BENEFIT	RISKS
<ul style="list-style-type: none"> reduces competition/pests crops grow faster higher yields cheap/easy to use works quickly 	<ul style="list-style-type: none"> pollution harms/kills non-target species bioamplification/biomagnification pesticide-resistant pests birth defects, ...

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Activity: Pesticide Use Across the Country

ISSUE
Pesticides are substances used to kill pests, such as dandelions or grubs. Some pesticides do not break down quickly, and they may enter local streams and wetlands, killing wild organisms. In response, some communities have banned the use of pesticides on lawns and gardens.

INSTRUCTIONS
A. Use the graph given to the right to answer the following questions.

Province/Region	1994 (%)	2006 (%)
Canada	~30	~35
BC	~25	~30
AB	~35	~40
SK	~30	~35
MB	~35	~40
ON	~30	~35
QC	~15	~20
NB	~15	~20
NS	~15	~20
PE	~10	~15
NF	~10	~15

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Activity: Pesticide Use Across the Country

QUESTIONS

1. Analyze the information in the graph by answering the following:

(a) Which province had the highest pesticide use in 1994? in 2006?

(a) 1994 ☞ SK
2006 ☞ MB

Province	1994 (%)	2006 (%)
Canada	30	35
BC	30	35
AB	35	40
SK	40	45
MB	35	45
ON	30	35
QC	15	20
NB	15	20
NS	15	20
PE	10	15
NF	10	15

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Activity: Pesticide Use Across the Country

QUESTIONS

1. Analyze the information in the graph by answering the following:

(b) Which province had the lowest pesticide use in 1994? in 2006?

(b) 1994 ☞ NF
2006 ☞ PE

Province	1994 (%)	2006 (%)
Canada	30	35
BC	30	35
AB	35	40
SK	40	45
MB	35	45
ON	30	35
QC	15	20
NB	15	20
NS	15	20
PE	10	15
NF	10	15

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Activity: Pesticide Use Across the Country

QUESTIONS

1. Analyze the information in the graph by answering the following:

(c) In 1994, what percentage of households used pesticides in NB?

(c) 20%

Province	1994 (%)	2006 (%)
Canada	30	35
BC	30	35
AB	35	40
SK	40	45
MB	35	45
ON	30	35
QC	15	20
NB	15	20
NS	15	20
PE	10	15
NF	10	15

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Activity: Pesticide Use Across the Country

QUESTIONS

2. An important skill is inferring information from a graph. Consider the following:

(b) In 2006, more pesticide was used in Ontario than in Manitoba, Saskatchewan, and Alberta combined. How is this possible given the data in the graph?

(b) ON has a much larger population than these provinces combined

Pesticide use by Canadian households

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Activity: Pesticide Use Across the Country

QUESTIONS

3. Banning pesticides may have benefits. Are there any drawbacks to banning pesticides? Are there any people or organizations that might not welcome a pesticide ban? Explain why.

answers will vary

Pesticide use by Canadian households


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Reducing Our Dependence on Pesticides

One alternative type of agriculture, **organic farming**, uses no synthetic pesticides or fertilizers. Organic farmers sometimes have to accept crop losses to naturally occurring pests. These losses, however, may be offset by the higher price growers get for their organic products. Organic farmers rely on a range of ecologically sustainable techniques

- biological control (i.e. predatory insects, mites, and disease-causing micro-organisms that prey on and infect prey species)
- altered timing (i.e. better timing of planting/harvesting can avoid peak pest populations)
- crop rotation and mixed planting
- baiting pest (i.e. pheromone baits can be used to confuse some mating insects).


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 **Reducing Our Dependence on Pesticides**

ALTERNATIVES TO PESTICIDE (ORGANIC FARMING)

- ❖ biological control (natural predatory/disease-causing organisms)
- ❖ altered planting/harvesting dates to avoid peak pest population
- ❖ crop rotation/mixed planting
- ❖ pheromone baits to confuse mating insects


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 **✓ Check Your Learning**

1. What is meant by the term "non-target organism?"

an organism that is not the intended "victim" of the pesticide


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 **✓ Check Your Learning**

2. Explain the difference between bioaccumulation and bioamplification.

bioaccumulation is the concentration of a toxin in the body of an organism whereas bioamplification is the increase in concentration of a toxin as it moves higher up the food chain/web


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 **Check Your Learning**

3. If a pesticide is effective but is found to accumulate in organisms, what can people do to prevent harm to the environment?

answers will vary


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 **Check Your Learning**

4. DDT has some potential health and environmental problems but is still a valuable pesticide in eliminating insects that carry diseases such as malaria in some parts of the world. Do you think DDT should be banned everywhere? Explain.

answers will vary

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 **Check Your Learning**

5. (a) Why are "pests" more likely to be found on a farm than in a natural ecosystem?

(a) "pest" is a word that humans created to describe any plant/animal that causes illness, harm, or annoyance to humans – in a natural ecosystem there are far fewer humans and so ...

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✓ Check Your Learning

5. (b) Explain why pests do not exist from an environmental point of view.

(b) from an environmental point of view, pests are just another organism (albeit one that bothers humans and so ...)
