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Food Pesticides and Their Risks to Children

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Bhopal, India—It was the site of one of the most tragic industrial disasters in all of history. In December, 1984, approximately 50,000 lbs. of a noxious gas known as methyl isocyanate (MIC) filled the night air, killing several thousand and injuring another 200,000 within a few hours. There are, even today, many persons who still incur illnesses and other physical and mental disabilities as a result of this disaster. In an effort to protect the Indian agricultural production and achieve industrial self sufficiency, MIC gas was shipped from the United States to India and used in conjunction with another compound to produce two environmentally pesticides, Sevin and Temik (Browning, 1993).

What are pesticides? The term pesticide refers to any crop protection chemicals. They are classified according to the pests they control. Insecticides, rodenticides, herbicides, and fungicides are all used to control insects, rodents, weeds and fungi, mold and mildew, respectively. Herbicides are the most widely used chemicals in agricultures (NAS, NRC, 1993). Because these pesticides are used, farmers have the ability to profitably produce some crops in areas that may otherwise, be unsuitable. They may also extend growing seasons, maintain product quality and increase shelf life (U. Cal.—DANR, 1992) In addition to their use in food production, pesticides are also used by consumers to control household insects and used by hospitals, hotels and restaurants to kill germs. While some pesticides, such as sulfur, do occur naturally, both natural and synthetic chemicals are used by farmers as needed to protect their crops.

While many more pesticides are being produced now than in the 1950's, a greater percentage of crops are being lost to insects and the quality of human health is becoming increasingly worse (Regenstein, 1982). Not only are human being affected by these chemicals but other beneficial organisms in our environment are dying as well. This may, in part, explain the growing insect resistance to pesticides.

In the physical environment, living and nonliving things are interconnected. There is a continuous relationship between plants, animals, soil, water, light and other living and nonliving things. This interwoven relationship is often likened to a spider web and is thus called, the environmental web. This web is very important because, like a spider web, changes on one thread of the web can be transmitted to other threads and consequently, have an effect on all parts (Prentice Hall, 1994). Whenever a part of the web is broken the entire web becomes weak. Pesticides, in high amounts, have been introduced to our ecosystems, breaking the web. To elaborate, birds and other predatory insects as well as other creatures that are part of the natural "webbed" system have been killed by these chemicals. These animals are crucial in that they keep harmful insects under control. Their elimination allows for insects to multiply at increased rates. Another concern is chemical

farming, which tends to “burn up” the soil, using up its nutrients, killing off the microorganisms and compacting it so that water is less easily absorbed and runs off more rapidly, carrying the rich topsoil with it (Regenstein, 1982). Groundwater as well, has become a major concern due to the increase in chemical compounds irrigating the soil and moving to wells, streams and rivers, lakes and oceans. About half of the people in this country rely on well water for their drinking water and the EPA has found 98 different pesticides in the groundwater in 40 states-contaminating the water of more than 10 million people (Garland, 1993). Studies have also shown that pesticides which invade groundwater are almost impossible to remove and depending on half life and rate of biodegradation, they may persist there for years. I found this persistence to be true during graduate school when my experiences allowed me the opportunity to conduct a study testing the effects of the chemical pesticides, Dimilin, on the molt behavior of blue crabs in the Chesapeake Bay. Dimilin was being used and marketed to control mosquito larvae populations in forest areas and while it appeared to be helpful in controlling mosquito larvae, its rapid absorption into the soil as well as its runoff began to move into the Bay and accumulate. Because crabs are bottom feeders (get their food source from the bottom of the ocean), they ingested accumulated amounts of Dimilin into their systems, which resulted in an inhibition of chitin production (needed to make their shell). Consequently, the crabs would molt, but their shells remained soft. Without their hard-shelled protection, they became prey for other organisms and died. Not only does this upset the natural ecosystem, but workers and the entire crab economy are adversely affected as well.

In order for a pesticide to be registered and approved for use in the United States, the Environmental Protection Agency (EPS) must establish a tolerance. A tolerance is the maximum residue level of a pesticide, legally permitted in or on a food, feed or food component (Chaisson, et al, 1991). In determining the tolerance of a product, tests must be conducted by the manufacturer to establish whether a pesticide has the potential to cause negative effects on humans, wildlife, fish, plants, and even endangered species (USEPA, 1991). EPA must also carefully examine research exhibiting any potential risk of the pesticide to cause cancer, birth defects, reproductive or neurological disorders before it can be registered. A potential dietary exposure of the population must also be estimated and a cumulative lifetime exposure is calculated as well.

