

ASSESSMENT	Chapter 19 Test	BLM 19.3.1
------------	------------------------	-------------------

Multiple Choice Questions

- Decide which of the choices best completes the statement or answers the question.
 - Locate that question number on the separate answer sheet provided.
 - Use the procedure described by your teacher to answer each question. For example, “fill in the circle that corresponds to your choice” or “make an X over the letter corresponding to your choice.”
1. In the equation proposed by Hardy and Weinberg, the letter “ p ” represents the frequency of
 - a. recessive alleles.
 - b. dominant alleles.
 - c. heterozygotes in a population.
 - d. homozygous recessive individuals in a population.
 2. The Hardy-Weinberg equation, $p + q = 1$, means
 - a. all the p ’s in the population added to all the q ’s in a population will equal 1.
 - b. the frequency of the dominant allele is the inverse of the frequency of the recessive allele.
 - c. the frequency of the dominant allele added to the frequency of the recessive allele represents 100 percent of the alleles in a population.
 - d. the frequency of all of the genes in a population will add up to 1.
 3. In the equation proposed by Hardy and Weinberg, for a given gene, p^2 represents the frequency of
 - a. homozygous dominant individuals in the population.
 - b. homozygous recessive individuals in the population.
 - c. heterozygous individuals in the population.
 - d. geozygous individuals in the population.
 4. An individual is homozygous recessive for gene “ a .” The frequency of alleles in its gametes will be
 - a. p .
 - b. pq .
 - c. p and q .
 - d. q .
 5. If $p = 0.50$ and $q = 0.50$, then the frequency of homozygous dominant individuals in the population is
 - a. 0.25.
 - b. 0.50.
 - c. 0.75.
 - d. 0.

ASSESSMENT	Chapter 19 Test	BLM 19.3.1
-------------------	------------------------	-------------------

6. If there are 45 000 individuals in a population, and 20 000 have the recessive phenotype for a specific gene, then the frequency of the recessive allele in this population is
 - a. 20 000.
 - b. 0.44.
 - c. 0.67.
 - d. 25 000.
7. A population of butterflies has two colour forms: yellow, which is dominant, and black, which is recessive. When using the formula $p^2 + 2pq + q^2 = 1$ to determine allele frequencies, the first step would be to determine the number of
 - a. yellow individuals.
 - b. black individuals.
 - c. heterozygous individuals.
 - d. dominant alleles in the population.
8. If the frequency of dominant alleles is 0.24 and the frequency of recessive alleles is 0.76, the expected frequency of heterozygotes in the next generation is
 - a. 0.24.
 - b. 0.76.
 - c. 0.058.
 - d. 0.36.

Use the following information to answer the next question.

Polydactylism in Humans

In a population of humans, the gene for number of fingers has two forms. Individuals with the dominant form of this gene have six fingers. Individuals with the recessive form of the gene have five fingers. In one generation, the frequency of recessive alleles was found to be 0.0021. In the next generation, the frequency of the recessive alleles was also 0.0021.

9. According to the conditions of the Hardy-Weinberg principle, the frequency of the recessive alleles from one generation to the next indicates that
 - a. the population sampled must have been very large.
 - b. people with polydactylism tend to mate with other people with polydactylism.
 - c. there was a considerable immigration of people into the population sampled.
 - d. new mutations of the dominant form of the gene were appearing in the population.

ASSESSMENT	Chapter 19 Test	BLM 19.3.1
-------------------	------------------------	-------------------

Use the following information to answer the next question.

Lizards

On a small (1.4 km²) island in the Pacific Ocean, a researcher noticed two forms of a lizard. One form was light grey and the other was black. The total population of the species was always around 150 individuals. Over a period of 5 years, the number of black lizards increased from 12 to 54 individuals.

10. The most probable cause of the increase in the number of black lizards is
- genetic equilibrium.
 - immigration of black lizards from another island.
 - random mating of the lizards.
 - natural selection in favour of the black form.

Use the following information to answer the next three questions.

