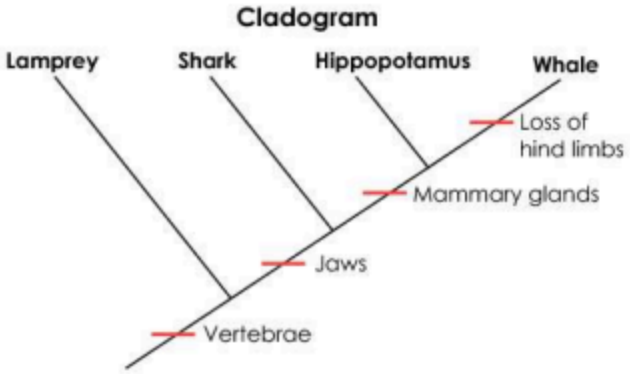
Evolution
Speciation

BIOLOGY. EVOLUTION **OH.2025.Q21**

The following question has two parts. First, answer part A. Then, answer part B.

Part A

The cladogram shows the evolutionary relationships among four animals and some of the traits they share.



Which two animals share the most traits?

Ⓐ shark and whale

Ⓑ lamprey and shark

Ⓒ whale and hippopotamus

Ⓓ hippopotamus and lamprey

Part B

Select all of the traits shared by the two animals that share the most traits.

☐ jaws

☐ vertebrae

☐ mammary gland

☐ loss of hind limbs

BIOLOGY. EVOLUTION
OH.2024.Q16

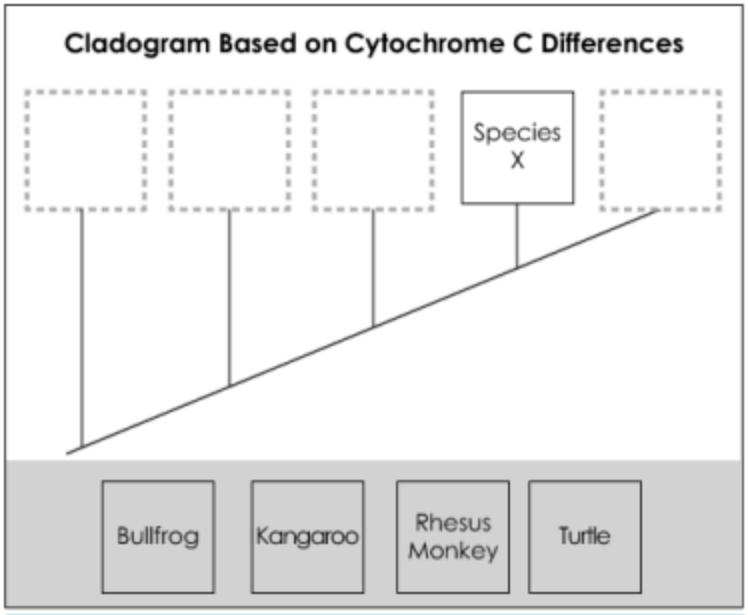
A biologist is studying the amino acid sequences of an unknown species, Species X. The table shows the number of Cytochrome C protein differences between Species X and several other organisms.

Cytochrome C Differences

Organism	Number of Differences From Species X
Bullfrog	18
Kangaroo	10
Turtle	15
Rhesus Monkey	1

Move each organism into the cladogram to show the relationships among Species X and the other organisms based on the table.

- Use only **one** organism in each blank box you fill in.



BIOLOGY. EVOLUTION
OH.2024.Q42

The following question has two parts. First, answer part A. Then, answer part B.

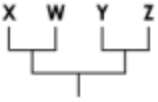
Part A

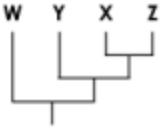
Students perform a lab simulation to compare the degree of relatedness of three unknown plant species to species W. The table shows the results of three tests.

