Student Name: ______________________

Simulating Evolution: Light and Dark Vipers

NOTE: The details in this activity are simplified and the time period is shortened, but the scenario is realistic. There are populations of snakes that show patterned and dark individuals and scientists suspect that the reasons are much like those described here. The viper in this activity is based on a small species in Europe *(Vipera berus)* that has dark individuals in some populations.

The Story

The story begins with a type of small viper that was widely distributed across a continent. These vipers were usually light brown in color with a slightly darker pattern that camouflaged them well. However, not all were light in color. Now and then, a genetic variation occurred that caused a baby viper to be born completely dark. Some of these babies survived and had babies of their own, passing on the gene for dark color. So there were always some dark vipers around, but not many. The reason there were so few dark snakes is that they were easier for predators to see (no camouflage) and most of them were eaten before they reached adulthood and could reproduce.

Things remained like this for many centuries and then something important happened. In one area of the continent—one small mountain range—the climate began to get slightly cooler. Over a period of about 150 years, average temperatures in those mountains dropped several degrees. This made it tougher for the vipers to survive. Being cold-blooded, they depended on warm weather and warm sun to raise their body temperatures enough for them to hunt, digest food, etc.

Now the dark snakes began to have an advantage over the light ones! The dark ones could warm up more quickly in the sun, which meant they spent less time basking, exposed to the view of predators. They were generally healthier, grew faster, got larger, survived longer, and as a result had more babies than the lighter snakes. This lab will show you the eventual result of dark vipers out-reproducing the light ones.

Data Table and Graph

1. To keep this simple, we will assume three things: (1) the population of vipers on the small mountain range remained 1000 snakes at all times, (2) we had 950 light ones and 50 dark ones to start (year zero), and (3) every ten years, the number of light vipers fell to 75% its previous value (25% less than the decade before).

2. On a sheet of notebook paper, use a ruler to make a neat data table with three columns. Put these titles at the top of the columns: **"Year," "Number of Light Vipers,"** and **"Number of Dark Vipers."**

3. In the first column ("Year") list the years by tens. Start with zero and count by tens to 150 (0, 10, 20, 30 … 150).

4. In the second column ("Number of Light Vipers"), put 950 at year 0. This is the number of light vipers on the mountain when our scenario began. Now use a calculator to enter the other numbers. Each one must be only 75% of the number above it. The easiest way to start is to multiply 950 by 0.75 and then round the answer (712.5) to the nearest whole number (713). Enter 713 at year 10, below 950. Now do the same thing with 713 (713 x 0.75; round the answer to the nearest whole number) and continue until the column is full at year 150.

5. In the third column ("Number of Dark Vipers"), enter 50 at year 0 (since the total number of vipers is always 1000 and 950 of them are light in year zero). Continue filling in the column by subtracting the number of light vipers from 1000. (For example, 1000 – 713 = 287, so 287 goes below 50 at year 10.)

6. **Show your teacher the numbers in your data table before you do anything else.**

7. On a sheet of graph paper, use a ruler to set up a large graph. Label the horizontal (x) axis, "Years," put 0 at the axis and number across by tens (10 through 150 from your data table). Label the vertical (y) axis, "Number of Vipers," put 0 at the axis and label the lines upward by tens from 50 to 1000, going up by 50s (50, 100, 150…).

8. On this graph, now plot two lines, one line for light vipers and one for dark. Use the ruler to connect the data points. Clearly label each line ("light vipers"…"dark vipers"). Ask your teacher for help if you need it.

9. Answer the questions below, then staple your data table and graph to the back of this sheet and turn them in.

Notes and Questions

Use this word bank to fill in the blanks below. A word may be used more than once or not at all.

yes	**reproduce**	**adaptation**	**population**
no	**seen**	**larger**	**populations**

1. These vipers did not change much! This kind of *small* change, producing only a new variety of the same kind of creature, is called __________. **Today, with what we know about genetics, people with various views on origins agree this happens in nature. The "evolution debate" is about whether ______ scale evolution also happens.** This is the development of a radically different kind of creature, like the first birds developing from small dinosaurs, perhaps due to many, many, many small changes accumulating over time.

2. Did any *individual viper* turn from light to dark? _____ What turned from light to dark was the ___________. This point is very important. *No one*, not even the most convinced evolutionist, claims that *individual* creatures morph into something new. **Evolution of any kind is not about individuals changing but about ____________ changing.** With that in mind, is a tadpole changing into a frog an example of evolution? ______ How about a caterpillar changing into a butterfly? ______

3. The viper lab simulates *natural selection* at work. **Natural selection is when one group of creatures (the dark vipers) has some advantage that lets them out-reproduce the others, so this advantage (dark color) eventually spreads through the entire population.** Natural selection is often called "survival of the fittest" because creatures that survive longer generally reproduce more. Our viper population eventually became dark because snakes with the dark color could __________ more than the light ones.

4. Notice that vipers elsewhere on the continent remained light in color. The fact that conditions (cooler climate) resulted in one ___________ evolving darker color did not mean light vipers disappeared from other populations.

5. In summary: **If some trait (dark color in this case) allows certain individuals to ___________ more than others, the population will eventually become like them, because the population will made up of be their descendants. This is called natural selection.** One reason for wide acceptance of natural selection is that scientists are confident they have _______ it happen: populations of insect pests become resistant to pesticides; populations of bacteria become resistant to antibiotics. People with various views of origins are aware of and accept these processes.