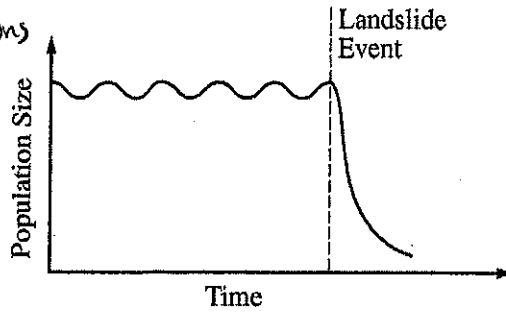


Evolution 2013 Released Questions

13. Ellis-van Creveld syndrome is a recessive genetic disorder that includes the characteristics of short stature and extra fingers or toes. In the general population, this syndrome occurs in approximately 1 in 150,000 live births. In a particular isolated population, however, the incidence of this syndrome among live births is 1 in 500. 2013 - 53

Assume that both the isolated population and the general population are in Hardy-Weinberg equilibrium with respect to this syndrome. Which of the following best describes the difference between the frequency of the allele that causes the syndrome in the general population and the frequency of the allele in the isolated population?

- (A) The frequency of the Ellis-van Creveld allele is 0.002 in the isolated population and 0.0000066 in the general population, which suggests that selection for this trait is occurring in both populations.
- (B) The frequency of the Ellis-van Creveld allele is 0.0447 in the isolated population and 0.0026 in the general population, showing that the rate of genetic mutation is highest among individuals in the isolated population.
- (C) The frequency of the Ellis-van Creveld allele is 0.002 in the isolated population and 0.0000066 in the general population, which demonstrates gametic incompatibility between the populations.
- (D) The frequency of the Ellis-van Creveld allele is 0.0447 in the isolated population and 0.0026 in the general population, which suggests that genetic drift has occurred in the isolated population.



2. Undersea landslides can disrupt marine habitats by burying organisms that live on the ocean floor. The graph above shows the size of a population of a certain organism that lives on the ocean floor. The population was affected by a recent landslide at the time indicated on the graph. Which of the following best predicts how the population will be affected by the landslide? 2013 - 4

- (A) The surviving organisms will evolve into a new species.
- (B) The reduced population will likely have allelic frequencies that are different from the initial population.
- (C) The population will adapt to deeper waters to avoid future landslides.
- (D) The reduced population will have a greater number of different genes than the initial population.

~~GO ON TO THE NEXT PAGE.~~

You can take these home!

3. The data below demonstrate the frequency of tasters and nontasters of a certain compound in four isolated populations that are in Hardy-Weinberg equilibrium. The allele for nontasters is recessive. In which population is the frequency of the recessive allele highest? 2013 - 40

	Population	Tasters	Nontasters	Size of Population
(A)	1	110	32	142
(B)	2	8,235	4,328	12,563
(C)	3	215	500	715
(D)	4	11,489	2,596	14,085

EFFECT OF ENVIRONMENTAL FACTORS ON DNA

Treatment	Mean Percent of DNA with Double-Strand Breaks	$2SE_{\bar{x}}$
Untreated control	9.8	2.4
BaP only	9.7	3.2
UVA only	10.1	3.4
UVA and BaP	35.1	5.0

2. Environmental mutagens can affect DNA in cells. Benzo[a]pyrene (BaP) is a mutagen that is commonly found in urban air pollution. Researchers claim that the effect of UVA radiation (UVA), another known mutagen, is amplified by the presence of BaP. To test their claim, the researchers exposed cultured eukaryotic cells to either BaP, UVA radiation, or both mutagens. The researchers then determined the percent of chromosomal DNA that contained damage in the form of double-strand breaks. The results are shown in the table.
- On the template below **construct** a graph using the data in the table to represent the effect of UVA and BaP on DNA.
 - Using the results from all treatments, **describe** the effect of BaP alone and UVA alone compared with the effect of the combined treatment of BaP and UVA on DNA.
 - Predict** the most likely effect on cell division for a cell containing DNA with double-strand breaks. **Justify** your prediction.
 - Point mutations alter the DNA sequence at a single nucleotide. **Describe** how point mutations affect the genetic makeup of the population **AND** impact the evolution of the population.