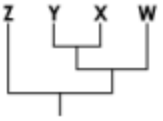
Test Result Comparisons With Species W

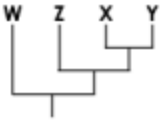
Species	Presence of Enzyme M	Number of Differences in Amino Acid Sequences	DNA Banding Patterns by Gel Electrophoresis
W	Absent	---	4 Bands Positions 5, 9, 11, 12
X	Present	12	3 Bands Positions 3, 5, 22
Y	Present	2	4 Bands Positions 5, 9, 11, 17
Z	Present	10	3 Bands Positions 3, 5, 22

Which cladogram shows the most likely degree of relatedness of the four organisms?

Ⓐ 

Ⓑ 

Ⓒ 

Ⓓ 

Part B

Select the **three** statements that support the species relationships shown in the cladogram.

- [ ] Enzyme M arose separately in species X, Y, and Z.
- [ ] The DNA band at position 17 was lost in species X.
- [ ] A DNA band at position 5 evolved prior to the emergence of enzyme M.
- [ ] Species Y shares more amino acid sequences with species W than with other species.
- [ ] The DNA band at position 22 first emerged after species X and Z diverged from the lineage.
- [ ] The DNA band located at position 11 appeared after species W and Y diverged from the lineage.

BIOLOGY. EVOLUTION
OH.2023.Q3

A geneticist examines part of a gene sequence in four different but related species. For each species, the bases in the sequence are indicated in the chart below.

DNA Base Sequence Data

Species #	DNA Strand
1	A A C A A G G T G T G C
2	A C C T A G G T G T G C
3	A C C A A G G T G T C C
4	A C C A A G T T G T C C

She then determines that the common ancestor of these four species has a DNA strand of A C C T A G G T G A G C.

Based on this data, which species is most closely related to the common ancestor?

- Ⓐ 1
- Ⓑ 2
- Ⓒ 3
- Ⓓ 4

BIOLOGY. EVOLUTION
OH.2023.Q7

Warblers are small insect-eating birds common to North America. Several closely related species of warblers evolved approximately two million years ago during the period between the advance and retreat of large glaciers.

Which statement explains how this glacial activity led to the formation of these species?

Ⓐ Glacial ice separated and isolated warbler sub-populations.

Ⓑ Glacially formed landscapes created new habitats where warbler populations mixed.

Ⓒ Glacial ice limited warbler access to resources resulting in decreased carrying capacity.

Ⓓ Glacially influenced climates maintained the genetic diversity within existing warbler species.

BIOLOGY. EVOLUTION
OH.2022.Q36

The table lists the occurrence of four traits within different groups of organisms: four limbs, amniotic egg, hair and two post-orbital fenestrae (holes in the skull).

Organisms and Traits

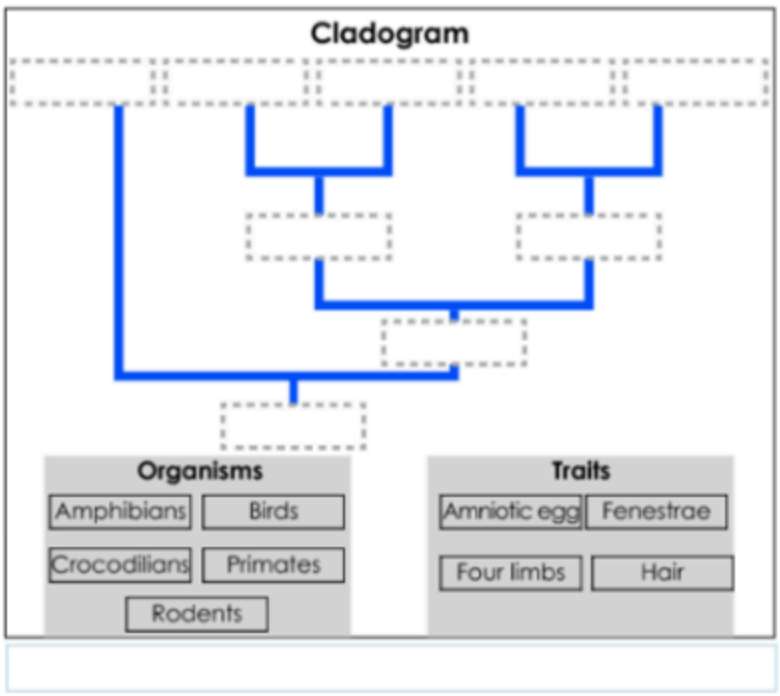
Organisms	Four Limbs	Amniotic Egg	Hair	Fenestrae
Amphibians	√			
Birds	√	√		√
Crocodilians	√	√		√
Primates	√	√	√	
Rodents	√	√	√	

Construct a cladogram to show the relatedness among these organisms, based on the traits in the table.

