



Natural Selection Student Handout

Name _____

Natural Selection Introduction (Fill in the Blanks!)

Have you ever wondered why giraffes have long necks or why dogs have such a good sense of smell? Animals tend to have traits that are well suited to their natural environments and give them a better chance to _____ and _____. The giraffe's _____ allows it to reach fruit in tall trees, and having a good nose means the dog can track down _____ from a great distance.

But, how do such favorable traits become common in animal populations? The answer is through _____. Favorable traits, like having a long neck for a giraffe, make the organism more likely to _____ and _____. Over time, these traits become more common in the population. In other words, the organism's environment *selects* for these _____.

A classic example of natural selection is the case of the peppered moth, made famous by the British scientist, Bernard Kettlewell. Peppered moths have two common varieties: dark-colored and light-colored. Kettlewell knew that dark-colored moths were more common in polluted industrial areas than in rural areas. Light-colored moths, however, were more common in the _____ areas. He _____ that dark moths were best suited to the polluted environment because they were able to blend in better to the darkened vegetation and avoid _____. By contrast, he thought that these dark moths were more likely to be seen by _____ in the clean, rural environment. To investigate, Kettlewell released a mixed group of light and dark-colored moths into each of these areas. He observed that _____ moths indeed survived best in the rural area and _____ moths survived better in the polluted area. Kettlewell had demonstrated _____ in action!

For today's activity, you will play the part of the predator by trying to 'eat' as many moths as possible in light and dark environments to simulate Kettlewell's results. You'll take it one more step for the second half of the activity by using chopsticks to prey on mixed colored frogs in a variety of environments to see how an environment *selects* for certain colors of frogs.



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Concept Check: For each of the environments below, list one trait that would be favored by natural selection and one that would be selected against.

Environment	Traits that would be selected for	Traits that would be selected against
Freshwater Pond		
Tundra (very cold, no trees)		
Amazon Rainforest		

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Activity: Natural Selection in Action

Peppered Moth Simulation Methods/Protocol:

Set up: Place the black paper in the center of your group. This represents a tree in a polluted environment. Empty all of the black and white circles from the Ziploc bag onto the black paper. The black circles represent the black version of the peppered moth, and the white circles represent the white version of the peppered moth.

Begin: Birds eat peppered moths. In this simulation, you will be the bird. You will have 10 seconds to pick up as many “moths” as you can and put them into a pile in front of you. You may use only your thumb and pointer finger from one hand (to simulate a bird’s beak). When time is up, count how many “moths” of each color you got. Record the results from everyone in your group in the table.

Peppered Moth Simulation in POLLUTED Environment			
Group Member	White “moths” eaten	Black “moths” eaten	Total “moths” eaten
Name 1:			
Name 2:			
Name 3:			
TOTAL NUMBER OF MOTHS EATEN (add up the numbers from each column)			
PERCENTAGE OF EACH TYPE OF MOTH EATEN (divide the number eaten of each type by the total number of moths eaten)			



Set up: Place the white paper in the center of your group. This represents a tree in a clean environment. Now put all of the black and white circles onto the white paper.

Begin: Repeat what you did last time. You have 10 seconds to collect as many “moths” as you can.

Peppered Moth Simulation in CLEAN Environment			
Group Member	White “moths” eaten	Black “moths” eaten	Total “moths” eaten
Name 1:			
Name 2:			
Name 3:			
TOTAL NUMBER OF MOTHS EATEN (add up the numbers from each column)			
PERCENTAGE OF EACH TYPE OF MOTH EATEN (divide the number eaten of each type by the total number of moths eaten)			



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Peppered Moth Simulation Analysis:

1. In the polluted environment (which caused the trees to be black) which color moth survived better in your simulation?

2. Why do you think that color of moth survived better?



3. In the clean environment (which caused the trees to be covered in white lichen) which moth survived better?

4. In the clean environment, which color moth will increase in frequency in the next generation due to natural selection?

5. Color in peppered moths is similar to eye color in humans. In humans, the “b” form of the eye color gene causes blue eyes. The “B” form of the gene causes brown eyes. Humans have 2 copies of each gene, one from each parent. If you are “bb” (you got a “b” from mom and a “b” from dad), you have blue eyes. If you are “BB,” you have brown eyes. The “B” brown copy is dominant (shown by the capital letter), meaning you only need one to have brown eyes. So if you are “Bb,” you have brown eyes.

In peppered moths, “m” causes white color and “M” causes black color. What color would each of the following individuals be?

mm:

MM:

Mm:

6. Scientists have researched actual populations of peppered moths. In the 1800s, most peppered moths found in England were white, and lived in forests where trees were covered in white lichen. Over the next hundred years, the black form of the moth became more and more common in the forests near big cities. What do you think might have caused the black form to become more common? (Hint: what do you think was happening to the trees, and why?)

7. In the 1950s, a scientist named H.B.D. Kettlewell investigated to see if natural selection was directing this increase in black moths. He put the same number of black and white moths in a polluted forest, and also in a clean forest. He counted the number of each type that got eaten by birds (just like you simulated in your experiment). Below are his results:

Kettlewell's Actual Results		
	Number of White form eaten by birds	Number of Black form eaten by birds
Clean woods	26	164
Polluted woods	43	15

a) Is natural selection acting on the color gene?

b) Does your data support or contradict Kettlewell's data?

8. In 1950, 90% of all peppered moths were black. England passed several important laws in the 1950s. In 2010, only 30% of peppered moths were black. What type of laws do you think England passed that might account for the decrease in the black form of peppered moths (and the increase in the white form)?

9. If the “M” allele was lost in the peppered moth population (all individuals were “mm”), what might happen to the population if the environment becomes polluted again?



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Natural Selection: Synthesis

10. Describe how variation in traits gives populations an advantage for survival.

11. Wolves have genes that give them a very powerful sense of smell (much more powerful than humans). This is an adaptation that was favored by natural selection (wolves with a better sense of smell survived longer and reproduced more offspring—who also got the genes for a better sense of smell—thereby increasing the frequency of those genes in the population). Give an example of TWO more adaptations in other organisms that may have resulted from variations that were favored by natural selection. (Think of new examples—not ones we've already talked about today.)

12. Cheetahs are very inbred. Because of this, they have very high levels of genetic homogeneity, to the point where they are almost all genetically identical. Why does this put cheetahs at a very high risk of extinction?

13. There is a population of bears with thick fur and thin fur. In cold weather, bears with thin fur do not survive as long because they freeze. In warm weather, bears with thick fur don't do as well because they overheat.

a) In a very cold climate, which type of bear will natural selection favor: bears with thick fur or thin fur?

b) Why did you make that prediction?

c) If the climate gets very hot due to global warming, which type of bear will natural selection favor: thick or thin fur?

d) Why did you make that prediction?

e) A disease kills all of the bears with thin fur in the population. Over the next 50 years, the climate gets significantly hotter due to global warming. The polar bear population goes extinct. Why might this polar bear species have been unable to survive?