Name _____ Class _____ Date _____

Skills Practice Lab

MODELING

Melanism in Insects

Natural selection, the reproductive success of organisms best suited to their environment, is a driving force in evolution. Natural selection occurs within *populations*, which are interbreeding groups of individuals of the same species. *Genetic variation*, the alternative types of genes for inherited traits, is one factor in the reproductive success of certain members of a population. The result of natural selection is *adaptation*, the changing of a population in a way that makes it better suited to its environment.

Industrial melanism is the term used to describe the adaptation of a population by the darkening of its individuals in response to industrial pollution. Consider a population of beetles that live on tree trunks. In the absence of pollution, the trunks of trees where these beetles live are light grayish green due to the presence of lichens. The beetles living on these trees are also light-colored and easily camouflaged on the tree trunks. Over time, however, the tree trunks become covered with soot and turn dark. Within a few decades, a dark variety of the beetle becomes more common than the light-colored variety in response to the pollution.

In this lab, you will simulate how successfully predators locate prey in different environments. Then you will relate changes in a population of beetles with two color variations to changes in the environment.

OBJECTIVES

Describe the importance of coloration in avoiding predation.

Relate environmental change to changes in organisms within an ecosystem.

Explain how natural selection causes populations to change.

MATERIALS

- colored pencils (2)
- forceps
- newspaper dots (60)
- sheet of newspaper
- sheet of white paper
- watch or clock with second hand
- white paper dots (60)

Procedure

PART 1: SIMULATING PREDATOR-PREY RELATIONSHIPS

1. Work with a partner, and decide which of you will be the "predator" and which will be the timekeeper.
2. Place a sheet of white paper on your lab table. If you are the timekeeper, scatter 30 white paper dots and 30 newspaper dots on the paper while your partner looks away. The dots represent a bird's prey. If you are the predator, use forceps to pick up as many dots as possible in 15 seconds while your lab partner watches the time. The forceps simulate a bird's beak.

3. Count the number of each type of dots picked up in 15 seconds. Record these numbers in **Table 1.**

TABLE 1 NUMBER OF PAPER DOTS SCATTERED AND RECOVERED

		Total number of dots scattered		Total number of dots picked up		Percent of available prey recovered	
Trial	Back-ground	News-paper	White	Contrasting background	Matching background	Contrasting background	Matching background
1							
2							
3							
4							

- How does the number of each type of dot captured compare with the number of each type of dot remaining on the paper?

_____

_____

_____

4. Replace the white paper with a sheet of newspaper. If you are the timekeeper, scatter 30 white paper dots and 30 newspaper dots on the newspaper. If you are the predator, repeat the hunting procedure while your partner watches the time. Again, record the numbers in **Table 1.**

- How does the number of each type of dot captured compare with the number of each type remaining on the newspaper?

_____

_____

_____

5. Change roles with your partner, and repeat steps 2–4.

PART 2: ANALYZING PREDATOR-PREY RELATIONSHIPS

6. Examine **Table 2,** which represents data from a 10-year study of a population of beetles native to the United States. The numbers represent beetles captured in traps that were located in the same area each year.

TABLE 2 LIGHT BEETLES AND DARK BEETLES CAPTURED

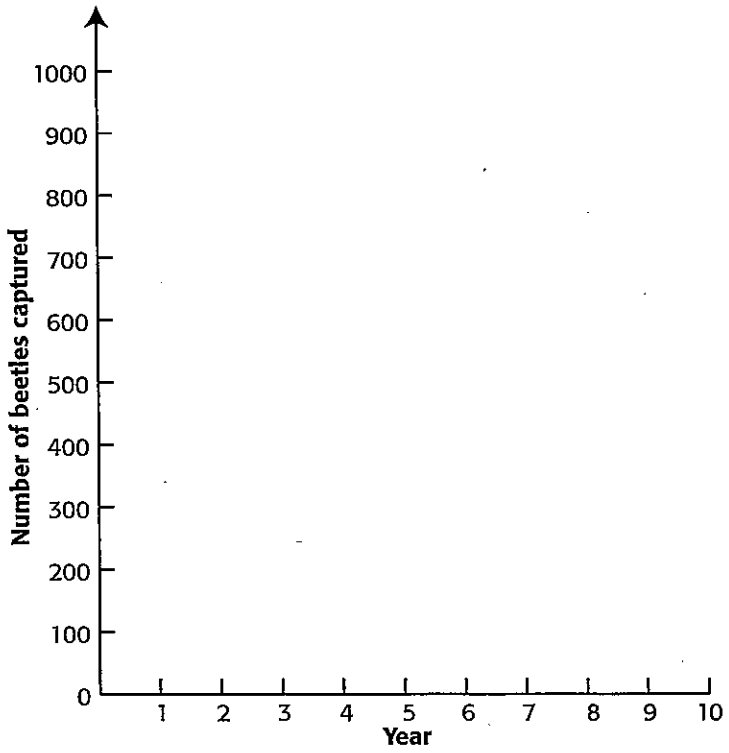
Year	Number of light beetles captured	Number of dark beetles captured
1	710	99
2	590	122
3	502	205
4	405	215
5	255	295
6	225	357
7	202	415
8	151	499
9	85	600
10	59	730

7. Use the data in **Table 2** to construct a graph comparing the number of light beetles captured with the number of dark beetles captured. Construct your graph in **Figure 1.** Use a different colored pencil to differentiate the two forms of beetles. Label the graph curves clearly or make a key.

8. Dispose of your materials according to your teacher's directions.

9. Clean up your work area, and wash your hands before leaving the lab.

FIGURE 1 CHANGE IN COLOR IN A BEETLE POPULATION



Analysis

1. **Analyzing Results** Assume that coloration is not important to successful predation. If you were a predator selecting from a field of an equal number of light prey and dark prey, you would expect to capture an approximately equal number of each color of prey. What did the experiment you conducted in Part 1 indicate?

2. **Analyzing Graphs** Using the graph you made in **Figure 1**, describe what happened in the population of beetles in the sampled area.

3. **Explaining Events** How is industrial melanism in a population of insects different from some students in your class dying their hair?

Conclusions

1. **Drawing Conclusions** From your graph, what conclusions can you make about how genes and evolutionary fitness may have contributed to the changes in the beetle population?

Name _____ Class _____ Date _____

2. **Making Predictions** What effect do you think using cleaner-burning fuels might have on a population of dark-colored insects that live on soot-covered tree trunks?

3. **Making Predictions** Assume that an increase in the dark variety of a population of beetles is an adaptive response to the darkening of tree trunks as a result of pollution. Then, over time, the pollution is reduced and the tree trunks return to their former light color. What would you expect to happen in the beetle population if the tree trunks on which they live became light again?

4. **Applying Conclusions** In the 1940s, DDT was used effectively as an insecticide against mosquitoes. Twenty years after the widespread use of DDT, a large proportion of mosquitoes was resistant to the insecticide. How is the rise of DDT-resistant mosquitoes similar to industrial melanism in beetles living on soot-covered trees?

Extensions

1. **Research and Communications** Use the library or an on-line database to discover other organisms that have shown adaptation by industrial melanism over a short period of time.
2. **Research and Communications** The term *artificial selection* is used to describe the process by which humans change domesticated animals and plants by breeding individuals with desirable characteristics. Use the library or the Internet to discover how the use of pesticides and antibiotics has affected insects and bacteria. Write a paragraph in which you state whether the changes in populations of these organisms can be attributed to natural selection or artificial selection. Be sure to justify your position.