What Is Natural Selection?

Worksheet

Natural selection is differential survival and reproduction based on heritable traits: individuals with advantageous traits pass more copies of their genes to the next generation, driving evolutionary adaptation.

Allele frequency change: $p_t = \frac{p_0(1-s)}{1 - s\cdot p_0}$

Questions

1. Which is required for natural selection to occur?

A) Identical traits in all individuals
B) Heritable variation in traits
C) Constant population size
D) Random mating only

2. What does a selection coefficient (s) close to 0 mean?

A) Strong selection against the allele
B) Almost no fitness difference
C) The allele is lethal
D) The allele frequency is 0

3. 'Survival of the fittest' most accurately means

A) Only the physically strongest survive
B) Those best suited to reproduce leave more offspring
C) All individuals have equal reproductive success
D) Fitness is fixed for a species forever

4. Natural selection directly changes what, generation to generation?

A) Individual organisms' DNA during their lifetime
B) Allele frequencies in a population
C) The number of chromosomes
D) Mutation rate

5. In a beetle population, the color allele frequency is p = 0.2 with a selection coefficient s = 0.3 favoring it. Find the frequency in the next generation.

6. A population of 1,000 birds has 40 individuals carrying a beneficial beak-shape allele (p = 0.04). With s = 0.5, estimate next-generation frequency.

7. Peppered moths: before industrial pollution the dark allele frequency was p = 0.01. Pollution gives dark moths s = 0.4 fitness advantage. Compute the frequency after one generation.

8. Define: What is natural selection?

9. Define: What are the four requirements for natural selection?

10. Define: What is 'fitness' in evolutionary biology?

Answer Key

1. B) Heritable variation in traits - Without heritable variation, there is nothing for selection to act on.

2. B) Almost no fitness difference - s0 means the allele confers little or no fitness advantage or disadvantage.

3. B) Those best suited to reproduce leave more offspring - 'Fitness' refers to reproductive success, not just strength or survival alone.

4. B) Allele frequencies in a population - Selection shifts which alleles become more or less common in the population's gene pool.

5. p' = p(1+s)/(1+sp) = 0.21.3/(1+0.30.2) = 0.26/1.06 0.245 (24.5%)

6. p' = p(1+s)/(1+sp) = 0.041.5/(1+0.50.04) = 0.06/1.02 0.0588 (5.88%) - a modest one-generation increase

7. p' = p(1+s)/(1+sp) = 0.011.4/(1+0.40.01) = 0.014/1.004 0.0139 (1.39%) - small early gains compound over many generations

8. The process where organisms with favorable heritable traits survive and reproduce more than others.

9. Variation, heredity, differential survival/reproduction, and environmental pressure (selection).

10. An organism's relative reproductive success compared to others in the population.