While the EPA is responsible for the registering of chemicals, monitoring of any chemical residues is the shared responsibility of the Food and Drug Administration (FDA) and the United States Department of Agriculture (USDA). FDA monitors pesticide tolerances for domestically produced food and imported foods except for meat, poultry and some egg products which are monitored by USDA (FDA, 1993). Dietary intakes are estimated by the FDA and compared with a safety standard referred to as the Reference Dose (RfD) set by EPA.

This RfD is the amount of a chemical that, if ingested over a lifetime, is not expected to cause any adverse health effects in any population subgroup. Through animal tests, this standard was achieved and it gets adjusted to allow for individual variations in susceptibility and apparent differences between humans and test animals (IFIC, 1996).

Is the federal government, however, really doing an adequate job at regulating pesticides in food? There are many opposing issues that could be addressed but, the focus in this unit will be on pesticide residues in children’s food. There are many articles that evaluate differences in children and adults that are not considered when measuring tolerance. In 1993, the National Academy of Science (NAS) published a report stating the need for the government to increase their efforts to assess the risks of agricultural pesticides to children and adequately protect them from detrimental health effects. As the report points out, the dietary patterns of children differ from those of adults in many ways. To expound upon this, children eat relatively

more food, particularly, fruits and vegetables, than adults do; therefore, they receive a high exposure to pesticides that are present on the food. Other points are as follows:

-A young child's renal system is not fully developed. For example, a newborn's kidneys are immature compared to an adult's making it more difficult for the infant to eliminate toxic waste. This can lead to a greater buildup and increases their vulnerability.
-A young child's brain, nervous system, immune system, and other organ systems are still developing and are therefore most susceptible to abnormalities and malfunctions than adults.
-When children are exposed to toxins, there is more time for resulting damage to occur than when adults are exposed. To elaborate, if a series of events have to occur before the toxic effects of chemicals present, then it is more likely that those events will occur someday if the children are exposed early in life as opposed to exposure much later.
-Due to the rapid cell growth in children, they appear to be more susceptible to some carcinogens than adults are (Garland, et al, 1993).

In addition to these facts about a child's vulnerability, there are some other issues regarding federal pesticide policy that are not considered—for children and adults. Firstly, the current policy works to favor the most toxic pesticides being used now over the newer ones and the alternative pest control methods. Most pesticides have not been fully tested for their health effects and in setting maximum tolerances for pesticide food residues, the EPA does not consider all exposures to pesticides, such as combined exposure effects or potential effects of inert ingredients. Tolerances may be based on outdated and possible inaccurate information about American's food consumption. Americans do not eat the way they ate 20 years ago and this could potentially result in an underestimation o human exposure to pesticides. Lastly, monitoring programs are limited, and do not always keep contaminated food from reaching the stores (Garland, et al, 1993). Even with environmental policies in place, agriculturists are still using unnecessarily high levels of chemical sprays to protect their crops and increase production. When a pesticide is banned, some chemical companies continue to manufacture the pesticide, endangering the lives of chemical workers in the process, and export it to a country with less stringent laws. It is then used on food crops there and that food gets imported to the United States. It gets pass the FDA's monitoring because only about one percent of imported food is tested and that banned pesticide ends up in our supermarkets (Garland, et al, 1993). Although consumers, have been made aware that these substances are in and on their foods, the magnitude of this in terms of potential long term effects is not realized, particularly in urban settings. More importantly, children need to be made aware of the processes by which foods get to their home and beyond that, the health hazards they may present.

The purpose of this unit is to enhance the fourth/fifth grade environmental science program by giving students the opportunity to discover and identify common chemical pesticides used and learn how these manmade substances disturb the natural environment. They will identify common sprays found in fruits and vegetables and measure water quality in their community. The processes by which these chemicals get in our foods will be researched and they will discuss ways in which changes can be made. Specific concepts and issues to be addressed are as follows:

1. Physical composition of the environment
2. Human's relationship with the environment
3. Chemical pesticide use on foods
    - health hazards
4. Community cleanup
    - effort to improve our food

Activity #1 -Tragedy at Bhopal

Objective To recognize the issues that faced the people of Bhopal during the time of the gaseous leak and discuss the effects of this disaster.

