

The Farmer and Her Flies: A Study in Natural Selection

Written by Jennifer Folsom

Grade Level: Middle School

Overview

Students will investigate the process of natural selection through an inquiry activity.

Objectives

Upon completion of this activity, students will be able to:

- Conduct a scientific investigation (problem, hypothesis, and data analysis)
- Conclude that the characteristics of populations of organisms can change over time in response to environmental pressures.
- Identify natural selection as a mechanism of biological change.

Important Words

- Pesticide
- Herbicide
- Insecticide
- Resistance

Materials

Copies of **Activity Sheet 1: The Farmer and her Flies**

Copies of **Activity Sheet 2: More Information for Investigation**

Pencils

Time Needed

45 minutes

Teacher Preparation

Read the background information and familiarize yourself with the problem. Study the student activity sheets. Be familiar with the conclusion section, so you are able to accurately explain the process of natural selection.

Background Information

Many scientists get started in their investigations by observing the natural world or looking at the results of the experiments of others. They start wondering “how” and “why” things happen the way they do. After being intrigued by some aspect of the problem, they think of a possible answer -- a hypothesis. After the hypothesis, there is more data collection and more experiments.

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Then, the scientists conclude that their hypothesis either is supported, rejected, or is somewhere in the middle. Then, more tests and data collection follow. Finally, when there is a hypothesis that has been supported by study after study, scientists declare it to be true. This scientific process starts with an inquiring mind, and this lesson depends on the inquiring minds of your students.

This activity is an inquiry into natural selection. It looks at how organisms change over time in response to pressures from their environment. In this case we are looking at flies and how they change in response to an insecticide.

Why do I need to talk about pesticides with my students?

It is important to go through the Introduction section and cover the information about pesticides because studies show that more than 60% of the American people do not use pesticides properly. They do not take the proper precautions or use them as directed. Improper use of pesticides can cause skin damage, cancer, other health problems, and even death. It is critical that students learn this information so that they can be well informed consumers and careful users of pesticides.

Proper use of pesticides is generally accepted to be safe by the U.S. government, chemical manufacturers, some scientists, and most citizens. However, there are many organizations, scientists, and citizens throughout the world that disagree. Some pesticides that were considered safe for many years were later discovered to be dangerous. For those who are concerned with possible harmful affects, there are safer products on the market that use less toxic plant extracts like orange peel, garlic, lemon eucalyptus, and other essential oils instead of traditional chemicals.

Environmentalists argue that chemical pesticides cause more harm than good. They kill untold numbers of untargeted animals and plants that the original user never meant to harm. The pesticides run off yards and find their way into the water system, spreading the pollution well beyond the original area. Pesticides that are sprayed over farm fields from airplanes often get swept away by air currents and spread across huge distances. Scientists also argue that the long-term effects of many pesticides have not been studied enough. They site DDT as a prime example of inadequate testing, and wonder how many more chemicals are still on the market and are just as dangerous.

DDT was a pesticide commonly used in the U.S. to kill mosquitoes and lice since its discovery in 1939. After a few years of use scientists became very concerned with its affects on human and environmental health. It was discovered that insects had developed a resistance to it, that it was extremely toxic to fish, seed-eating birds, and some other animals, that it affects human health, and that it "bioaccumulates." Bioaccumulation means that the higher you go up the food chain, the more pesticide you find in an animal's body.

Animals that ate fatty foods, like meat and nuts, were particularly at risk because DDT is stored in fatty tissues for long periods of time. As an animal ingests more and more of the chemical by eating other animals that have small amounts of the pesticide in their bodies, the pesticide can build up to fatal levels. It also makes the egg shells of many birds very thin, causing them to crack before the chick was fully developed, resulting in chick death. In 1962, Rachel Carson wrote the novel Silent Spring to alert the public to the problem of environmental pollution. It focused on the problems resulting from the use of DDT. As a result of growing public concern, the U.S. Environmental Protection Agency banned DDT in 1973.

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Activity 1: Introduction

5 minutes

Explain to your students that today they will be conducting a scientific investigation. They will be given a problem and will need to come up with a hypothesis that could answer it. They will get more information (see Activity 3) and will have to determine if their hypothesis is supported or not supported. Review with your students the terms **pesticide**, **insecticide**, and **herbicide**.

What is a pesticide? The U.S. Environmental Protection Agency (EPA) defines a pesticide as any product that kills any pest including, plants, animals, bacteria, algae, fungi, molds, or viruses. Examples of a few pesticides include bug repellants, roach traps and sprays, weed killers, bleach, disinfectants, and flea sprays and collars for pets.

What is an insecticide? Insecticides kill insects and sometimes spiders and other crawly arthropods. People use them in their homes, restaurants, schools, and on farm crops.

