

Lab: Modeling Evolution

(modified from Addison-Wesley Publishing)

Background: Ecosystems are constantly changing. Only a certain number of individuals from a given species can live in one habitat because resources such as food, water, space and air are limited. A change in the environment may threaten the life of an individual unless it has a trait that enables it to adapt to the environmental change. Such a trait may give an individual a better chance of survival and reproduce than similar individuals that do not possess that trait. The genes for the trait will be passed to the next generation or organisms and the trait may then become more frequent in the population over time. This process of natural selection, proposed by English naturalists Charles Darwin and Alfred Wallace in 1858, is one process that influences evolution, the change in a population of organisms through time.

Darwin and Wallace were not the first people to propose an explanation for the changes in species through time. Jean Baptiste de Lamarck (1744-1829)

argues that the earth was very old and had undergone gradual changes over time. Organisms had to change in their lifetime to better cope with their environment. Organisms that acquired these adaptations passed them on to their offspring, and gradually the species as a whole changed. Lamarck's ideas were inaccurate; changes acquired in one's lifetime cannot be passed on to the next generation. Lamarck and Darwin were missing a piece of the puzzle; it was not until the discovery of the principles of inheritance (genetics) and the source of new variants in a population (mutations) that evolution was truly understood.

Mutations are random. They cause changes in proteins that control cellular function and make up cell structures. Mutations are usually harmful or neutral; they very rarely give an individual an advantage over other individuals in a population. In natural selection, certain individuals of a population that possess a unique trait are more successful than the rest of the population in passing on their genes. Natural selection requires variation in a population upon which to operate. One way this variation is provided is by mutations.

Pre-lab Questions:

1. Relate genes, traits and environmental change.
2. Explain the difference between the conclusions of Darwin and Lamarck.
3. How do mutations play a role in natural selection?



Darwin's Finches by Joanna Barnum

Procedure:

- a. Verify that you have the following instructions in your paper bag.
- | | | | |
|--------------------------|--------------------------|----------------------------|---------------------------|
| <i>one left</i> | <i>one right</i> | <i>one up</i> | <i>one down</i> |
| <i>two left</i> | <i>two right</i> | <i>two up</i> | <i>two down</i> |
| <i>diagonal right up</i> | <i>diagonal left up</i> | <i>diagonal right down</i> | <i>diagonal left down</i> |
| <i>repeat last step</i> | <i>reverse last step</i> | <i>no change</i> | <i>no change</i> |
- b. Fill in the center square of your graph paper. This square will be your starting point
- c. Shake the instructions in the bag and, without looking, select one and read it aloud.
- d. Everyone else at your table should follow that instruction and fill in the appropriate square. Instructions should always originate from the last square colored. It is very important that the person who selects the instruction does not follow the instruction – this is the mutation. When complete, place the instruction back in the bag so that it may be selected again.
- e. Rotating clockwise around your group. The next person should repeat the process until your group has selected a total of 20 instructions.
- f. You have now created your genetic code for generation one. Mr. Rush/Ms. Magee will now apply a selective pressure to the group by which your traits will determine your ability to pass your genes on to the next generation.
- g. If you have died or failed to pass on your genes in the first generation, your life in this lab has ended. Select someone at your table to be your parent and copy their genetic code in order to be reborn into the next generation.
- h. Repeat steps c through g for three generations.

Analysis:

4. Describe your organism and name the three traits that were selected for in this lab.
5. Did you survive all three generations? Why or why not?
6. How are mutations represented in this lab?
7. How are traits represented in this lab?
8. Were you in control of your genetic code? Explain why this was necessary.
9. How were the selective pressures and selected traits related to the process of natural selection?
10. How are mutations within individuals related to the evolution of a species?