Materials The Bhopal Chemical Leak

Introduction Throughout the years, in this country and abroad, plants and factories have been working diligently to protect agricultural production and become industrially more self-sufficient. While some plants have seemingly met with success, others have fallen short, endangering the lives of thousands of people. Bhopal, India was once of those countries. Pesticides were created here that eventually killed many thousand and injured several others within a matter of hours. Through this activity, children will learn of the events of the incident.

Procedure

1. Provide the children with the book, *The Bhopal Chemical Leak,* that describes what happened in Bhopal. Have them read it.
2. Have the children work in small groups to research the stories of various characters in the book.

    Characters (Groups):

    Survivors
    - Technician in plant
    - Pregnant woman
    - Brother of worker at railway station
    - Journalist in town

    CEO of Union Carbide

    Lawyer

    *Reporter (this group will research to find questions to ask the groups).
3. After research is completed, one student will be chosen to represent each group.

4. The representatives will use the research gathered to present a dramatization of a talk show where the topic is the “Bhopal Tragedy.” Those students not on the panel will represent the audience and will allowed to ask one question (must be thought out and clearly stated).

Discussion questions:

- In what ways, if any, are people still suffering?
- How could have been avoided?
- Could anything like this happen in our country? How?

Activity #2

Objective Identify common animal and plant pests and determine the groups of pesticides that control these pests.

Materials (1) Felt pieces with pictures (along with the names of insects, mites, eelworms, fungi, bacteria, viruses and weeds; (2) Felt pieces with words: Fungicides, Insecticides, Herbicides, Rodenticides; (3) Felt pieces with (pesticide) words: CAPTAN, Alar, Dioxin, EDBC’s and ETU’s (Teacher suggestion reading: Pesticides. Necessary Risk , Charlene Billings); (4) Apples, carton of milk, strawberries (optional), potato chips.

Introduction There are many pesticides used today, on many different plant and animal pesticides. While they are too numerous to individually name, it is worth knowing the general classification of pests and the methods by which they are controlled.

Procedure

1. Teacher will use a felt board to display the groups of animal pests (insects, mites, eelworms) and plant pests (fungi, bacteria, viruses, and weeds). The pesticides that would most likely control these will then be matched respectively (Insecticides, Fungicides, Herbicides, Rodenticides).
2. Four main pesticides used on food will be identified and discussed.

   -Each student will be given an apple, a carton of milk, a strawberry, and potato chips.

   -The students will be asked to (write) share what they like about each of these foods.

   -The pesticides that have been used on each of these foods will be introduced and their effects will be shared as well.

   -The students will write and share what they think should be done with these foods and discussion will take place to determine how these chemicals are regulated.

Extension activity: **Play the game—SNAP!**

Materials (Prepared in advance by teacher): playing cards with names and pictures of pesticides discussed as well as cards with pictures and names of pests controlled by these.

Procedure Two/three players per game. Deal the cards face down in front of each player (players do not look at their cards) until all of the cards have been dealt. Taking turns, each player quickly turns over the top card of their pile and puts it in front of them (the card must be turned away from them so they don't see it before everyone else). When a card turned up matches a card on someone else's pile (pest—pesticide), the first of those two players to yell- SNAP! wins both snap piles. The loser starts the play again. If a player yells SNAP! at the wrong time, they must give all other players one card. The person who wins all of the cards is the WINNER!
Adapted from *Let's Play Cards* , by Judie Goodwin. Devyn Press, Louisville, KY, 1989.

Activity #3

Objective To create a live food chain.

Materials Freshwater algae culture (suggestion euglena), 4 uncovered mayonnaise jars (one for each group), 4—5 dozen daphnia or water fleas, 4—5 dozen hydra, water. Vocabulary: producers, consumers, equilibrium, organism.

Introduction Before anyone can fully understand the effects of a pesticide, they must realize the connectedness between living and nonliving things. There are certain nonliving, physical factors which are crucial to the proper growth and development of living things. Sunlight, oxygen, and water are three of those things. Sunlight is the main source by which energy is obtained. Water and atmospheric gases, in the form of oxygen, nitrogen and carbon dioxide, help to create an environment conducive to the growth of living organisms by providing a sense of nourishment. In an ecosystem, an organism may belong to one of three groups: producers, consumers, or decomposers. Producers are organisms which use energy from sunlight to 'produce' food for other organisms. There are usually plant products and are eaten or 'consumed' by the consumers. The death of a consumer provides food source for the decomposers (usually bacteria). This transfer of food energy from producers to consumers to decomposers is referred to an a food chain . This interrelationship between the plants, the plant eating animals (herbivores), the animal-eating animals (carnivores and the animal or plant-eating animals (omnivorous) is important in maintaining a balance within a community. Thus if any of the members are eliminated, the entire chain is affected. Pesticides sprayed on gains may be ingested by animals that graze on them. These animals, in turn may be ingested by us.