What is an herbicide? Herbicides are used to kill weeds and other unwanted plants. People use them in yards, on golf courses, and on farm crops. Many herbicides are very specific as to what they kill. They can be sprayed on fields of corn, and kill only the weeds and not the corn. Other herbicides kill all the plants that they touch. Scientists have developed farm crops that are resistant to certain herbicides. This way the whole field can be sprayed and only the weeds, not the crop, will be killed.

Ask the students if they have ever seen anyone use pesticides. Are there special rules about using them? The federal government regulates which pesticide products can be used by unlicensed, untrained consumers and which ones can be used only by professionals. The government also dictates where they can be used. Some can't be used around food, for instance. Some can't be used around water, like streams or lakes. Some can't be used around children or pets. All pesticides must carry directions for use on the label and those directions should be followed at all times.

Are there any precautions people need to take so they don't get hurt from using them? It depends on the product, but the general rule is to avoid contact with your body. Usually people wear some type of mask or protective clothing. Many people take showers or at least wash their hands after they finish using the product. Again as a general rule, you should not get any pesticides on your skin, breathe them in, or ingest them.

There are a few pesticides currently considered safe to put on the skin. Some mosquito repellants are listed for use on human skin and some flea chemicals are listed as acceptable for pet skin. You should always read the label to learn these products' acceptable uses.

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Activity 2: The Farmer and Her Flies

25 minutes

Hand out **Activity Sheet 1: The Farmer and Her Flies**. Ask students to read the story or read it to the class and have them follow along. Allow the students to get into groups of two and ask them to answer the questions at the bottom of the sheet.

After they have finished, ask them to share their hypotheses with the rest of the class. They will probably fall into the first three of the four categories listed below. The fourth category is very difficult. They may not get it at this point and that is okay.

Common Hypotheses

1. The conditions in the barn were different.
(humidity, temperature, wind strength)
2. The way she sprayed was different.
(didn't get everywhere, didn't use as much, didn't spray the same places)
3. The spray itself was different.
(it got too old, it went bad because it got too hot or too cold)
4. The flies were different.
(a different kind of flies moved in, the flies "got used to it," the flies mutated)

Activity 3: More Information for Investigation

25 minutes

Hand out **Activity Sheet 2: More Information for Investigation**. Ask students to read the story or read it to the class. Allow the students to work in their small groups to answer the questions that follow. After they have finished, go through the questions with the students. Ask them to share their new hypotheses. When each group has had a chance to share their opinions, go back to any groups that focused on the flies being somehow different. Point out that they came up with an interesting idea.

Conclusion

15 minutes

If no groups came up with this idea, ask if they think it's possible that the flies that are now in Sheri's barn could somehow be different from those that used to be in Sheri's barn. Is it possible that some new species of fly has moved into the barn and that it was resistant to the "Getlost?"

Explain to the students that it is more likely that the original population of flies was just diverse, like many populations. Human populations are diverse, too. Not only do humans have different hair and skin colors, but they also have varying resistances to diseases. Some people can be exposed to chicken pox and not get it. They have something different about them that makes them **resistant**, meaning that it does not bother them. Certain races of people seem to be more resistant

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to certain types of cancer, than other races. Women of European descent, for example, are less resistant to breast cancer than are women of African descent.

Ask the students if it would be possible that the original population of flies in the barn had a few members that were resistant to the “Getlost”. Since they were resistant, they didn’t die when the “Getlost” was applied. The flies that weren’t resistant were killed by the insecticide. Others may have survived the spraying, if they were hiding or happened to be out of the barn at that time. The flies that lived -- both the resistant and the other just plain “lucky” flies -- were able to reproduce and make baby flies. Since offspring are a lot like their parents, most of those baby flies were also resistant to the spray.

When Sheri sprayed again, she killed most of the non-resistant flies, but again the resistant ones lived. The survivors continued to reproduce and produce more resistant flies. As time went on, more and more of the fly population had a resistance to the “Getlost”. Once almost all the flies were the offspring of resistant parents, very few of the flies died when she sprayed. The only flies she was killing were the flies that were not resistant.

Explain that this process is called **natural selection**. It means that organisms are selected for success or selected for elimination by the conditions in their environment. In this case, the determining condition is the presence of the insecticide, which influences the flies’ survival. Those that can tolerate exposure to it survive. Those that can’t die.

Natural selection does not work on individual organisms. For example, the flies that were not resistant to the “Getlost” did not somehow become resistant. They died, and dead flies can’t reproduce. Natural selection works on populations. Of the whole bunch of original flies, the resistant ones survived the pressure. The non-resistant ones didn’t. So as time goes on, there are fewer and fewer non-resistant flies. The process of natural selection has changed the makeup (i.e., the traits) of the population of flies.

Points to ponder

- Bob had not ever sprayed his flies before. When he sprayed the first time, the flies that did not happen to be resistant died. What do the students think will happen to Bob’s flies if he keeps spraying the “Getlost”?
- What could Sheri do now that her fly population is mostly made up of flies that are resistant to the “Getlost?”
- If she chooses to use another pesticide, do you think the same thing would happen? Could some of the flies also be resistant to a new pesticide?

