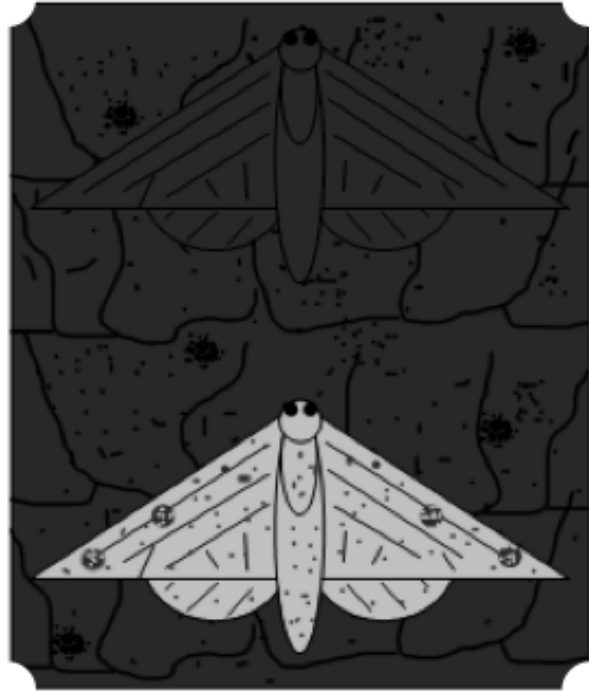
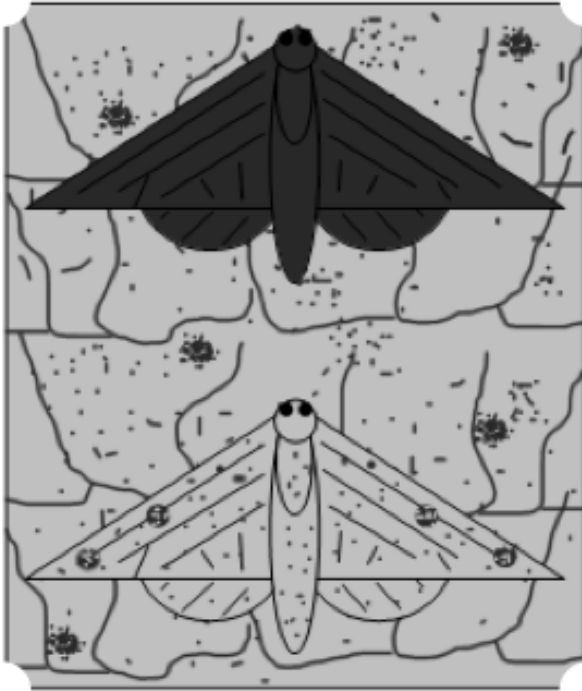


# The Peppered Moth Simulation Activity

Now you see me, now you don't... Natural selection at work!

By Jason Orbaugh



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## Materials Needed:



Standard Hole Punch

+



3 Cups

+



Sponge

+



The Hunter's Tool

## Lesson Objectives:

1. To illustrate the principles of natural selection and population genetics
2. To illustrate how natural selection can produce shifts in allele frequency within a population

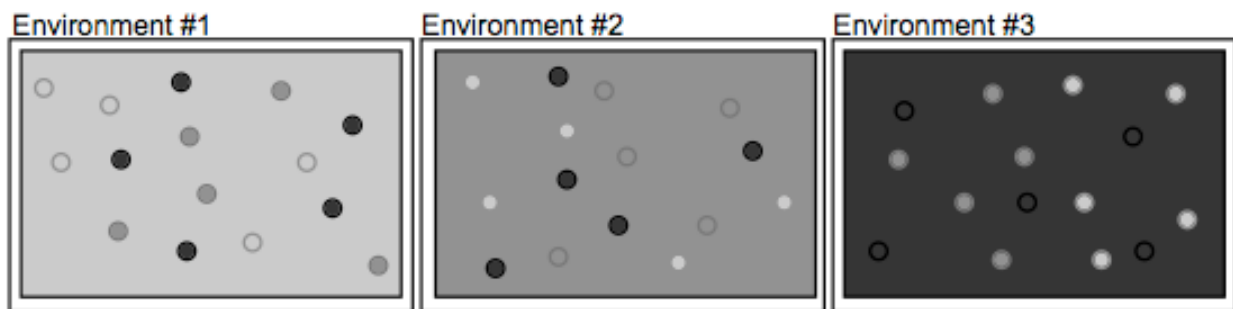
## Teacher Notes:

This activity is NOT intended to recreate the peppered moth example, but rather uses the example of the peppered moth to illustrate the basic principles of population genetics.

This activity introduces three environments (light gray, medium gray, and dark gray) and three moth genotypes resulting in the expression of three moth phenotypes (see the chart below).

