Lab 2 — Evolution & Natural Selection

What you will be provided:

Backgrounds and paper "prey" disks
Forceps
Counters

Objectives:

- Understand the primary mechanism producing adaptive evolutionary change.
- Understand that although mutation is random, selection is not.

Natural Selection

One of Charles Darwin's most important contributions was proposing a mechanism for producing evolutionary change. Darwin noted that all animals can produce far more offspring than can be supported in an environment with limited resources, so there must be a "struggle for existence" as organisms compete for resources. Given that not all individuals in a population are alike, some individuals likely have characteristics that make the more successful at surviving or reproducing, that is, they are more "fit." This "survival of the fittest" is the essence of **Natural Selection** and a cornerstone to understanding evolution.

Evolution by Natural Selection requires four conditions:

- More individuals are produced than can be supported by the environment. This is a universal characteristic of all life if conditions are suitable for that organism.
- There must be variation within the population. The source of the variation is mutation, a random process (the mutations that are produced are independent of an organism's needs, and indeed, most are deleterious).
- Some of the variation must lead to differences in the ability to survive and reproduce. In other words, the environment affects the abilities of individuals to survive and reproduce
- The variations must be heritable, resulting in an evolutionary change *in the population* in the next generation.

Traits that are produced by natural selection are called **adaptations**. Adaptations are traits that were beneficial to an organism's ancestors, and usually are still beneficial to that organism. Although other mechanisms (such as genetic drift) can also produce evolutionary change, they do not produce adaptations.

In this exercise, we want to reinforce the concept with a demonstration of how natural selection works. It is far too time-consuming to observe natural selection at work in natural populations, so we will use artificial populations consisting of paper chips. We will simulate natural selection for several generations.

Procedure

1. You will work in groups of 3-4 students.
2. The environment will be simulated using pieces of multicolored fabric that reflects the complexity of many real environments. Each group should fully spread one such piece of fabric flat on their lab bench.
3. The "prey" are small disks of colored paper. The prey species is quite variable in color. Each group should obtain 4 containers of prey, each of a different color.
4. Count out 25 prey items from each color (thus 100 items total) and mix them together.
5. One person, the **distributor**, should be selected to randomly disperse the prey by spreading them out on the colored fabric background. Make sure they do not stick together. While this is being done, the other students that are to be predators should have their backs turned and not be watching.
6. One at a time, the **predator** students (other than the distributer) in the group should turn around and use forceps to pick up *the first prey that they see*. Move the prey disk to the discard area or cup while following it with your eyes so you do not search for additional prey. While the first student is preying on the disks, the other students should keep their backs turned.
7. Students should then take turns each capturing a prey disk while the other predators have their backs turned (this reduces the chance of studying the environment and locating prey beforehand).
8. The distributor should keep count of the number of prey of each type being captured.
9. Continue alternating to capture prey as quickly as you can until your group has captured 75 prey (i.e., 25% are left alive). ***Count carefully***!
10. You will need to allow the surviving prey to reproduce so you don't drive them to extinction. Color pattern is heritable, so each prey disk will produce three additional offspring that are the same color as the parent (these prey reproduce asexually).
11. Carefully shake off your fabric to remove the survivors: you should have 25 left. For each chip that survived, add 3 more of the same color from the reserve supply. You should once again have 100 prey chips.
12. Redistribute these chips on the fabric background as you did in Step 5, and prey on them as you did in Steps 6-9. Repeat the entire process for 3 generations.
13. For the last (4th) generation, you will model a change in the environment by using a different colored fabric background. Repeat the distribution of prey chips based on the number of survivors from the 3rd generation and prey on them as you did previously.
14. Record the results and answer the questions on the worksheet for this lab.