Activity Sheet 1: The Farmer and her Flies

Name _____ Date _____

A southern Missouri farmer named Sheri had a dairy farm with a large barn full of cattle. She had been having problems with flies all summer. There were so many that her cattle's health was being affected. Sheri was worried about her cattle, so she went to the farm store and bought an insecticide called "Getlost". The label said the insecticide was safe to spray on cattle and would kill those pesky flies. On August 14th, Sheri put on gloves and a face mask, then sprayed the barn and the cattle with the "Getlost".

The insecticide killed nearly all the flies. There were still a few buzzing around the cattle, but not enough to endanger their health. Sheri was a little confused why there were still some flies left. She had done a good job spraying and didn't think she had missed any. She didn't worry too much about it. The cattle seemed much happier and healthier. The few flies that were left didn't seem to bother them.

By January 23rd, the barn was again filled with thousands of flies and the cattle were suffering once more. Sheri sprayed again with the "Getlost." The same thing happened. Most of the flies died, but there were still a few left in the barn. Again, the few flies that were left didn't seem to bother the cattle, so Sheri didn't worry too much.

By March 29th, the barn was full of flies again. Sheri sprayed and most of the flies died. Soon the barn was filled with flies again! Sheri was upset because it seemed like she had just sprayed. On April 18th, she sprayed yet again, being sure to get spray everywhere. Most of the flies died, but soon the barn was swarming with them again. On May 6th, she sprayed again, and only about half of the flies died. Two weeks later, on May 20th, the flies were everywhere again. Sheri sprayed again, but it didn't seem like many flies died. On May 25th she sprayed again, but hardly any flies died this time.

Answer the following questions with complete sentences.

1. When did the spray work well?

2. When did it not work very well?

3. The problem you need to investigate is that the flies stopped being killed by the "Getlost." What is your hypothesis?

Activity Sheet 2: More Information for Investigation

Name _____ Date _____

Sheri spoke with a farmer down the road. Bob had been farming his whole life and she thought he might know something about her problem. Bob said that some insecticides go bad when they get old and don't work as well. He suggested that Sheri buy some new "Getlost" and try again. That sounded like a good hypothesis to her. She thought she'd test it out. She bought a new jug of it and sprayed the barn and cattle on June 4th. She did a good job getting it everywhere. Much to her disappointment, hardly any flies died.

On June 7th, Sheri went back to Bob's farm and gave him the new jug of "Getlost." She told him it barely did anything. Bob had a hard time believing that. He hadn't ever used "Getlost" before, but he had always heard it was a good product. He took the "Getlost" from her and sprayed it on his flies. To the surprise of both of them, it killed almost all of Bob's flies!

Now both farmers were confused. "Getlost" worked on Bob's flies, but not Sheri's. The two of them went back to Sheri's farm on the same day. Sheri had had enough with the spraying, so Bob sprayed her flies the same way he had sprayed his. Bob was sure the flies would die. He thought Sheri had just been spraying it wrong. Much to his surprise, very few of her flies died.

Answer the following questions with complete sentences.

1. Could something have been wrong with the spray? Why or why not?

2. Could Sheri have just been spraying it wrong, as Bob thought? Why or why not?

3. Does the new information on this page help to support your hypothesis? Why or why not?

4. Why did the "Getlost" work on Bob's flies and not on Sheri's? What could be different between the two? What is your new hypothesis?

- Pesticide is the same age and strength.
- Pesticide was sprayed was the same way.
- The temperature was the same
- The weather was the same.

Activity Sheet 1: Teacher Key

1. When did the spray work well?

The spray worked well the first three times she sprayed in August, January, and March.

2. When did it not work very well?

The spray worked did not work well any of the times she sprayed in April and May.

3. The problem you need to investigate is that the flies stopped being killed by the “Getlost”. What is your hypothesis?

Varies, but will probably have to do with either the insecticide, flies, or how it was sprayed.

Answers for Activity Sheet 2: More information for Investigation:

1. Could something be wrong with the spray? Why or why not?

Not likely. It worked just fine on Bob’s flies.

2. Could she have just been spraying it wrong as Bob thought? Why or why not?

Not likely. When Bob sprayed it at her barn it didn’t work either. The way he sprayed it, it worked just fine at his barn. The first three times she sprayed it, it worked too.

3. Does this new information on this page help to support your hypothesis? Why or why not?

That depends on what they proposed before. It does not support that there was something wrong with the spray, how it was applied, or the conditions in which it was applied.

4. Why did the “Getlost” work on Bob’s flies and not on Sheri’s? What could be different between the two? What is your new hypothesis?

- Pesticide is the same age and strength.
- Pesticide was sprayed was the same way.
- The temperature was the same
- The weather was the same.

They should have ruled out problems with the “Getlost” itself, including it going bad, how it was applied, and what the conditions were like when it was applied. Their hypothesis needs to propose another option.
