

Pesticides In Panama: How Serious Are They?

Objectives:

- To have students become aware of pesticide uses and misuses
- To have students practice geographic skills
- To have students learn the effect of pesticides on the environmental food chain
- To have students develop problem solving skills using math
- To have students deduct possible solutions to pesticide problems
- To have students learn safety and preventive measures

Learning Skills: Critical Thinking, Problem-Solving, Deduction

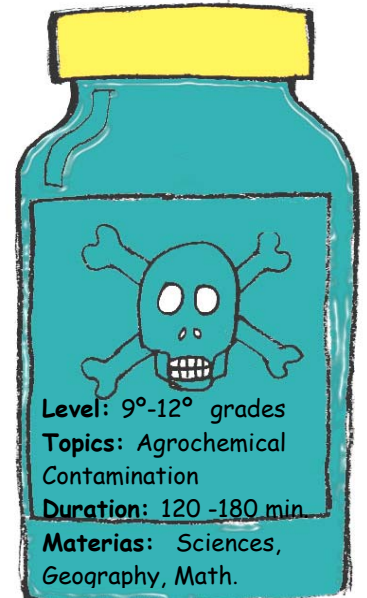
Background:

Many farmers use agricultural chemicals on their farms. These chemicals are used to control pests and are therefore known as pesticides.

"Pesticides" is a broad heading and includes herbicides, insecticides, rodenticides, fungicides and others (Hetzl, 1996). All of these may affect humans but more people are poisoned by insecticides and herbicides.

Worldwide Central America has become the most utilized zone per capita for pesticides (Jenkins, 1995). Panama leads in Central America for the usage of pesticides per inhabitant and also in the amount of pesticides used in cultivated hectares. In addition, in Panama, the average use of pesticides by the agricultural worker (Kg/person) ranks second in all of Central America. Panama imports 700 million tons of pesticides or 3 kilos of pesticides per inhabitant per year. The country is also known as the major consumer of insecticides per capita of Latin America. One may then ask "Why would a small country of 2.7 million people need to use all these pesticides?"

There are several possible answers to this question (Molieri, 1995):



1. Panama has a paradigm agricultural export model that states an unlimited use of pesticides would be the basis for obtaining competitive levels of productivity.
2. Panama has a political determination to link to the international markets by competing with quality export products that are available internationally. This implicitly means an intensive usage of agricultural chemicals.
3. Panama depends on its banana industry as a major export and to maintain the production of bananas a high volume of pesticides are needed. This industry annually generates approximately 200 million dollars.
4. It is interesting to note that almost half of the producers have less than one hectare of land and almost 75% have five hectares of land. To achieve a greater production rate, the farmers intensively utilize more pesticides. Also, such small lots makes it more difficult to implement ways of reducing pesticide hazards.
5. There is also a local internal expansion of agricultural products like rice, sugar cane, yucca, yam, etc. and the production of cattle, pork and poultry.

Pesticides have four principal entry ways into Panama: Almirante(45%), Puerto Armuelles (14%), Panama (23%), and David (10%) {Molieri, 1995}. Most of the crops raised in Panama are doused with pesticides. There are many indirect routes of pesticide contamination via drinking fountains, rivers, oceans, plants, etc.

One insecticide which is prohibited in the United States and is sprayed here in Panama is Gramoxone. It is sprayed on products like onion, celery, potatoes, and parsley. For example, parsley and celery are fumigated 26X's in only 90 days.

In Panama, during the period of 1966-1976, 156 cases were diagnosed due to pesticide intoxication. Pesticides are classified according to their chemical basis. The 156 cases fell into the following groups: Organophosphates (37%), carbamates (37%), organochlorides (9%), inorganics (arsenic, cyanide and lead) 3%, and others (14%). Most of the more toxic pesticides fall into three major groups: organophosphates, carbamates and bipyridyls.