Genotype	Phenotype
Homozygous for light gray (gg)	Light Gray
Heterozygous (Gg)	Medium Gray
Homozygous for dark gray (GG)	Dark Gray

For the purpose of this activity, the various colored sheets of paper will represent the changing environment. Paper dots, created by a standard hole punch, will represent the moths and students will represent the birds (predators to the moth).



Each environment will contain 60 moths (20 of each phenotype). The birds should be focused on eating quickly. Communicate to your students that this is a timed exercise and speed is the objective (refer to the additional notes below).

**Let the hunting begin!** Line students up on one side of the room, such that the environments may not be seen or studied for detail. Then, send one student at a time to hunt. Hunting will require the student to moisten their hunting tool (index finger) on a wet sponge. The objective of the hunter is to capture one moth from each of the three environments and drop it into the designated cup (the dot will stick to their moist fingertip). Once students have completed a round of hunting, I recommend telling them that their performance on the first round was too SLOW. It's time to speed it up!

Repeat a second round of hunting with an emphasis on SPEED.

***Additional Notes:***

- 1. Perform the moth hunting exercise before distributing the worksheet below.*
- 2. Do not allow students to observe or study the environments (sheets of paper with various colored dots) prior to hunting. I recommend concealing each environment by placing a second sheet of paper over each one until you are ready to start hunting. The average student, focused on performing the action quickly, may not even notice the color variations.*

Name \_\_\_\_\_  
Period \_\_\_\_\_  
Date \_\_\_\_\_

## Peppered Moth Simulation Activity

Before the year 1845, in the city of Manchester, England a population of light gray colored moths known as Peppered moths lived in the surrounding forests. They would cling to the trunks of trees that were themselves covered with a light gray colored bark. The fact that these moths were able to blend in with this light gray background served as an adaptation, providing protection in the form of camouflage from birds (predators). Due to natural variations within the moth population, as a result of random mutation, multiple color alleles existed. Around 1845 the city started becoming more industrialized, with factories pouring black coal smoke into the air. This pollution fell into the surrounding forests and slowly turned the bark of the trees to a darker gray color thereby making the lighter gray moths more vulnerable to predation. Suddenly the dark gray colored moths possessed an adaptation. As a result, over a period of approximately fifty years the moth population experienced a “shift” in the frequency of the alleles that determine moth coloration. Due to the effects of natural selection, the frequency of the allele for light gray color decreased and the frequency of the allele for dark gray color increased. Natural selection says that those individuals best suited for survival in a specific environment are likely to live longer and reproduced more.

For the purposes of today’s simulation, let us assume that within the population, there are two alleles for the gene that determines moth color. These alleles include light gray (g) and dark gray (G). And, moths that are heterozygous for this allele (Gg) expressed a medium gray phenotype.

### Questions:

1. Define Natural Selection.
2. Define Adaptation.
3. What adaptation did certain moths have that increased their fitness (ability to survive)?
4. What color were the trees around Manchester before 1845? What color did they change to? What caused the change?
5. What color were the majority of the peppered moths before 1845?
6. What caused the first dark gray moths to appear within the population?
7. Was the change in moth color, from light gray to dark gray, a beneficial change for the moth population as a whole? Why or why not?

## Results of the Peppered Moth Demonstration:

<i>Peppered Moth Population</i> (Natural Color Variation)	Environment #1 Manchester (Before 1845) <b>Number of Survivors</b>	Environment # 2 Manchester (25 yrs after 1845) <b>Number of Survivors</b>	Environment # 3 Manchester (50 yrs after 1845) <b>Number of Survivors</b>
<i>Light Gray Moths</i> (gg)			
<i>Medium Gray Moths</i> (Gg)			
<i>Dark Gray Moths</i> (GG)			

Note: Each environment started with 20 moths of each color. **Number of survivors = 20 - Number Eaten**

8. Which moths seem to have the greatest fitness for environment #1? Why?
9. Which moths seem to have the lowest fitness for environment #1? Why?
10. Which moths seem to have the greatest fitness for environment #2? Why?
11. Which moths seem to have the greatest fitness for environment #3? Why?
12. What do you think would happen to the peppered moth population if after the industrial revolution the trees changed back to their original light gray colored bark?
13. Now, thinking outside of this example, is appearance the only characteristic that determines whether an individual plant or animal is suited to its environment? If so, explain. If not, please give an example of another characteristic(s) (adaptation) that could increase an organism's chances of survival.
14. In your opinion, is natural variation within a population beneficial to the long-term survival of a population (or species) as a whole? Please explain, why or why not.

Environment #1

Environment #2

Environment #3

### **Light Gray Moths (gg)**

#### **Instructions:**

Using a standard hole punch, place 20 light gray moths on each of the three environments.



### **Medium Gray Moths (Gg)**

#### **Instructions:**

Using a standard hole punch, place 20 medium gray moths on each of the three environments.

### **Dark Gray Moths (GG)**

#### **Instructions:**

Using a standard hole punch, place 20 dark gray moths on each of the three environments.