

Introduction to Natural Selection

Learning objective 7.1.A Describe the causes of natural selection, and 7.1.B explain how natural selection affects populations.

Name: _____

Date: _____

Period: _____

Use the tool **Who Leaves the Most Offspring**. Parts 1 and 2 use **Run it**, Parts 3 and 4 use **Survival or offspring?**, and Part 5 uses **When the environment changes**. Natural selection is the idea in this course you have heard explained most often. The point of this worksheet is to stop explaining it and start counting: give a population an advantage, run the generations, and read what comes out.

Part 1 • Run the model

A new variant starts at **10%** of the population. Set each advantage in turn and record what happens over **50** generations.

Advantage per generation	Frequency at generation 50	Generations to reach 95%	Did it ever fall?
5%			
10%			
25%			
50%			
100%			

1. State the three conditions natural selection requires.

2. A 5% advantage means the variant leaves five more offspring per hundred than the alternative — far too small to notice in any one generation. Using your table, explain whether that is enough.

Part 2 · What is actually changing

Look at the curve on **Run it** and answer without the tool. These questions are about what the graph does and does not show.

3. The curve is an S rather than a straight line. Explain why the variant spreads slowly at first, then quickly, then slowly again.

4. Explain why it is wrong to say that an individual organism in this population evolved.

5. Competition for limited resources is doing the work in this model. Explain how competition leads to a change in the proportions of a population.

Part 3 · Testing “survival of the fittest”

Switch to **Survival or offspring?** Before you look at the answer for each case, write down which variant you expect to take over. Then record what happens.

Case	Survives better	More offspring	Your prediction	Actually takes over
Case 1				
Case 2				
Case 3				
Case 4				

6. Define evolutionary fitness, and state how it is calculated in this model.

7. In two of the four cases, the variant that survives better is the one that disappears. Explain how that is possible.

Part 4 · Breaking it on purpose

Open the section **The three things selection needs, removed one at a time**. Record what happens to the allele frequency when each requirement is taken away.

Requirement removed	What that means in practice	Frequency after 50 generations	Did anything change?
Variation			
Heritability			
Differential reproduction			

8. All three broken runs give the same result. State what that result is, and explain what it tells you about how the three requirements relate to one another.

9. A population has heritable variation and differential reproduction, but the trait under selection turns out not to be heritable after all. Predict what happens over 100 generations, and justify your prediction.

Part 5 · When the environment changes its mind

Go to **When the environment changes**. Compare the two runs, then record what the fluctuating one does in each spell.

Generations	Environment	Which variant it favors	Frequency at the end of the spell
0-12			
12-24			
24-36			
36-48			

10. An allele rises for twelve generations and then begins to fall, although nothing about the allele has changed. Explain what must have happened.

11. In the constant environment the allele reaches 100% and stays there. In the fluctuating one it never gets above 94%. Explain why a fluctuating environment preserves variation that a constant one destroys.

12. Explain why natural selection cannot be said to be working toward anything.

What the model simplifies

The population is treated as haploid, with one allele per individual, so the arithmetic stays visible. Real diploid populations hide recessive alleles in heterozygotes, which changes how quickly selection can remove them — Topic 7.2 takes that up.

The population is treated as infinitely large, so frequencies change exactly as the fitnesses dictate. Real populations are finite and chance plays a part, sometimes a decisive one; Topic 7.4 puts numbers on that.

Fitness is a single number that does not change as the variant becomes common. In real populations fitness is often frequency-dependent — a variant can be advantageous while rare and disadvantageous once it is everywhere — which is another way variation is preserved.

Survival and offspring number are the only two components of fitness here. Real reproductive success also depends on age at first reproduction, mating success, and whether the offspring themselves survive to breed.

The environments are drawn from the peppered moth, a real and well-documented case, but the fitness values are illustrative round numbers chosen so the arithmetic can be followed rather than measurements taken from a particular study.