2017-2

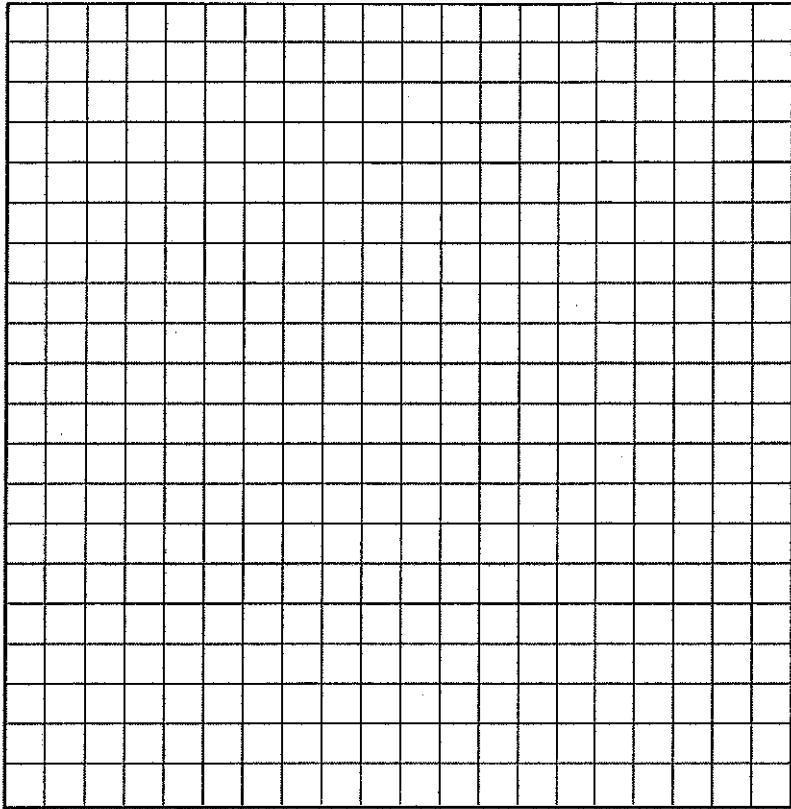
THIS PAGE MAY BE USED FOR TAKING NOTES AND PLANNING YOUR ANSWERS.

NOTES WRITTEN ON THIS PAGE WILL NOT BE SCORED.

WRITE ALL YOUR RESPONSES ON THE LINED PAGES.

2017-2

PAGE FOR ANSWERING QUESTION 2



Handwriting lines for providing an answer.

GO ON TO THE NEXT PAGE.

Questions 4-6

Rhagoletis pomonella is a parasitic fly native to North America that infests fruit trees. The female fly lays her eggs in the fruit. The larvae hatch and burrow through the developing fruit. The next year, the adult flies emerge.

Prior to the European colonization of North America, the major host of *Rhagoletis* was a native species of hawthorn, *Crataegus marshallii*. The domestic apple tree, *Malus domestica*, is not native to North America, but was imported by European settlers in the late 1700s and early 1800s.

When apple trees were first imported into North America, there was no evidence that *Rhagoletis* could use them as hosts. Apples set fruit earlier in the season and develop faster, where hawthorns set later and develop more slowly.

Recent analysis of *Rhagoletis* populations has shown that two distinct populations of flies have evolved from the original ancestral population of flies that were parasitic on hawthorns. One population infests only apple trees, and the other infests only hawthorns. The life cycles of both fly populations are coordinated with those of their host trees. The flies of each population apparently can distinguish and select mates with similar host preferences and reject mates from the population specific to the other host tree. There is very little hybridization (only about 5 percent) between the two groups.

4. The divergence between the two populations of *Rhagoletis* must have occurred very rapidly because 2013-20

- (A) the apple tree was imported into North America with European settlement approximately 200 years ago
- (B) flies were imported into North America with European settlement approximately 200 years ago
- (C) long-distance rail transport of fruit increased only after the American Civil War (1861-1865)
- (D) heavy use of gunpowder during the American Civil War (1861-1865) led to increased mutation rates in many natural populations of plants and animals

5. Initially, which of the following isolating mechanisms is likely to have been the most important in preventing gene flow between the two populations of *Rhagoletis*? 2013-21

- (A) Gamete incompatibility
- (B) Temporal isolation
- (C) Mechanical isolation
- (D) Reduced hybrid viability

6. Matings between individuals from the two populations of *Rhagoletis* produce hybrid flies that appear to be healthy and have normal life spans. The eggs laid by these hybrid flies, however, hatch less often than those of flies from either of the two populations. What isolating mechanism seems to be important in this hybrid population? 2013-22

- (A) Prezygotic isolation
- (B) Mechanical isolation
- (C) Reduced hybrid fertility
- (D) Habitat isolation

7. Scientists have found that the existing populations of a certain species of amphibian are small in number, lacking in genetic diversity, and separated from each other by wide areas of dry land. Which of the following human actions is most likely to improve the long-term survival of the amphibians? 2013-24

- (A) Cloning the largest individuals to counteract the effects of aggressive predation
- (B) Reducing the population size by one-fifth to decrease competition for limited resources
- (C) Constructing a dam and irrigation system to control flooding
- (D) Building ponds in the areas of dry land to promote interbreeding between the separated populations

GO ON TO THE NEXT PAGE.