Ear Lobes

In humans, there are two forms of ear lobes: attached and unattached (free). Individuals with unattached (free) ear lobes show the dominant form of this gene, while individuals with attached ear lobes have the recessive trait. In a sample of 25 individuals, 1 person was found to have attached ear lobes.

11. The frequency of the allele for attached ear lobes in this population is
- 0.040.
 - 0.96.
 - 0.20.
 - 0.0016.
12. The number of individuals in this population who are expected to be heterozygous for the gene for attached ear lobes is
- 5.
 - 1.
 - 16.
 - 8.
13. A scientist would not expect the allele frequencies for attached and unattached ear lobes in this population to be the same in the next generation because
- the population is very small.
 - immigration into this population is not allowed.
 - there are many alleles that determine ear lobe shape in humans.
 - genetic drift could not occur.

ASSESSMENT	Chapter 19 Test	BLM 19.3.1
-------------------	------------------------	-------------------

Use the following information to answer the next question.

Butterflies

On a small island off the coast of England, most of a population of butterflies had six spots on the hind wing year after year. There were a few butterflies in the population with five spots, and even a few individuals with four spots on their hind wing. The population was sampled annually and routinely had a size of well over 1000 individuals. However, something happened to the population one year, and only one individual butterfly from this population could be found. The next year butterflies of this population were once again abundant, but now most of the individuals in the population had only four spots on their hind wing.

14. The change in the number of wing spots in this population of butterflies is an example of
 - a. natural selection.
 - b. the bottleneck effect.
 - c. Hardy-Weinberg equilibrium.
 - d. non-random mating in the population.
15. Natural selection is the only process that leads directly to
 - a. the founder effect.
 - b. evolutionary adaptation.
 - c. Hardy-Weinberg equilibrium.
 - d. sexual adaptation.
16. Natural selection occurs when
 - a. there is genetic variation in a population and the environment can support more individuals than are born.
 - b. individuals change in response to a changing environment.
 - c. there is genetic variation in a population and the environment is changing.
 - d. more individuals are born than can survive in an environment that is not changing.
17. The population that would most likely exhibit the effects of genetic drift is one with a population size of
 - a. 250 individuals.
 - b. 47 individuals.
 - c. 200 individuals.
 - d. 15 000 individuals.
18. In sheep, black coat (wool) colour is recessive to white coat colour. In a flock of sheep, if the frequency of the white allele is 0.872, then the frequency of the black allele is
 - a. 0.872.
 - b. 0.128.
 - c. 0.760.
 - d. 0.240.

ASSESSMENT	Chapter 19 Test	BLM 19.3.1
-------------------	------------------------	-------------------

19. In humans, assume that the allele for tongue rolling is dominant to the allele that prevents tongue rolling. In a class of 33 students, the frequency of students who could not roll their tongues was 0.417. The expected number of homozygous dominant individuals in this population is
- 4.
 - 14.
 - 19.
 - 6.
20. In pea plants, the allele that results in tall plants is dominant to the allele that results in short plants. A student determined that in a population of 568 pea plants only 47 displayed the recessive phenotype. The expected number of heterozygous plants in this population is
- 404.
 - 288.
 - 233.
 - 284.
21. Which of the following statements is TRUE with respect to the phenotype of silk moths? (Assume that there are only two forms of a single gene that determine the phenotype in this species of moth.)
- Homozygous dominant individuals look different than heterozygous individuals.
 - Homozygous dominant individuals look the same as those that are homozygous recessive individuals.
 - Homozygous recessive individuals look different than heterozygous individuals.
 - Heterozygous individuals look the same as homozygous recessive individuals.
22. The population most likely to be in genetic equilibrium is
- a small population of birds on an island.
 - a large population of birds in close contact with other populations of the same species.
 - a medium-sized population of birds where females select mates on the basis of male size.
 - a large population of birds that is isolated from other populations of the same species by a mountain range.
23. Which row below would indicate the species most likely to have experienced genetic change due to the bottleneck effect?

