

Instructions

For this activity, you will examine how evolutionary forces affect allele frequencies and fitness in populations using a browser-based software called **evolfoRces**, which is linked from the class website. In evolfoRces, you can evolve a population which has a single gene controlled by two alleles, **A** and **a** ("big A" and "little a"). Please refer to the "About and Help" tab for a description of what each tab does.

The goal of this activity is to understand how different evolutionary forces affect allele frequencies and population fitness over time. For any simulation, allele A's frequency will either change over time, or it won't change over time. Here are some options for what can happen:

1. **Allele A will fix in the population.** This means allele a is lost from the population.
2. **Allele A will be lost from the population.** This means allele A fixes in the population.
3. **Allele frequencies will reach a stable equilibrium over time**, i.e. allele frequencies will not change, but NOTHING fixes or is lost. This means evolution is not occurring (but, as we will see, there are many different ways to achieve equilibrium some of which involve a "balance" between evolutionary forces!).
4. **Allele frequencies will not reach a stable equilibrium over time**, i.e. evolution will be ongoing and allele frequencies will continue changing, i.e. the population continues to evolve. This can happen either when fixation/equilibrium will occur but requires more generations, or fixation/equilibrium will not occur and the population will "forever" remain unstable.
 - a. ***HINT!!!*** *To check if a population has reached equilibrium, re-run the simulation with fewer/more generations and see if results are consistent. If consistent, population has reached equilibrium. "Storing results" is very helpful for this!!*

There are several pieces of information which we can observe from population simulations that help us to further understand how alleles change in frequency over time, including:

- If fixation occurs, how many generations did it take?
- If fixation does not occur, does the population reach an equilibrium or continue to evolve?
- What is the effect of the starting allele A frequency?
- How do different scenarios influence population variation, as measured by heterozygosity?
- How do different scenarios influence population mean population fitness?

Part 1: Natural selection ("Single Population" Tab)

- 250 generations
- Mutation rates set to 0
- Genetic drift turned OFF
- Choose your favorite color!

Starting Allele A frequency	W(AA)	W(Aa)	W(aa)	Mode of selection	Strength of selection	Result after sim: <ul style="list-style-type: none"> • "A" Fixation • "A" Loss • Equilibrium • No equilibrium 	Fixation/loss generation, if ever	"Before" fitness	"After" fitness	"Before" heterozygosity	"After" heterozygosity
0.5	1	0.9	0.8		Moderate						
0.2	1	0.9	0.8		Moderate						
0.8	1	0.9	0.8		Moderate						
0.5	1	0.6	0.2		Strong						
0.5	1	0.99	0.98		Weak						
0.5	0.85	1.0	0.85		Moderate						
0.2	0.85	1.0	0.85		Moderate						
0.8	0.85	1.0	0.85		Moderate						
0.5	0.6	1.0	0.6		Strong						
0.5	0.98	1.0	0.98		Weak						

Based on your table, answer the following questions:

1. How does natural selection influence fitness in populations? Consider this for *each mode*, and then determine whether the answer is the same or different for different modes of selection.
2. How does natural selection influence variation (heterozygosity) in populations? Consider this for *each mode*, and then determine whether the answer is the same or different for different modes of selection.
3. Under which circumstances (i.e., MODE and STRENGTH of selection) did allele "A" fix? Under which circumstances did allele "a" fix?

4. Consider **directional selection only**:

a. What is the effect of **starting allele "A" frequency** on a) whether fixation occurred, and b) if so, the time to fixation?

b. What is the effect of **strength of selection** on a) whether fixation occurred, and b) if so, the time to fixation?

5. Consider **balancing selection only**:

a. What is the effect of **starting allele "A" frequency** on a) whether fixation occurred, and b) if so, the time to fixation?

b. What is the effect of **strength of selection** on a) whether fixation occurred, and b) if so, the time to fixation?