

# Supplemental Material

*CBE—Life Sciences Education*

Abraham et al.

# DCI:

## Dominance Concept Inventory

For each question, please indicate your response by placing an 'X' next to your choice. Please read through each question carefully before responding.

1. A sunflower population has two alleles of a gene for petal color. 75% of the alleles in the population are P1 and 25% of the alleles are P2.

Given this information, please indicate which of the following a biologist would infer about the alleles:

- Yes     No    A. Allele P2 is recessive.  
 Yes     No    B. Allele P1 has higher relative fitness than allele P2.  
 Yes     No    C. Allele P2 will decrease in frequency over time.

2. A very large frog population has two alleles of a gene for skin color. The dominant allele is at 60% frequency and the recessive allele is at 40% frequency. There is no migration or natural selection, and mating between frogs is random.

Given this information, then after 200 generations: (select one)

- A. the allele frequencies will be 100% dominant and 0% recessive.  
 B. the allele frequencies will be 75% dominant and 25% recessive  
 C. the allele frequencies will be 60% dominant and 40% recessive.  
 D. the allele frequencies will be 50% dominant and 50% recessive  
 E. there is no way to predict what the allele frequencies will be.

3. A population of mustard plants started with two alleles of a gene, R1 and R2, for resistance to a harmful toxin in the soil. Allele R1 codes for high resistance, while allele R2 codes for low resistance. Over time allele R2 decreased in frequency until it disappeared entirely.

Given this information, please indicate which of the following a biologist would infer about the mode of inheritance for allele R2: (select one)

- A. It is dominant.  
 B. It is recessive.  
 C. It is co-dominant.  
 D. It is impossible to determine.

4. A large population of rabbits has two alleles of a gene for ear length. Allele E1 codes for long ears, while allele E2 codes for short ears. Heterozygotes with alleles E1 and E2 have medium length ears. All possible genotypes are present in the rabbit population. The rabbits mate randomly each generation.

Given this information, please indicate which of the following a biologist would infer about the alleles:

- Yes     No    A. Allele E1 is incompletely dominant.  
 Yes     No    B. Allele E2 will likely decrease in frequency over time.  
 Yes     No    C. Heterozygotes will have the highest relative fitness.

5. A population of trees has two alleles of a gene for leaf hairs, alleles D1 and D2. D1 codes for sharp leaf hairs. D2 codes for sticky leaf hairs. Homozygous individuals have two copies of D1 or D2. Heterozygous individuals have one copy of each allele, and have both sharp and sticky leaf hairs.

Given this information, please indicate which of the following a biologist would infer about the fitness of the genotypes: (select one)

- A. D1 homozygotes will have the highest relative fitness.  
 B. Heterozygotes will have the highest relative fitness.  
 C. D2 homozygotes will have the highest relative fitness.  
 D. It is impossible to determine which has the highest fitness.

6. A population of antelope has two alleles of a gene for horn shape. Allele B1 codes for curved dull horns and is the dominant allele. Allele B2 codes for straight sharp horns and is the recessive allele.

Given this information, please indicate which of the following a biologist would infer about the alleles:

- Yes     No    A. Allele B1 is at a higher frequency than allele B2.  
 Yes     No    B. Allele B1 will increase in frequency over time.  
 Yes     No    C. Allele B2 will eventually disappear from the population.

7. Imagine a biologist established two equally large isolated populations of beetles, both of which have two alleles of a gene that determines the shape of an enzyme. One allele is dominant and the other recessive; the dominant allele is at 60% frequency and the recessive allele is at 40% frequency in both initial populations.

In Population A, she caused an environmental change that makes the DOMINANT trait life-threatening to juveniles. In Population B, she caused an environmental change that makes the RECESSIVE trait life-threatening to juveniles. Both changes result in equal relative fitness of the alleles.

Part I: If the biologist compared the frequencies of alleles in the two populations over time, which of the following would be the most likely result? (select one)

- A. The dominant allele in Population A was lost more quickly than the recessive allele in Population B.
- B. The recessive allele in Population B was lost more quickly than the dominant allele in Population A.
- C. Both alleles were lost from Population A and Population B at approximately the same rate.

Part II: Which of the following statements explain your reason for choosing that answer?

- Yes  No A. The alleles affect survival in similar ways.
- Yes  No B. Recessive alleles are weaker than dominant alleles.
- Yes  No C. Recessive alleles are masked in some individuals.
- Yes  No D. Dominant alleles generally increase in frequency.

8. A rose population has two alleles of a gene for thorn length. Long thorns help protect the roses from herbivory by deer. Allele H1 codes for long thorns, while allele H2 codes for short thorns.

Given this information, please indicate which of the following a biologist would infer about the mode of inheritance for allele H2?

- A. It is dominant.
- B. It is recessive.
- C. It is co-dominant.
- D. It is impossible to determine.

9. A large population of ivy plants has two alleles of a gene for leaf thickness. Allele C1 codes for thick leaves while allele C2 codes for thin leaves. Homozygous individuals with two copies of C1 have higher fitness than homozygous individuals with two copies of C2. Heterozygous individuals have one copy of each allele. All possible genotypes are present in the ivy plant population.

Given this information, please indicate which of the following a biologist would infer about the fitness of the heterozygous genotype:

- A. Heterozygotes will have lower relative fitness to C1 and C2 homozygotes.
- B. Heterozygotes will have an intermediate fitness to C1 and C2 homozygotes.
- C. Heterozygotes will have higher relative fitness to C1 and C2 homozygotes.
- D. It is impossible to determine the relative fitness of the heterozygotes.
10. Imagine a biologist established two large isolated populations of a marine grass, both of which have two alleles of a gene that determines blade color. One allele is dominant and codes for dark blades; the other allele is recessive and codes for light blades. Neither blade color improves reproduction or survival of individuals.

In Population A, the RECESSIVE allele is at 45% frequency. In Population B, the RECESSIVE allele is at 20% frequency.

Part I: Given only this information, which of the following would probably happen to the RECESSIVE allele over the next few generations? (select one)

- A. It would decrease in both populations.
- B. It would persist in Population A only.
- C. It would persist in Population B only.
- D. It would persist in both populations.
- E. It would increase in both populations.

Part II: Which of the following statements explain your reason for choosing that answer?

- Yes  No A. Dominant alleles generally replace recessive alleles over time in populations.
- Yes  No B. Alleles that provide no advantage or harm often disappear after a few generations.
- Yes  No C. Alleles that provide no advantage or harm often persist for many generations.