However, organochlorine pesticides can be toxic as well if not used appropriately. Chlorothalonil is a broad-spectrum organochlorine pesticide (fungicide) used to control fungi that threaten vegetables, trees, small fruits. Chlorothalonil is slightly toxic to mammals. It can cause severe eye

and skin irritation in certain formulations (Walker, 1992). A loss of muscle coordination, rapid breathing, nose bleeding, vomiting and hyperactivity may be caused by very high doses. Dermatitis, vaginal bleeding, bright yellow and/or bloody urine, and kidney tumors may also occur, following by death (Occupational Health Services, 1994). In marine animals, chlorothalonil is highly toxic to fish, aquatic invertebrates and marine organisms. The toxin builds up in fish. Chlorothalonil is practically non-toxic to birds. In the body, chlorothalonil is not very water soluble, does not store in fatty tissues and is rapidly excreted from the body. In aerobic soils, the half-life for chlorothalonil is from one to three months. Increased soil moisture increases chlorothalonil degradation. Chlorothalonil is a fairly persistent fungicide on plants, depending on the rate of application. Although Chlorothalonil is no longer used in US, many are manufactured there for use elsewhere, especially in developing countries.

The US military also conducted secret tests of toxic herbicides in Panama. During the 1960s and '70s, "Agent Orange" was first used in Vietnam in defoliating forests to expose movements of Viet Cong guerrillas. The nickname of "Agent Orange" came from the drums the chemical herbicide was shipped in which were painted black with an orange stripe (Robberson, T, 1999). Also, in the 1960s and 1970s, Agent Orange was sprayed by planes in Panama near a popular beach, a recreation center, a sporting club and a lake that supplied Panama's City's drinking water ("US Military Tested Agent Orange in Panama, August 25, 1999)." The insecticide is highly toxic and contains the highly toxic chemical dioxin.

Now that we are aware that pesticides in Panama are a serious environmental issue, what can the country do? First, education is needed to help protect Panamanian farmers and their workers in agricultural areas. They must be able to read and exercise good judgment, as the most important information about a pesticide is found on the label (Hetzl, 1996). Manufacturers are required to provide information regarding how the pesticide is to be used. Also toxicity levels, mixing, rate of application, precautions to take, kind of clothing and personal protective equipment needed and symptoms of poisoning if exposed to the pesticide needs to be provided. The label of the pesticide must be always read before purchasing, mixing and applying pesticide.

Secondly, personal protective equipment needs to be available. The minimum protection when working with pesticides is long sleeves, shoes, long pants and socks, rubber gloves, and splash-proof eye protection, regardless

of the toxicity level of the pesticide (Hetzl, 1996). Boots need to be unlined rubber or neoprene when mixing pesticides. The workers can never wear cloth or leathered boots when mixing, or applying pesticides. Cloth or leather boots will absorb pesticides and allow the pesticide to contact the skin of the leg or foot and will be a source of residues causing chronic exposure (Hetzl, 1996).

Lastly, pesticide poisoning can be a lethal, if safety and preventive measures are not taken. As mentioned previously, the more toxic pesticides fall into three chemical groups: organophosphates, carbamates and Bipyridyls. Organophosphates and carbamates are insecticides that affect humans by inhibiting the production of the enzyme cholinesterase which is important in the correct functioning of the nervous system (Hetzl, 1996). Depending on how exposure occurred, symptoms of poisoning by organophosphates and carbamates may vary. The reported cases are either mild or moderate. Mild cases of poisoning include some or all of the following symptoms: headache, fatigue, dizziness, loss of appetite with nausea and stomach cramps, blurred vision (tearing and shrinking of the size of the pupils), sweating, slobbering, vomiting, diarrhea, slowed heart beat, and muscle rippling. Moderate cases of poisoning will progress from dilated pupils and secretions from the eyes, nose, mouth, lungs, and skin to unconsciousness and seizures (Hetzl, 1996). Treatment for poisoning must be sought. Seek antidotal information from the "Note to Physician" statement on the pesticide label. Additional information can be obtained from the hospital.

Chemicals such as paraquat (Gramoxone) and diquat are classified as bipyridyls. Poisonings from chemicals affect skin, nails, mucous membranes, gastro-intestinal tract, and respiratory system.

Depending on how poison entered the body, symptoms of poisoning vary accordingly. Exposure directly to the skin usually causes irritation and cracking. Repeated exposure to fingernails they may start to show irregular growth and may also turn black around the cuticles or entirely black. Inhalation of droplets usually causes irritation of nose and throat. Nose bleeds may be caused if repeated or prolonged exposures.