Procedure

1. In the uncovered jar collect some of the freshwater algae (in water and store in the sunlight for several days until the water turns bright green (producers).
2. Next, introduce the first level consumer a dozen or so daphnia. Observe carefully and record observations.
3. When the organisms appear to be disappearing, add the second level consumer, a dozen hydra. Observe carefully and record observations.

Discussion questions:

1. How can you keep your mini habitat going until the energy stops flowing?
2. What freshwater animal could you add to keep the population of hydra control?

Activities in the Life Sciences, Helen J. Challand, Ph.D, 1982, Children's Press Chicago.

Extension activity: **Make a Food Dangler**

Materials Animal shapes to be traced (provided by teacher, thin string, crayons, hole puncher.

1. Trace the animal shape to the oaktag. Cut out its 'belly' (consumer).
2. Trace the next animal shape onto the oaktag and cut out its belly (consumer).
3. Trace the plant food (producer) on to the oaktag and cut it out.
4. Use hole puncher to punch hole in the top of the producer and at the top of the 'belly' of both consumers.
5. Dangle the producer inside of the consumer by attaching the top of the plant food to the top of consumers stomach. Then dangle this inside the other consumer.
6. Color both sides of the completed dangler.
7. Write a paragraph explaining your dangler.

Extension: **Make a food chain including what you ate for breakfast.**

Activity #5 How Polluted is Your Water?

Objective To investigate levels of pollution in varying parts of a river.

Materials (for each group) dip net or small strainer, white plastic collecting dish, magnifying glass, plastic spoon, eyedropper, rubber gloves, *indicator animal chart.

Vocabulary Pollution, Indicator animal, herbivore, carnivore, vegetation

Introduction Polluted water contains fewer living organisms than clean water. The industrial, agricultural, or sewage treatment waste that pollutes our streams and rivers poisons the water and reduces its oxygen content which can kill organisms low on the food chain. If they are eliminated, then we are all ultimately effected. Often times we do not realize how our waste, be it from home or the field, ends up in our water but, the storm drains provide a direct route for these pollutants to enter our rivers and destroy important animals needed for the food chain of energy to continue. Each group of aquatic organisms has its own level of tolerance for pollution. Some can only live in clean water while others are able to survive in heavily polluted water. This means that by their presence, animals act as "indicators" of pollution levels. Students will work in groups of two to look for "indicator animals" in two samples from different points in the Quinnipiac River and use this information to determine how polluted the two samples are.

Procedure Before going to the site, review safety rules, identify the indicator animal chart and

practice using it. Make sure students understand the various levels of pollution.

1. Select two contrasting sites, Site A(relatively clean) and Site B(relatively polluted), from which to take samples. Locate them on the map and discuss each site surrounding. Mark the location of the sites in the Data Table.
2. (At site) Wearing rubber gloves, put about 1 cm of water from the stream or river into your collecting dish.
3. Using the dip net, make three sweeps through the water. These should be made through vegetation and near to the bottom to disturb any animals attached there. If rocks are present, move them to uncover hidden animals.
4. Drain the water from the net, then tip the contents of the net into the collecting dish.
5. Use the magnifying glass and indicator animal chart to identify the animals in your sample. Use the spoon or eyedropper to remove animals from the collecting dish following identification.
6. When you identify an animal group, mark its presence at the site on the Data Table with a check or cross on the appropriate line.
7. Return the animals caught to the stream or river.
8. Go to Site B and repeat steps 2 through 7.

Discussion questions:

- Where did you find the greater variety of animals?
- Where did you find the greater number of animals?
- Use the indicator animal chart to determine the pollution status of the two sites. Write this in the Data Table. - According to the indicator animals found, which site was more polluted?
- What could have caused pollution at the polluted site (recall maps)?
- Why are some animals unable to tolerate pollution?

Extension activity: **Create a Poster**

Make a list of possible water pollutants in these areas. What effects can each of these have on human health?