A. Move the organism labels into the blank boxes in the cladogram to show the relatedness among the animals.

B. Move the trait labels into the blank boxes in the cladogram to show where each trait appeared.

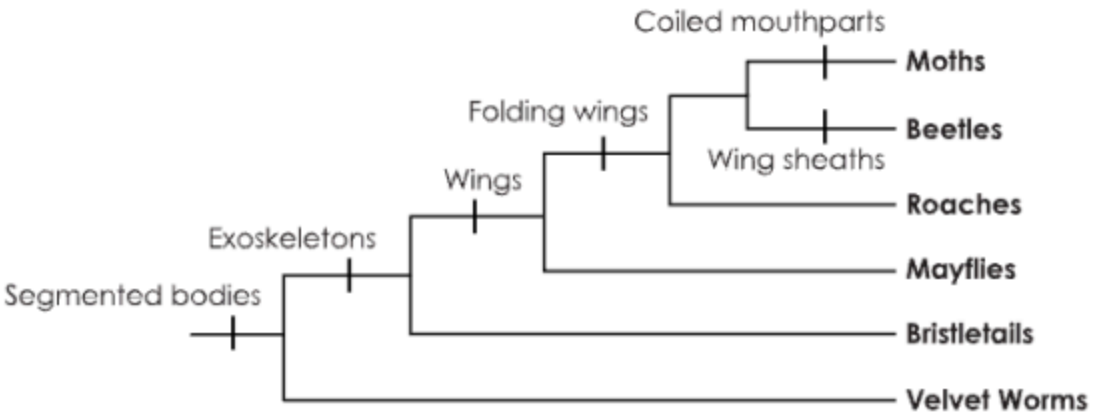
- Move only **one** label into each blank box.
- There may be more than one correct answer.



BIOLOGY. EVOLUTION
OH.2022.Q7

Animals with segmented bodies include organisms like worms, beetles, and butterflies. Scientists study the morphological variation among these organisms to determine their evolutionary relationships. A cladogram shows the relationships among groups of animals with segmented bodies.

Relationships Among Segmented Animals



The following question has two parts. First, answer part A. Then, answer part B.

Part A

Select the boxes to show each trait possessed by each group of segmented animals.

	Beetles	Bristletails	Mayflies	Moths	Roaches	Velvet Worms
Wings	☐	☐	☐	☐	☐	☐
Exoskeletons	☐	☐	☐	☐	☐	☐
Wing sheaths	☐	☐	☐	☐	☐	☐
Folding wings	☐	☐	☐	☐	☐	☐
Coiled mouthparts	☐	☐	☐	☐	☐	☐

Part B

Select the **two** organisms that are most closely related.

- ☐ beetles
- ☐ bristletails
- ☐ mayflies
- ☐ moths
- ☐ roaches
- ☐ velvet worms

BIOLOGY. EVOLUTION
OH.2021.Q21

A table shows information about several traits displayed by different groups of plants.

Traits in Plant Groups

	Algae	Ferns	Gingko	Liverworts	Spruce	Wheat
Cones			x		x	
Cuticles		x	x	x	x	x
Flowers						x
Needles					x	
Seeds			x		x	x
Stomata		x	x		x	x

Which statement explains the relationships among gingko, spruce, and wheat?

Ⓐ These three plant groups are all equally related.

Ⓑ Gingkos are more ancient than spruce or wheat.

Ⓒ A group that contains gingko and spruce is the ancestor of wheat.