If ingested (swallowed) paraquat or other bipyridyls usually cause severe lung tissue damage. Immediately following ingestion the victim will experience pain in the mouth, throat, chest and abdominal area (Hetzl, 1996). Other symptoms may follow like vomiting, diarrhea, and muscle aches.

Three to fourteen days, after ingestion, coughing, difficult breathing and fluid build up in the lungs may occur. Total recovery may not be possible.

Treatment for poisoning when a bipyridyl has been ingested should be immediate. The stomach should be emptied and an absorbent to bind the chemical ions should be given. Hospital treatment is absolutely necessary.

Although Panama prohibits and restricts the most illegal pesticide products in Central America there are more than 400 pesticide products that are easily accessible from the black market (Molieri, 1995). Both the accessibility and cost of the product seem to be the major contributing factors for the selection of these suicidal products.

Vocabulary: chlorothanolil, agent orange, acute toxicity, herbicide, fungicide, rodenticide, insecticide, food chain, Hairy Cell Leukemia, dermatitis, bar graph, rank, Kg/person, Kg/hectare, zone per capita

Materials: Clipboard (1 per student), map of Panama, map of causeway and adjacent islands (one per group of three), 2 real situational models (one will be used for extension), pencils, handouts with questions, graph paper, easel, pesticide bag with label, 2 long sleeved shirts, 2 pairs of unlined rubber or neoprene boots, 2 pairs of long pants, 2 pairs of rubber gloves and 2 splash-proof eye protection glasses

Methodology:

1. Welcome the students to Culebra and ask them to gather around as they get off the buses. Introduce yourself and the docents briefly and introduce the topic. May then begin with a startling fact. "Would you believe Panama imports about 3 kilos of pesticides per inhabitant per year?" More simply stated 3 kilos is about how much a new born baby weighs. In fact, Central America has become the *most utilized zone per capita* for pesticides in the entire world. Why do you think Panama imports so many pesticides? What are pesticides used for and where are they used? Are different types of pesticides used for different purposes? (herbicides, rodenticides, insecticides, and fungicides).

We will find out the answers to these questions later on today as we study a real incident that occurred in one of Panama's major agricultural areas.

2. Walk to bunkers and have students sit in circles of three. Students will be given a map of Panama on a clipboard, pencils, and handouts. Briefly review objectives of activity.

3. Students will then be asked to first locate agricultural provinces of Panama by shading regions on map (Bocas del Toro, Chiriqui, Herrera, Coclé, Los Santos y Panamá)
4. Docent will discuss with students how pesticides enter Panama (many enter illegally). There are 4 principal entry ways¹: Almirante (45%), Puerto Armuelles (14%), Panama via Colon (23%) and David via Costa Rica (10%). Students are to label entry ways on map. Ask students to rank on their maps from 1-4 which entry way receives the most pesticides, 1 being the highest and 4 being the lowest. Discuss results.
5. Students will be asked to study a real situation concerning a chlorothalonil fungicide spillage in the Rio Chiriqui Viejo, near Divala, Chiriqui during 1992. Define chlorothalonil as a chemical that belongs to one of the four major groups of pesticides. A fungicide is just what the word states it kills fungi which are commonly found on leaves. Can you remember the other remaining groups?... No? Well they are rodenticides, that kill rodents, insecticides, that kill insects, and herbicides, that kill weeds.
6. Students will be asked to locate Rio Chiriqui Viejo which was affected by the spillage using a detailed Panamanian map. They will trace the spillage to a major body of water. Students will name the body of water.
7. Students will be asked how such a spillage would affect our environment. They will be asked to build a food chain after docents review a simple food chain. For example, the sun helps plants to grow. Plants are at the beginning of the food chain and have the necessary energy. They are called the producers. Animals need sunshine, plants and water to live. Animals that eat plants are called consumers. Big animals eat little animals. The decomposers (fungi, insects, etc.) are the last part of the food chain to transfer energy and may be found in the soil. Students need to realize how pesticides become part of the food chain- soil, water, ocean, wildlife, and humankind are all affected.
8. Students will be asked to look at map and place an "X" on figures which have been affected by pesticide chlorothalonil. Students will need to read background information to help them with their deductions (see students handout).
9. Students are now ready to build a simple food chain. They can use arrows or a pyramid or some other creative method.
10. Students are to fill in Table I (Effects of Chlorothalonil on Different Organisms) and Table II (Amount of Pesticide Usage in Central American

¹ Percentages are for docents usage, students will guess.

