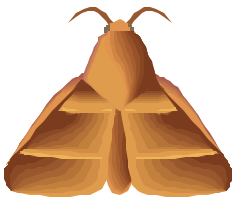
**Now You See 'em, Now You Don't!**
**Natural Selection and the Environment**

*Name_____
*Period_____
*Date_____

# I INTRODUCTION

When your grandparents were young, infectious diseases such as tuberculosis, pneumonia, and syphilis killed thousands of people every year. Then in the 1940's, penicillin and other antibiotics were developed, and public health officials believed infectious diseases were a thing of the past. Today, however, tuberculosis, pneumonia, and many other ailments are back with a vengeance! What happened? ***Natural selection*** occurred. {____}



| *Say?* | *Mean?* | *Matter?* |
|---|---|---|
| | | |

One problem that many people have with the theory of evolution is that they think it all happened in the distant past. Darwin himself believed this. Modern evolutionary biologists argue that evolution is not merely a phenomenon of the past, but that it continues today. One example of present-day evolution has been caused by the increasing industrial pollution in the nineteenth and twentieth centuries. {____}

| *Say?* | *Mean?* | *Matter?* |
|---|---|---|
| | | |

In England, there is a species called the peppered moth, *Biston betularia*, that provides us with a great example of understanding the process of natural selection. Some of the peppered moths are dark-colored, and some are lighter-colored. Before the Industrial Revolution, most moths were white and matched the color of lichens growing on trees. Predatory birds could not see them, because the moths sat quietly on the lichens during the day and blended in. During the Industrial Revolution, Britain's growing industries began to burn huge quantities of coal for fuel. With no pollution-control technology, soot from the smokestacks soon blanketed the countryside around the factories and mills. The lichens died from the pollutants leaving the trees open to expose of the soot. Soon, tree trunks were sooty black and the white moths were no longer camouflaged leaving them prey to birds. The black sooty trees became an excellent camouflage for the black moths. Black moths, once rare, survived and reproduced, and flourished in numbers. Therefore, a change in allele frequencies resulted in a change in phenotypic frequencies, called ***industrial melanism***. {____}

| *Say?* | *Mean?* | *Matter?* |
|---|---|---|
| | | |

## II MATERIALS

_____TI-83 graphing calculator
____Your THINKING CAP
____LOTS of patience since you will be entering and interpreting data

## III PROBLEM

**How does the environment affect natural selection?** {____}

In this lab you will examine some data about peppered moths, graph the data, and draw some conclusions based on the data and graph. The data table shows a comparison of the number of light-colored and dark-colored peppered moths by decade. In 1860, for example, if 100 moths were counted, 90 of them would have been light-colored to dark-colored and 10 of them would have been dark-colored. {____}

| 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 |

## IV PROCEDURE

1. Press [Y=] If there are any equations on this screen, press [▼] to place the cursor next to Y1=, and then [CLEAR] press 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 the data. Press [▲] to move 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).

A. To do this, type in the first number in **L1** (1860) and press either [ENTER] or [▼] .

Continue until all the data is entered. {____}

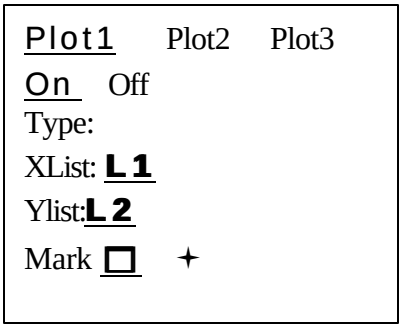
B. After you have completed the data from **L1**, press [▶] to move to **L2** and enter the light-colored data. {____}

C. Enter the dark-colored data in **L3**. {____}

D. Make sure you have the SAME number of entries in each list. {____}

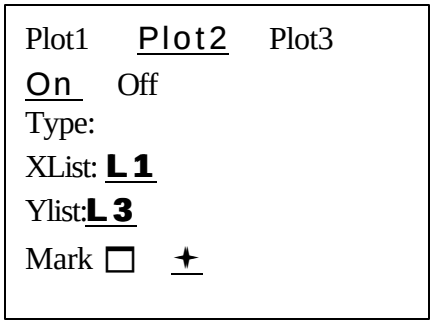
7. Press [2nd] [STAT PLOT]. Press [ENTER] to select **1:Plot1**.

Set your TI-83 as shown below: {____}



8. Press [2nd] [STAT PLOT] . Highlight **2:Plot2** and then press [ENTER]

Set your TI-83 as shown below: {____}




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 (In other words, which is the INDEPENDENT variable and which is the DEPENDENT variable?). Leave the Xres at 1. {____}

10. Press [GRAPH] to see your data displayed graphically. {____}

11. When your data is displayed graphically, show your teacher and obtain his/her signature:

**X**_____ {____}

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## V DATA ANALYSIS (Be certain to answer ALL questions in COMPLETE sentences for FULL credit, unless otherwise stated. Thank you) {___}

1. Identify the independent variable and the dependent variable. {____}

2. Examine the data in the table. In 2-3 sentences, DESCRIBE the trend you observe in the numbers of light-colored and dark-colored moths as the decades passed. {____}

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

4. Calculate the change in number of the light-colored moths per year. **Show your work**. _____ {____}

5. Calculate the change in number of the light-colored moths per decade. **Show your work**. _____ {____}

6. From 1950 to 1970, what was the change in the number of dark-colored moths? _____ {____}

7. Calculate the change in number of the dark-colored moths per year. **Show your work**. _____ {____}

8. Calculate the change in number of the dark-colored moths per decade. **Show your work**. _____ {____}

9. Using the calculations you conducted in problems 3 - 8, determine when you would expect the number of each type of moth to be the same, and EXPLAIN in 2-3 sentences how you determined this. {____}