Row	Species	Description
a.	domestic cow	In 1999, one thousand cow-calf pairs roamed the foothills on a ranch in southern Alberta.
b.	elk	Banff had a robust elk population numbering in the thousands in 2004.
c.	coyote	In 2006, the population of coyotes in Calgary was estimated at 600 individuals.
d.	whooping crane	In 1938, only 14 adult whooping cranes (<i>Grus americana</i>) survived.

ASSESSMENT	Chapter 19 Test	BLM 19.3.1
-------------------	------------------------	-------------------

Use the information from the table below to answer the next four questions.

Population	Population size (N)	Recessive allele frequency in different generations		
		1	2	3
A	23	0.234	0.179	0.112
B	147	0.337	0.335	0.351
C	9 085	0.540	0.541	0.540
D	12 960	0.348	0.356	0.401

Table 1. Measurements of recessive allele frequencies in four different populations of the same species in three successive generations. The first generation is 1, the second generation is 2, and the last generation is 3.

24. The population in the chart that is most likely experiencing genetic drift is the population labelled
- A.
 - B.
 - C.
 - D.
25. The population most likely to be experiencing genetic equilibrium is population
- A.
 - B.
 - C.
 - D.
26. The population most likely experiencing natural selection is population
- A.
 - B.
 - C.
 - D.
27. In order to establish that natural selection is occurring in one of the four populations, scientists would have to
- measure immigration and emigration.
 - monitor population density.
 - prevent mutations from occurring.
 - randomly mate individuals in the population in each generation.

ASSESSMENT	Chapter 19 Test	BLM 19.3.1
------------	------------------------	-------------------

Use Figure 1 for the next two questions.

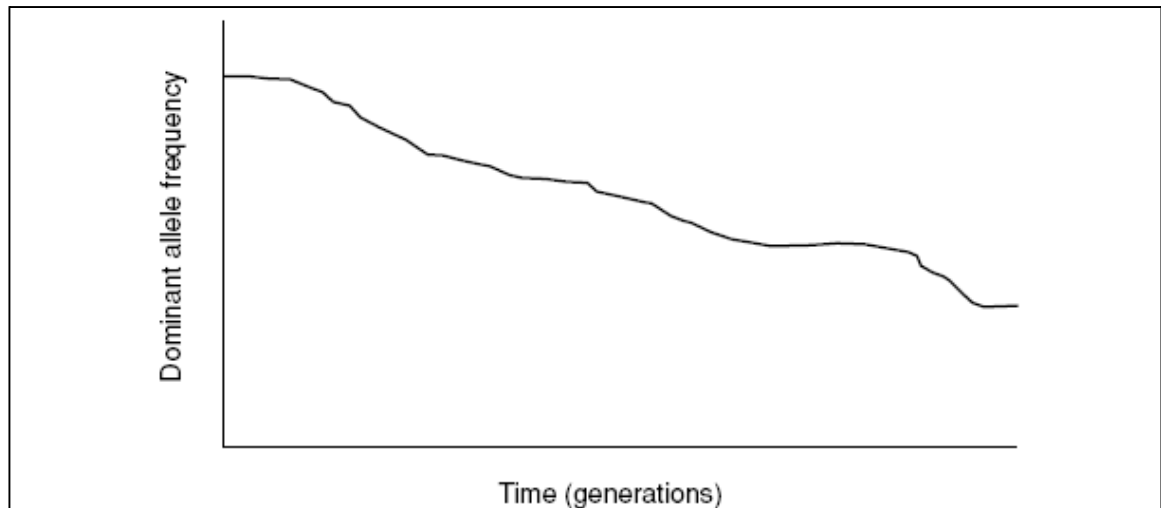


Figure 1. Change in dominant allele frequency in a population of fruit flies

28. If the population of fruit flies was isolated in a small container, the change in the frequency of the dominant allele would most likely be caused by
- immigration and emigration.
 - random mating.
 - all individuals having an equal chance of mating.
 - genetic drift.
29. Assume this was a wild population of fruit flies in a tropical forest. An evolutionary biologist would be interested in this population because it
- might be experiencing a bottleneck.
 - is likely experiencing natural selection against the dominant allele.
 - is experiencing a high rate of mutation.
 - seems that the recessive allele is overpowering the dominant allele.

