EXPLORATIONS

Activity 7

Objectives

- To numerically and graphically compare two sets of data
- To recognize and analyze patterns in long-term data
- To demonstrate an understanding of the effect of the environment on natural selection
- To explain how humans can influence natural selection by manipulating the environment

Like Moths Around a Flame

In this activity you will

- examine some data about moths.
- graph the data.
- draw some conclusions based on the data and the graph.

Introduction

Imagine that you have a piece of red construction paper on your desk in front of you. If you wrote your name on the piece of construction paper with a red marker, and then wrote your name on the same paper with a black marker, which do you think would be easier to read? If you showed the paper to one of your friends across the room, which do you think they would see? A similar scenario happens all the time in nature. Blending into the environment can help an animal avoid being seen, which may help it avoid being eaten by a predator.

In England, there is a species of insect called the peppered moth that provides us with a great example of this, and helps us understand the process of *natural selection*. Some of these moths are dark-colored, and some are lighter-colored. The color of each moth is determined by its genes for color, so a moth that is born dark stays dark, and a moth that is born light stays light. The peppered moth is most active during the nighttime hours (nocturnal), and spends its days resting on things like tree trunks. From the mid-1800s until the mid-1900s, people noticed that the number of moths of each color changed.

Problem

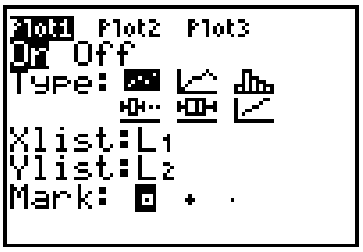
How does the environment affect natural selection? The data table below shows a comparison of the number of moths of each color by decade. In 1860, for example, if 100 moths were counted, 90 of them would have been light and 10 of them would have been dark.

Year	Light-Colored	Dark-Colored
1860	90	10
1870	85	15
1880	75	25
1890	60	40
1900	50	50
1910	40	60
1920	30	70
1930	25	75
1940	20	80
1950	15	85
1960	20	80
1970	30	70

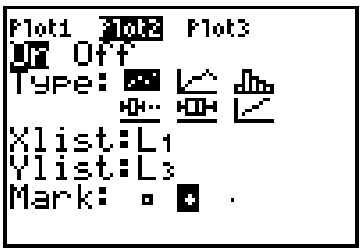
Procedure

1. Press [Y=]. If there are any equations on this screen, press [▼] to place the cursor next to **Y1=**, and then press [CLEAR] to clear the equation. Repeat this sequence to clear all equations.
2. Press [MODE] and make sure the defaults are set. If you need to change a setting, press [▼] to move the cursor, and then press [ENTER] to highlight the item on the left.
3. Press [2nd] [FORMAT] and make sure the defaults are set.
4. Press [STAT] [ENTER].
5. Clear **L1** of all data. Press [▲] to move to the heading **L1**. Press [CLEAR] [ENTER]. Repeat this procedure for any list that has data in it.
6. Using the data table above, enter the data into **L1** (year), **L2** (light-colored), and **L3** (dark-colored). To do this, type in the first number in **L1** (1860) and press either [ENTER] or [▼] to move down to the next spot in the list, then enter the next number. Continue until all the data is entered. When you complete the data from **L1**, press [▶] to move to **L2** and enter the light-colored data. Enter the dark-colored data in **L3**. Make sure you have the same number of entries in each list.

7. Press 2nd [STAT PLOT]. Press ENTER to select **1:Plot1**. Set your TI-83 Plus as shown at the right.



8. Press 2nd [STAT PLOT]. Highlight **2:Plot2** and then press ENTER. Set your TI-83 Plus as shown at the right.



9. Press WINDOW and make appropriate settings for the size of your graph. Remember what you are plotting on the X-axis and on the Y-axis. Leave the **Xres** at **1**.

10. Press GRAPH to see your data displayed graphically.

Data Collection and Analysis

Activity 7: Like Moths Around a Flame

Name _____

Date _____

Data Analysis

1. What is the independent variable in this activity?

What is the dependent variable?

2. Examine the data in the table. Describe the trend you see in the numbers of light-colored moths as the decades passed. Also, describe the trend you see in the numbers of dark-colored moths.

3. From 1950 to 1970, what was the change in the number of light-colored moths?

Calculate the change in the number of light-colored moths per year.

Calculate the change in the number of light-colored moths per decade.

4. From 1950 to 1970, what was the change in the number of dark-colored moths?

Calculate the change in the number of dark-colored moths per year.

Calculate the change in the number of dark-colored moths per decade.

5. Using the calculations you just did in #3 and #4, determine when you would expect the number of each type of moth to be the same. Explain how you determined this.

6. During the middle 1800s, England began what was called the Industrial Revolution. Industry really increased, and with that increase came a much greater need for energy. Since nuclear power plants were still decades away, what was the source of energy that England used to power their huge increase in industry?

What was the environmental impact of using this type of fuel?

How do you think this impact influenced the numbers of light- and dark-colored moths?

7. During the middle 1900s, environmentalists really started voicing their concerns about the harmful effects that industry was having on the environment. England and other countries started paying closer attention to cleaning up the environment by reducing emissions from industrial factories. These concerns helped to promote policies like the Clean Air Act in many countries. As these policies became implemented, new forms of energy started being used, and industry was required to reduce emissions from their existing factories.

What was the environmental impact of the Clean Air Act?

How do you think this impact influenced the numbers of light- and dark-colored moths?

8. Explain how your answers to #6 and #7 describe the effects of natural selection on the population of peppered moths in England.

9. What do you think would happen to the environment and to the moth population if factories went back to using coal for their power, and the Clean Air Acts were eliminated? Explain your response.

10. Brainstorm and then describe another example of natural selection in animals, and one in plants.

Teacher Notes

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Concepts

- Natural selection
- Environmental impact on organisms

Data Collection and Analysis – Answer Key

In this activity there are two sets of data that have the same independent variable. Make sure students realize that both dependent variables share the same independent variable.

1. The independent variable in this activity is the year.

The dependent variable is the number of moths.

2. Light-colored moth population decreases until 1950, and then starts to increase. The dark-colored moth population increases until 1950, and then starts to decrease.

3. From 1950 to 1970, the change in the number of light-colored moths is an increase of 15.

The change in the number of moths per year is an increase of 3/4, (0.75) per year over 20 years.

The change in the number of moths per decade is an increase of 7.5 moths per decade over 20 years.

4. For dark-colored moths, the change from 1950 to 1970 is a decrease of 15.

The change in the number of moths per year is a decrease of 3/4 per year over 20 years.

The change in the number of moths per decade is a decrease of 7.5 moths per decade over 20 years.

5. You would expect the number of each type of moth to be the same in the 1990s. Explanations will vary.

6. The source of energy that England used to power their huge increase in industry was coal.

The environmental impact of using this type of fuel was that there was more soot in the air, falling onto the trees and discoloring the light-colored bark.

The impact on moths: Dark-colored moths would increase, and light-colored moths would decrease.

7. The environmental impact of the Clean Air Act was that there was less soot in the air, so less fallout onto the trees.

The impact on moths: Light-colored moths would increase, and dark-colored moths would decrease.

8. Depending on the color of the tree bark, either the light- or dark-colored moths would be selected *for* or selected *against*. Those selected *for* would be allowed to reproduce, while those selected *against* would not.

9. It is likely that the population of the dark-colored moths would increase because of the darker colored bark. Dark moths would be selected *for*.

10. Answers will vary.