10. During the Industrial Revolution, what was the source of energy that England used to power their factories and mills? {____}

11. Describe, in 2-3 sentences, the environmental impact of using the type of fuel you named in question 10. {____}

12. Considering the impact, explain, in 3-4 sentences, how the numbers of light- and dark-colored moths were influenced. {____}

13. 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 and mills. 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. In 4-5 sentences, EXPLAIN the environmental impact of the Clean Air Act, and how this impact influenced the numbers of light- and dark-colored moths {____}

14. Review your answers for questions 10-13 and EXPLAIN, in 2-3 sentences, how natural selection effected the populations of the peppered moth in England. {____}

15. Predict what would happen to the environment and the moth population if factories and mills reverted to using coal for their power, and the Clean Air Acts were eliminated in 4-5 sentences. {____}

16. Brainstorm and then describe another example of natural selection in animals. {____}

****Extra Credit****
Brainstorm and then describe another example of natural selection in plants. {____}

# *ANSWER KEY*

# Lab: Now You See 'em, Now You Don't!

# Natural Selection and the Environment

1. independent variable: year, dependent variable: 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. 15
4. an increase of 3/4 (0.75) per year over 20 years
5. an increase of 7.5 moths per decade over 20 years
6. 15
7. a decrease pf 3/4 per year over 20 years
8. a decrease of 7.5 moths per decade over 20 years
9. You would expect the number of each type of moth to be the same in the 1990s. Explanations will vary.
10. coal
11. more soot in the air, tree bark gets darker
12. dark-colored moths would increase, light-colored moths would decrease
13. less soot in the air, less fallout onto the trees and light-colored moths increase, and dark-colored moths decrease
14. 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.
15. 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*.
16. answers will vary

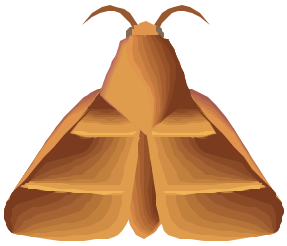
**EC** answers will vary

-Lab adapted from:
(1) Biology with the TI-83 Plus by Jeff Lukens and Bob Tower of Texas Instruments, 2001, Activity 7--Like Moths Around a Flame. 7800 Banner Drive, M/S 3918, Dallas, TX 75251
-Some lab parts directly taken from:
(2) Audesirk, Teresa and Gerald Audesirk. Biology: Life on Earth, 4th ed. Prentice Hall, 1996. pp 316-317.
(3) Mader, Sylvia. Biology. McGraw Hill, 2001. pp 301-303.
-Graphics taken from MS word and MS online

# Now You See 'em, Now You Don't! Natural Selection and the Environment

***Subject:** Honors Biology, 9th grade

***Time:** 1-2 periods (56 minutes each)



***Expected Schoolwide Learning Results (ESLRs):**

- ✓Effective Communicators
- ✓Complex Thinkers
- ✓Self-Directed Learners

***California Science Standards: Grade 9-12**

**Evolution**

7. The frequency of an allele in a gene pool of a population depends on many factors, and may be stable or unstable over time. As a basis for understanding this concept, students will know:

a. Why natural selection acts on phenotypes rather than the genotype of an organism.

d. Variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.

8. Evolution is the result of genetic changes that occur in constantly changing environments. As a basis for understanding this concept, students will know:

a. How natural selection determines the differential survival of groups of organisms.

b. A great diversity of species increases the chance that at least some organisms survive large changes in the environment.

**Investigation and Experimentation**

1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content the other four standards, students should develop their own questions and perform investigations. Students will:

a. Select and use appropriate tools and technology (such as computer linked spread sheet and graphing calculators) to perform tests, collect data, analyze relationships, and display data.

d. Formulate explanations using logic and evidence.

e. Solve scientific problems…

g. Recognize the use and limitations of models and theories as scientific representations of reality.

k. Recognize the cumulative nature of scientific evidence.

l. Analyze situations and solve problems that require combining and applying concepts from more than on area of science.

***Overview**

Natural selection is a process which may result in certain consequences. It utilizes only variations that happen to be provided by genetic changes and is an ongoing process since the environment is always changing. During the 1880s, the Industrial Revolution altered the environment, and the peppered moth population of England was affected. Evolution has been documented by the affect of the changing environment.

## *Purpose

This activity will provide students with evidence of evolution.

## *Objectives

The student will be able to:

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

## *Instruction

I Implement literacy strategies such as "popcorn" activity and reading as a class. To hold students accountable, students will be required to fill in information based upon what they read, what the material stated, and why the material might be important. The worksheet has condensed this to 1. *Say?* What does the reading material state? 2. *Mean?* What does the material mean? and 3. *Matter?* Why does the reading material matter? Additionally, students may not move on to another section of the lab, unless they have placed a check mark into the following symbol: {_✓_}

II Teacher demonstration of the graphing calculator function done on the overhead screen with special screen.

III Students will participate in lab

IV Review of main concepts from lab

## *Check for Understanding

Students will be closely monitored during lab. Questions will be posed throughout the brief lecture, quick teacher demonstration, and extended lab activity; students may respond individually or as a group.

## *Guided Practice

Students will read through reading material and watch the teacher during the graphing calculator demonstration. This includes utilizing schoolwide literacy strategies, programming a graphing calculator, and entering data. These techniques will be practiced by the students during the lab activity.

## *Individual Assessment

Assessment will be evident in the finished lab document (see lab handout pages 1-4). A final assessment will be in the form of an examination.

## *Independent Practice

Students will answer questions following the lab activity.

## *Materials

-Lab worksheet

-graphing calculators (student have their own as required by all La Serna math classes)

-overhead graphing calculator projector (in science stockroom)

## *Safety

None