Countries). From Table II, three bar graphs will be constructed. Docents need to explain why bar graphs are used and how. The scores are plotted along the horizontal baseline, also called the abscissa or X axis. The frequencies (number or percent of cases) are plotted along the vertical axis, also called the ordinate or Y axis. The height of each bar represents the frequency or percent of cases in that interval. Once the frequency of each Central American country is graphed, a student will be able to compare the countries. (Docents will do the first country on the easel)

11. Students will analyze data and answer questions concerning Table II (See Handout)

12. After working out this real situation and answering question No. 12 on the handout, students are now ready to discuss safety measures. Bring out the pesticide package. What if someone is poisoned? Ask students what important information should a pesticide label contain (type of chemical, there should be antidotal information from the "Note to Physician" statement on the pesticide label, and additional information can be obtained from the hospital. Bring out the safety equipment and let students dress up so they can sense the safety equipment through touch and vision What safety measures can be taken to prevent agricultural workers from poisoning themselves? Personal protective equipment needs to be available- unlined rubber boots especially when mixing chemicals, long sleeved shirts, pants, and splash-proof eye protection. Ask questions concerning the type of safety clothes worn.

13. The evaluation will be conducted in the same teams of three. Each team will represent an environmental group who needs to offer at least three solutions to the existing pesticide problems in Panama's agricultural areas.

14. Time permitting students will be taken to aquariums and touch tanks to enjoy and learn about our marine display. (10 minutes)

Evaluation: Each team of three will act as environmentalists who have come to solve the pesticide problems in the agricultural areas of Bocas del Toro and Chiriqui. They need to state at least two reasons why Panama has pesticide problems and as environmentalists what would they do?

Extensions in Classroom:

Have students do Agent Orange Real Situation Model No. 2 (Based on News Article "Agent Orange Affects Soldiers' Health" by John Linday-Poland, November 1999) and then answer handout. Also, may discuss how different

classes of pesticides cause different symptoms. May discuss chemical nature of three major classes and their half-lives. Symptoms also vary from chemical to chemical and port of entry i.e. by ingestion or absorption are important to know.

References:

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Background Information for Students:

Would you believe that Central America uses the most pesticides per capita in the world? Many of Panama's pesticide spillages are not even registered. There are four major entry ways of pesticides into the Republic of Panama: Almirante, Puerto Armuelles, Panama and David. It seems that the use of pesticides in Panama are increasing. In Panama, pesticides are used on a variety of crops like rice, banana, coffee, sugar cane, beans, peas, corn, potatoes, pepper, celery, carrots, cabbage, calulilower, broccoli, etc. Depending on the use, pesticides are classified in four major categories: insecticides, rodenticides, herbicides, and fungicides.

One commonly used fungicide in Panama is called Chlorothalonil. In acute toxicity, Chlorothalonil is slightly toxic to mammals, but it can cause severe eye and skin irritations in certain formulations. Very high doses may cause a loss of muscle coordination, rapid breathing, nose bleeding, vomiting and hyperactivity in humans. Dermatitis, vaginal bleeding, bright yellow and/or bloody urine and kidney tumors may also occur, followed by death. In addition, chlorothalonil is rapidly excreted, primarily unchanged, from the body. It is not thought to be stored in animal tissues. Residues have not been found in the tissues of dairy cows. Chlorothalonil is practically non-toxic to birds. Chlorothalonil is not very water soluble and highly toxic to fish, aquatic invertebrates, and marine organisms.

Real Situation Model No. 1 (Based on a true incident written in a book chapter; Molieri, 1995).

There is a possibility that the Rio Chiriqui Viejo valley region has been affected the most by pesticides. In 1992, in Divala, Chiriqui area there was a pesticide spillage in the Rio Chiriqui Viejo. More than 4,000 liters of Chlorothalonil (clorotanol), a chemical organochloride and fungicide was spilled, and as a result, there was an environmental contamination in the Rio Chiriqui Viejo. Pesticides when used excessively or when used frequently over a period of time will affect the food chain. What consequences do you think this spillage had on the environmental food chain?

