**Introduction:**

EvoDots is a computer program that lets you explore evolution by natural selection in a population of dots. You will act as a predator by clicking on and “eating” the dots, which are your prey. Make sure to follow the directions. All the italic questions must be answered on this handout. Make sure to answer your questions in complete sentences and in such a way as you know what the question was.

**Pre-Lab Questions:**

Below is a screen-shot of the evodots program. The dots, which are your “prey,” are different colors and each color of dot moves at a different speed from the others.

1. What is the source of “genetic variability?” What trait will affect how easily a dot will be “eaten?”

2. What are the variants of this trait / the possible phenotypes?

The trait we are looking at today is controlled by a single gene.

3. What must be true about the number of alleles for this gene?

4. What is another word for “several alleles for the same trait?”

5. How did these alleles originally arise in the dot population?
To launch the program:
1. Log in to the computer
2. Go to Google and enter “Evodots”
3. Click on the first link “Evodots”
4. Scroll down to “Download Evodots 1.1” and click on “Uncompressed Windows Application”
5. Click on the Run button, which will launch the program
6. Click on the introduction screen to make it disappear. Now you are ready to use the program

Program Tutorial:
1. Once you open the program, you will see the EvoDots window containing three white areas, three buttons, and three check boxes. Look to make sure that all three check boxes are checked.
2. Click on the New Population button. This creates a new population of 50 dots, scattered at random across the white area on the left.
3. The white area on the upper right now contains a histogram (bar graph) showing how many dots of each color there are in your population.
4. This is not a game. You are a predator on the dots – this means you want to eat as many dots in as little time as possible! When you click on the Run button, the dots will start to move around.
5. To “eat” the dots, you will click on a dot and it will disappear. As you kill dots, the number remaining will drop.
6. When you are done with the simulation, you will make your population reproduce by pressing the Reproduction button.

Procedure

Experiment 1: Natural Selection on Dots Relative to their Speed
1. Generate a hypothesis about what you expect will happen to the distribution of dots over five generations.
   ⇝ Answer this question on the ANSWER SHEET: What change will you see in the distribution of dot speed over five generations and why?
2. Click on the “New Population” button.
3. Click the “Run” button, eat 25 dots as fast as you can (number remaining will be 25), then click on the Stop button.
4. Look at the two histograms to the right of the population. The top histogram is of the beginning population and the bottom histogram is the population of survivors.
   ⇝ Answer this question on the ANSWER SHEET: Has the number of each speed (color) of dots changed? Explain how.
5. Now click on the “Reproduce” button. Because the heritable button is checked, the mother dot passes her traits on to the daughter dots (both color and speed).

6. Click on the Run button again, and eat 25 more dots as fast as you can. Again, compare the survivors to the starting population.

7. Continue for three more rounds of reproduction and predation and take note of the results. By clicking on the triangle in the top right corner you can see the history window, which will further help you examine the trends.

8. At the end of the 5 generations describe your results.

   Answer this question on the ANSWER SHEET: Were there changes in the numbers of each dot speed over 5 generations? Did these changes support your hypothesis? Has evolution occurred in your dots population? How do you know?

Experiment 2: Evolution relative to dot size OR dot visibility

1. Go to File/Options at the top left of the program. Pick either dot size or visibility. This will change the trait that is variable for your dots.

2. Make another hypothesis addressing this new trait.

   Answer this question on the ANSWER SHEET: What change will you see in the number of dot (size or visibility) over five generations and why?

3. Run your experiment for 5 generations and describe your results.

   Answer this question on the ANSWER SHEET: Were there changes in the numbers of dot size or visibility over 5 generations? Did these changes support your hypothesis? Has evolution occurred in your dots population? How do you know? Can natural selection act on multiple traits? Explain

Conditions for Natural Selection:

Charles Darwin identified natural selection as the mechanism accounting for adaptive evolution. Darwin’s theory of evolution by natural selection works under the following conditions:

1. There must be a big, diverse population

   a. Another term for this is genetic variation. When talking about variation we often refer to traits (things like different eye colors, or arm lengths, or brain sizes).

   b. If there are lots of different traits within a population then we say it is diverse.

   Answer this question on the ANSWER SHEET: What was the source of diversity in your first evodots program?
2. There must be an **environmental pressure** or **selection factor**
   a. This is something in the environment that makes it harder for some organisms with certain trait(s) to survive than others.
   b. The selection factor cannot be random. This means that a predator or other environmental factor kills some organisms more easily than others because of a difference in traits

   ⇢ **Answer this question on the ANSWER SHEET:** What was the selection factor in your program introduction? What trait was it selecting against (killing most easily)? What was it selecting for (allowing to survive most easily)?

3. The traits that are selected for must be **heritable**
   a. This means that the trait that allowed a parent to survive is passed on to future generations
   b. The only way for a trait to be heritable is if it is coded for in the DNA of a parent’s egg or sperm

   ⇢ **Answer this question on the ANSWER SHEET:** Was the trait that was selected for heritable in this experiment? Explain.

4. Lots of **time** must elapse
   a. To see a change in the average traits of an population, many generations must be born
   b. For some organisms this may only take several days (bacteria) and for others it may takes hundreds or thousands of years

   ⇢ **Answer this question on the ANSWER SHEET:** What did we do to mimic time in this experiment? Did enough “time” elapse for you to see a marked change in the average traits of your dot population?

**Experiment 3: Testing Needed Evolutionary Conditions**

1. Recall that we made sure the three boxes “variable” “heritable” and “selective” were checked. In this experiment you will uncheck one of the boxes.

   ⇢ **Answer this question on the ANSWER SHEET:** State which box you deselected and describe how will this affect the results of your experiment? Specifically, will you expect to see changes in the numbers of dots with each phenotype for trait you have chosen after 5 generation of selection? Explain why or why not.

2. Run your experiment for 5 generation of selection.

   ⇢ **Answer this question on the ANSWER SHEET:** Were there differences in the numbers of each phenotype over 5 generations? Did these differences support your hypothesis? Has evolution occurred in your dots population? How do you know?