Ⓓ Spruce share an ancestor with a group that contains gingko and wheat.

Diversity of Life

BIOLOGY. EVOLUTION
OH.2019.Q21

The European corn borer is a pest whose larvae cause damage to corn crops in the United States. Pesticides can be used to control the larvae. As an alternative, scientists have developed a genetically engineered form of corn called the Bt strain. It produces a toxin in its cells called Bt, which is poisonous to the corn borer larvae. Farmers who plant fields of Bt corn are required by law to plant fields of non-Bt corn nearby as well.

Which statement explains why farmers would be required to plant non-Bt corn near Bt corn?

Ⓐ To provide controls for Bt toxin experiments with corn borers

Ⓑ To keep corn borers from cross-pollinating Bt and non-Bt corn

Ⓒ To slow reproductive selection for a Bt toxin-resistant corn borer

Ⓓ To prevent movement of corn borers from Bt to non-Bt corn fields

BIOLOGY. EVOLUTION
OH.2019.Q43

Scientists observe that four desert lizard species eat insects as part of their diet. The table shows the percentages of each lizard's diet that are made up of different insects.

Lizard Insect Diet Data (%)

Lizard Species	Ants	Locusts	Beetles	Termites	Larvae
M	0	20	20	50	10
N	20	40	30	0	10
O	0	30	10	30	30
P	90	0	10	0	0

Which statement could explain the dietary specialization of lizard species P?

(A) Lizard P has more genetic variability than lizards M, N, and O.

(B) Lizard P occupies a different ecological niche than lizards M, N, and O.

(C) Each lizard chose to have adaptations that allow them to exploit different resources.

(D) Ants have a smaller population than the locust, beetle, termite, and larvae populations.

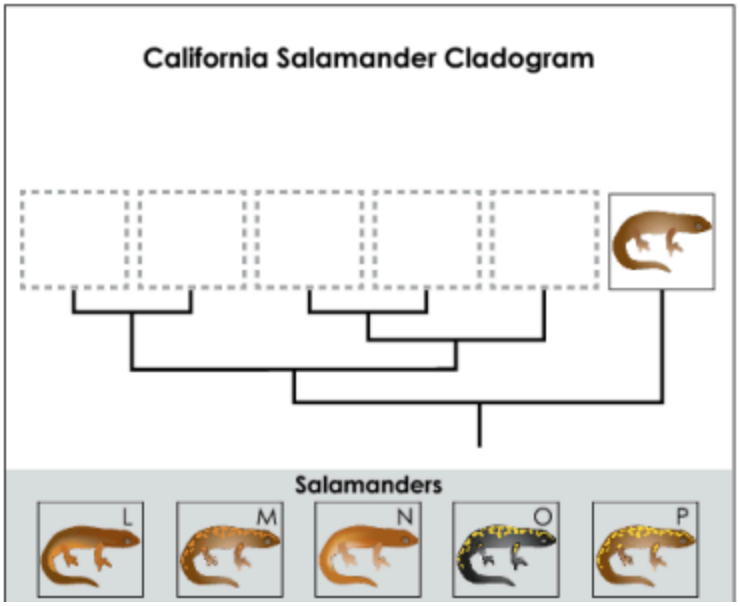
BIOLOGY. EVOLUTION
OH.2018.Q11

Stimulus:
https://drive.google.com/file/d/1RQ08dKRCB_si9sd0QN_E2ZKjzAVzwfR-/view?usp=sharing

Complete the blank cladogram using the information in the salamander distribution map and accompanying explanatory text.

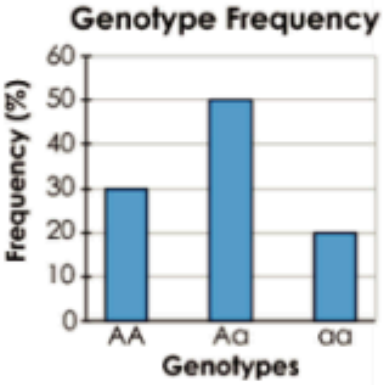
Place the correct salamander into each of the blank boxes.

