

# Supplemental Material

*CBE—Life Sciences Education*

Abraham et al.

**Please carefully read each section before answering the questions. Several of the questions will require calculations to answer them. Answer questions to the best of your ability. However, if you do not know the answer to a question write, “I don’t know” in the space provided.**

**Define the following terms or principles:**

1) Gene \_\_\_\_\_

2) Locus \_\_\_\_\_

3) Allele \_\_\_\_\_

4) Mutation-Selection Balance \_\_\_\_\_

5) Founder Effect \_\_\_\_\_

6) Bottleneck \_\_\_\_\_

7) Incomplete Dominance \_\_\_\_\_

8) Gene Copy Number? \_\_\_\_\_

9) Allele Fixation \_\_\_\_\_

*\*Probe student definitions, ask for concrete examples\**

On the following questions (8 – 15), please indicate the correct answer by writing **True** or **False** (**T, F**) on the blank space to the left of each question.

**This process can cause an allele to be lost from a population:**

\_\_\_\_\_ 8) Genetic Drift

\_\_\_\_\_ 9) Mutation

\_\_\_\_\_ 10) Gene Flow

\_\_\_\_\_ 11) Natural Selection

*\*Ask student to explain process through which allele is fixed for each answer\**

**This process can add genetic variation to a population:**

\_\_\_\_\_ 12) Genetic Drift

\_\_\_\_\_ 13) Mutation

\_\_\_\_\_ 14) Gene Flow

\_\_\_\_\_ 15) Natural Selection

\_\_\_\_\_ 16) Recombination? If by genetic variation you mean new genotypes, it can.

*\*Ask student to explain process through which variation is added for each answer\**

**For the following questions (16 – 19), please indicate the correct answer by writing Always, Sometimes, or Never (A, S, N) on the blank space to the left of each question.**

\_\_\_\_\_ 16) The effects of random changes in allele frequencies are relatively greater in small populations than in large ones. (Consider that it will vary if other factors come into play)

\_\_\_\_\_ 17) Natural selection causes random changes in the allele frequencies in a population (think about apparent pattern vs. actual process)

\_\_\_\_\_ 18) Mutations are deleterious (selectively disadvantageous)

\_\_\_\_\_ 19) Heterozygous genotypes are selectively advantageous relative to homozygous genotypes

*\*Ask student to further explain each answer\**

**For the following questions, please read the short introduction, then answer the question in the space provided. Show all of your work for any calculations you do.**

20) In the space below, list the assumptions of the Hardy-Weinberg Equilibrium.

*\*Ask student to describe situations that would violate the assumptions, and how they would affect allele or genotype frequencies\**

21) Which of the following plays a role in determining whether an allele will rise or fall in frequency in a large population over time? Select any or all answers, and explain your answer(s)

in the space below.

- A. If the allele is common or rare
- B. If the allele is dominant or recessive
- C. If the allele is favored or disfavored by selection

**A population of rabbits has the following phenotypic frequencies: Black hair = 0.6, White hair = 0.4. Hair color is determined by two alleles at a single gene locus. One of them is dominant.**

22) Is the allele for black hair or white hair the dominant allele? Explain your answer

**A population of mice has the following allele frequencies:  $g_1 = 0.75$ ,  $g_2 = 0.25$ .  $g_1$  codes for a long tail, while the allele  $g_2$  codes for a short tail.**

23) Which allele is dominant? Explain your answer.

24) Which allele is selectively advantageous? Explain your answer.

**You find a horned lizard population with long-horned (HH), medium-horned (Hh) and short-horned (hh) lizard individuals.**

25) Given what you know, which phenotype is the most selectively advantageous? Explain in the space below.

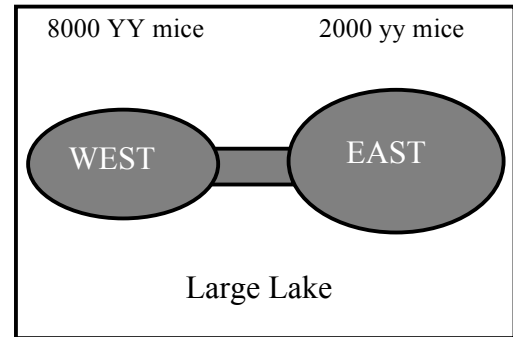
**Your neighbor's farm has a population of pea plants. Pea plant height is coded for by a single gene locus. The dominant T allele codes for tall plants, while the recessive t allele codes for short plants. The genotypic frequency is 40 TT, 40 Tt, and 40 tt. Your neighbor decides to only cross-pollinate between plants of a similar height each year (i.e. tall with tall, short with short).**

26) What do you think will happen to the frequency of the t allele in the population over the next 10 years? Explain why.

27) What do you think will happen to the frequency of the tt genotype in the population over the next 10 years? Explain why.

To answer the following questions, you will be asked to read the introductory paragraphs and to perform some basic calculations.

In Large Lake, the water level is dropping. A land bridge has appeared between West and East Islands, allowing mice to move freely between them (Figure 1). West Island was home to a population of 8,000 mice, all with genotype **YY**. East Island was home to a population of 2,000 mice, all with genotype **yy**.



28) Assuming no mice die, what will the frequency of allele **y** be in the newly merged population (before mating).

29) Assuming that the population is in Hardy-Weinberg Equilibrium, what do you predict will happen to the frequency of allele **y** after 10 generations? Explain why.

30) Assuming that the population is in Hardy-Weinberg Equilibrium, provide the expected frequencies of **YY**, **Yy**, and **yy** genotypes after one generation.

**YY** \_\_\_\_ ; **Yy** \_\_\_\_ ; **yy** \_\_\_\_

**A population of fruit bats has 64 pointy-eared individuals, and 36 round-eared individuals. You know that the gene locus that codes for ear shape has a dominant allele T, which causes pointy ear tips, and a recessive allele t, which causes rounded ear tips.**

31) The genotypic frequencies in the population are:

**TT** \_\_\_\_ ; **Tt** \_\_\_\_ ; **tt** \_\_\_\_

You find a population of coastal tree frogs (*Rana abrahama*). You know that some populations are under strong selective pressure from infection by the chytrid fungus (*Batrachochytrium dendrobatidis*). M is an allele that codes for slimy skin, while m is the allele that codes for dry skin. *R. abrahama* individuals with combination skin (Mm) are better able to resist chytrid infections. You are unsure if the population you found is under selection pressure from chytrid infection. You take the opportunity to collect the following genotype data:

250 MM, 450 Mm, 50 mm

32) Calculate the expected genotypic frequencies of the population, if it were in Hardy-Weinberg equilibrium.

MM \_\_\_\_; Mm \_\_\_\_; mm \_\_\_\_

Compare the observed and expected genotypic frequencies using a chi-square test. Critical values are provided in the table to the right.

33) Are the observed and expected genotypic frequencies significantly different?

Critical Values	
df	$\alpha = 0.05$
1	3.841
2	5.991
3	7.815
4	9.488

**\*Follow up Questions (general)\***

- 1) Can you give me your overall thoughts about the questions?
- 2) Were they things that you have encountered before?
- 3) For selected questions, “Can you explain that to me a little bit more?”