Instructions:

These questions will help you become aware of the usage of pesticides in Panama. Using the map or analyzing the data answer the list of statements and/or questions that follow:

1. Pesticides are mostly used in agricultural areas. As you look at Panama's map, locate the major agricultural areas by shading in the areas. Next name and indicate by use of arrows, the four principal entry ways of pesticides in Panama.
2. Now, you will need to familiarize yourself with the region where the pesticide spillage occurred. Locate Rio Chiriqui Viejo on the map provided. Trace the river all the way to its major body of water. What is the name of the body of water? _____
3. Observing the guide about the food chain, draw a food-chain for fresh water, and one more for sea water. You can use arrows, triangles, or any other form or creative system to draw the chain (docents will help you).
4. Go back to the map and place an "X" on figures which were affected by the chlorothalonil spillage (See Student Background Information for information).
5. Determine which animals were affected by the chemical spillage by marking yes or no. Also specify animal by name. Please see Table I

Table I. Effect of Chlorothalonil in Different Organisms (Rio Chiriqui Viejo)

	Yes/ No	Examples
Effected Humans		
Effected Mammals		
Effected Birds		
Effected Aquatic Organisms		
Effected marine organisms		

7. Three bar graphs need to be constructed to show the average annual importation of pesticides, the average Kg/Person, and the Kg/Hectare pesticides in the different countries of Central America. Use the data located on the chart below to construct your bar graphs.

Table 2. Amount of Pesticide Usage in Central American Countries

Country	Inhabitants	Área (km ²)	Importation (Ton)	Kg./Person	Kg./Hectare
Belice	248,000	22,965	433	2.6	8.7
Costa Rica	3,604,642	51,100	9,924	4	16
El Salvador	5,839,000	20,749	6,300	1.2	7.9
Guatemala	11,090,000	108,889	9,027	1.2	7.2
Honduras	6,249,598	112,492	10,760	2.6	13.3
Nicaragua	4,923,000	131,812	9,772	3.1	15.3
Panama	2,809,000	75,517	7,505	3.4	18.8

8. We are now ready to analyze our data with our teammates. Answer the following questions:
- Which country in Central America imports the most tons of pesticides into its country? Rank the countries from highest to lowest.
 - Which country utilizes the most pesticides per inhabitant (Kg per person) Rank the countries from highest to lowest.
 - Which country utilizes the most pesticides per Kg/Hectare?
 - Rank the countries from highest to lowest.
 - Explain why Panama does not have the highest importation rate?
 - We now need to compare our results with other Central American Countries. Why do you think Panama uses so many more pesticides?
 - Pesticides especially affect the agricultural workers and their families, why?
 - What would you do as a citizen of Panama to help reduce pesticide usage?
 - What precautions should agricultural farmers take when using pesticides?

Agent Orange Situational Model No. 2

Across from the island of Culebra where you are visiting, lies a nearby island called Flamenco. Right next to Flamenco lies the island of Perico. Would you believe a site so close to us was once sprayed by a chemical that remains in the soil for decades? How did that happen? Well, as you all know Panama, has had malaria and yellow fever outbreaks. In the 1950s, the US military occupied Flamenco island and used Agent Orange to help control weeds and in turn the insect population.

In January 4, 1958 a US soldiers were stationed on Flamenco Island. One eye-witness reporting the spraying of a deadly herbicide one dry season day. This chemical was called Agent Orange and was sprayed all over the island. Consequently, all the trees lost their leaves and about ten million fish died and were found on the rocks. The smell was unbearable. Many of the soldiers became violently ill from the chemical and were hospitalized. As a result of the soldier's exposure, he developed a rare form of leukemia called Hairy Cell Leukemia., Army officials say that today Agent Orange should have dissipated. However, the dioxin contained in most Agent Orange- the toxin that causes the disease- may remain in the soil for decades.

Below is a map and a list of statements and/or questions on how Agent Orange affected the environment.

1. Locate and label all the land linked by the causeway.
2. Is the causeway natural? If yes, why? If not, why?
3. 3.What type of land masses are these? (Look at Numbers 1-5)
4. What effect does Agent Orange have on the environmental food chain?
5. What makes Agent Orange so dangerous?
6. Which groups are affected by agent Orange. Fill the table.

Grupo	Yes or No
Effects on Humans	
Effects on Aquatic Life	
Effects on Aquatic Life	