- You should use all of the salamanders.
- There may be more than one correct answer.



BIOLOGY. EVOLUTION
OH.PT.Q5

A species of butterfly, *Heliconius cydno alithea*, has both white and yellow individuals. Its white allele is dominant and its yellow allele is recessive. The graph shows the genotype frequency for a generation of the butterfly.

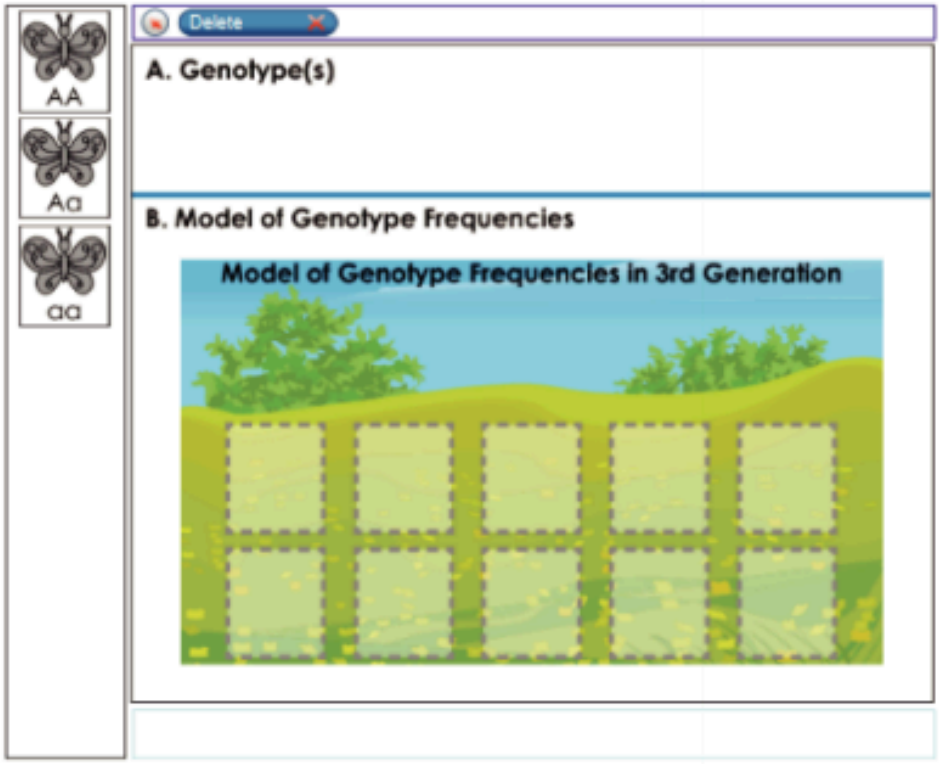


If a predator introduced to the butterfly habitat prefers the yellow trait, predict the genotype frequencies that will occur in the third generation.

A. Place the genotype(s) that will have higher rates of predation in the blank box.

B. Place ten butterflies in their habitat to create an approximate model of the genotype frequency in the new generation, assuming all genotypes are represented.

- There may be more than one correct answer.
- You may use each butterfly more than once.



BIOLOGY.EVOLUTION
OH.PT.Q16 & Q18

To understand how reactions happen in cells, scientists often isolate enzymes and their substrates to conduct experiments in laboratories. The enzymes and substrates used in the following experiment are involved in reactions that produce gas, which can be collected and measured.

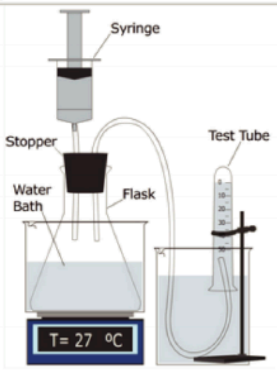
Select an enzyme, a substrate and a temperature. Then click Start to conduct a study of enzyme activity. The results will appear in the table below.