Use the following information to answer the next question.

Chestnut Blight Fungus

During the last century, the chestnut blight fungus (*Cryphonectria parasitica*), an introduced species, decimated populations of the American chestnut tree (*Castanea dentate*).

30. As a result of the chestnut blight fungus, the current populations of American chestnut trees have little genetic variation due to the
- founder effect.
 - gooseneck effect.
 - Hardy-Weinberg effect.
 - bottleneck effect.

ASSESSMENT	Chapter 19 Test	BLM 19.3.1
------------	------------------------	-------------------

Numerical Response Questions

- Record your answer on the answer sheet provided.
- If an answer is a value between 0 and 1 (e.g., 0.25), then be sure to record the 0 before the decimal place.

Use the following information to answer the next two questions.

Siberian Tigers

In North America, there are about 70 Siberian tigers in captivity. In this species of tigers, coat colour can be either black stripes on an orange background, or black stripes on a white background.

In Siberian tigers, white background fur colour is recessive, while the orange background fur colour is dominant.

- Calculate the total number of alleles coding for coat colour in the captive population of Siberian tigers in North American. Record your **three-digit** answer in the numerical response section on the answer sheet.

Coat colour alleles: _____

- If there are three tigers with black stripes on the white background fur colour, calculate the frequency of the recessive allele in this population. Record your **four-digit** answer in the numerical response section on the answer sheet.

Frequency of recessive allele in this population: _____

Use the following information to answer the next question.

Cystic Fibrosis

Cystic fibrosis (CF) is the most common fatal genetic disease affecting young Canadians. CF affects mainly the lungs and the digestive system. In the lungs, CF causes severe breathing problems. A build-up of thick mucous makes it difficult to clear bacteria and leads to cycles of infection and inflammation, which damage the delicate lung tissues.

Cystic fibrosis (CF) is one of the most common severe autosomal recessive disorders in Caucasian populations. In Canada, approximately 1 in 2500 children born in this county has CF.

- Calculate the frequency of carriers of the CF gene in Canada. Record your **answer as a value from 0 to 1, rounded to two decimal places**, in the numerical response section on the answer sheet.

Frequency of Canadians carrying the CF gene: _____

ASSESSMENT	Chapter 19 Test	BLM 19.3.1
------------	------------------------	-------------------

Written Response Questions

Use the following information to answer the next question.

Pea Plants

Pea plants are annual plants that live for one year and then die. They reproduce only once, producing perhaps 50 seeds per plant. A large pea plant may reach a mass of 1.0 kg. In the 1850s, Gregor Mendel experimented with crosses of pea plants. In one set of crosses, he crossed pure breeding plants that had flowers on the side of the stems (axial flowers) with pure breeding plants that had flowers at the end of the stems (terminal flowers). In the F_1 generation, all of the offspring had axial flowers. The F_1 plants were then self-crossed. The data for this cross are presented in the table below.

Number of F_2 plants with axial flowers	Number of F_2 plants with terminal flowers
651	207

1. a) **Designate** symbols for the alleles governing the phenotype of the flower position, and **calculate** the allele frequency for each allele. (4 marks)

- b) **Calculate** the number of heterozygous pea plants you would expect in Mendel's F_2 generation. (2 marks)

- c) Assuming Mendel had no preferences for the position of the flower in pea plants, **predict** how many heterozygotes would occur if the next generation had 2500 pea plants. (2 marks)

	Chapter 19 Test	BLM 19.3.1
ASSESSMENT		

- d) **Identify** three conditions that would have to be met for Part c) in order for your prediction to be correct. **Explain** why each of the conditions would have to be met. (6 marks)