Make a poster or model of your findings.

* For indicator animal charts, please see *Nature Projects on File* . The Diagram Group, Facts on File, Inc., New York, 1992.

DATA TABLE

Animal Group Site A Site B

Sludge worm

Rat-tailed maggot

Blood worm

Water louse

Caddis fly larva

Freshwater shrimp

Snail

Mayfly nymph

Stonefly nymph

Fish

Pollution Status:

Activity #6 Improving what you eat

Objective To identify ways of avoiding pesticides in foods and discuss other ways of improving farming, gardening and yard care.

Vocabulary organic farming

Introduction Upon being made aware of pesticides issues that may affect our health, it is important to make changes in any way possible. It may be as small as sharing on your knowledge with someone else or as large as changing your diet. All of it, however, is important to improving what we eat, our environment and ultimately our health. One effort in improving foods we consume, besides writing letters to congress, has been the purchasing of organic foods. Organic foods include fruits, herbs and vegetables that have been grown on farms that support and promote proper care of soils and work to eliminate toxic chemicals from the food chain.

Procedure

- The students will visit an organic farm and tour the site to observe the organic farming practices. (They will be encouraged to purchase these foods and make observations and comparisons to what they purchase in the market).
-Write an essay persuading someone to buy organic foods instead of chemically sprayed foods. Provide examples to support your argument.

Vocabulary Terms

pesticide—any chemical that is used to kill pests, especially insects and rodents.
fungicide—a substance that destroys or inhibits the growth of fungi.
insecticide—an agent used to kill insects.
herbicide—a substance used to destroy plants, especially weeds.
rodenticide—a chemical agent used to eliminate rodents.
fungus—any plants lacking chlorophyll that produce specialized fruiting bodies (ex. yeast, mold, mushroom).
bacteria—one celled microorganisms that exist either as a free living organism or a parasite.
virus—infective microorganism that is able to produce a disease in human, animal, and plant life.
food chain—transfer of food energy between producers, consumers, and decomposers.
producers—organisms that use energy from sunlight to manufacture food for other organisms (ex. plants).
consumers—organisms that ingest producers for energy.
equilibrium—a condition where all acting influences are canceled by others resulting in a stable, balanced, or unchanging system.
organism—a living thing (ex. plant or animal).
pollution—contamination of air, soil, or water by the release of toxic substances.
herbivore—plant-eating animals.
carnivore—meat-eating animals.
vegetation—the plants of an area or region.
organic farming—farming practices which allow food to be grown with fertilizers that consist of only animal or vegetable matter, with no use of chemical fertilizers or pesticides.

Reading List

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13. Richards, R., *101 Science Surprises.* Sterling Publishing Co., New York, 1993.
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15. University of California Division of Agriculture and Natural Resources, *Beyond Pesticides—Biological Approaches to Pest Management in California.* Agriculture and Natural Resources Publications, Oakland, CA., 1992.
16. United States Environmental Protection Agency: prevention, Pesticides and Toxic Substances. EPA's Pesticide Programs, Washington, D. C., May 1991.

Teacher Resource

A directory of certified organic farms in Connecticut may be obtained through either the address below or your local library:

The Northeast Organic Farming Assoc. of CT

Box 386, Northford, CT 06472

(203) 484-2445

Student Reading List

Challand, Helen J., Ph.D., *Activities in the Life Sciences.* Childrens Press, Chicago, 1982.

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SYNOPSIS

Pesticides are chemicals used in agriculture to protect crops from insects and other pests. Although progress seems to have been made in pest control, the quality of human health is on the decline, and children especially, may be at risk. While there are many science issues being studied in relation to a child's vulnerability to pesticides (i.e. poor renal function, CNS/Immune system abnormalities and malfunctions, cancer susceptibility), concerns regarding the current pesticide policy for both children and adults are also growing.

Consumers have been made aware of these issues and the substances found in and on their foods, however, the magnitude of this in terms of potential long term effects does not seem to be realized, particularly in urban settings. Our children, more importantly, need to be made aware of the potential health hazards their food may have.

This unit is written with fourth and fifth graders in mind and will allow them to discover and identify common chemical pesticides used on food. They will also learn how these manmade substances disturb the natural environment. By the end of this unit, students will be able to identify some of the sprays that have been found on fruits and vegetables and measure the water quality in their community. The processes by which these chemicals get into our foods will be researched as well and they will discuss ways in which changes can be made.