Enzyme 1

Substrate A

Temperature (degrees C) 27

Start



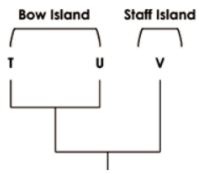
Enzyme	Substrate	Temperature (C)	Water Displaced (mL)	Bubbles
1	A	27	10	Some
1	A	37	15	Many
1	A	75	0	None
1	A	100	0	None
1	B	27	0	None
1	B	37	0	None
1	B	75	0	None
1	B	100	0	None

Enzyme	Substrate	Temperature (C)	Water Displaced (mL)	Bubbles
2	A	27	0	None
2	A	37	0	None
2	A	75	0	None
2	A	100	0	None
2	B	27	3	A Little
2	B	37	6	Few
2	B	75	15	Many
2	B	100	0	None

E
C

lizards from different island lizard populations are unable to produce offspring.

The lizards on Bow Island experience different selection pressures, and begin to occupy different niches over a number of generations.



Enter a number (1-4) next to each statement to identify the order in which the events must have occurred on these two islands.

BIOLOGY.EVOLUTION
OH.PT.Q21

The table lists the presence or absence of genes for two proteins in different animal groups.

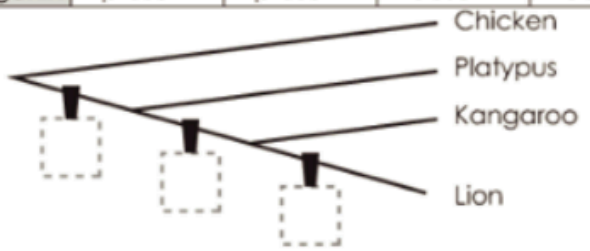
Use the data in the table to determine when the genes for these proteins appeared or were lost within the cladogram shown.

Move a label into each blank box.

- You may **not** need to fill in all of the blank boxes.
- You may **not** need to use all of the labels.

Comparison of Animal Groups

	Aves (birds)	Prototheria (egg-laying mammals)	Metatheria (marsupial mammals)	Eutheria (placental mammals)
Example	Chicken	Platypus	Kangaroo	Lion
Gene				
Casein	absent	present	present	present
Vitellogenin	present	present	absent	absent



C gain of gene casein

⊖ loss of gene casein

V gain of gene vitellogenin

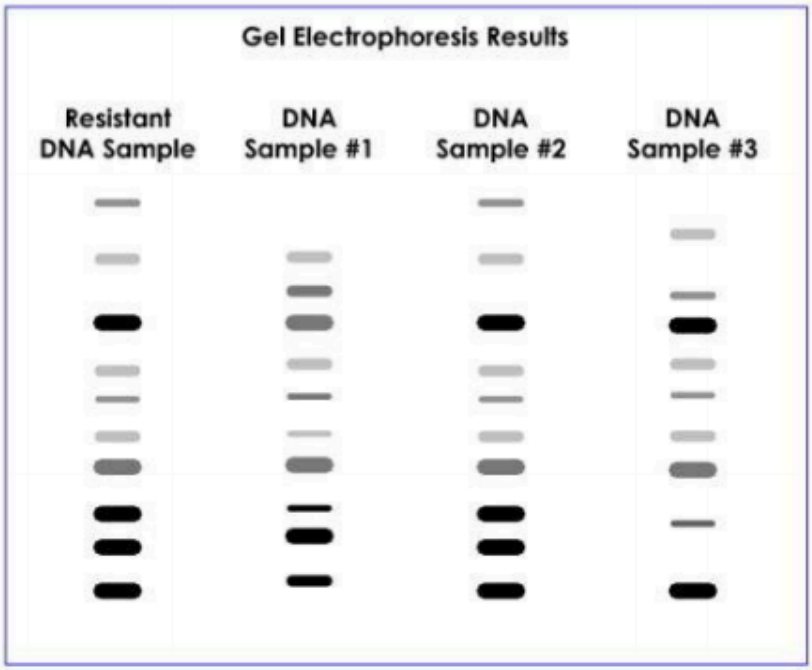
⊼ loss of gene vitellogenin

BIOLOGY.EVOLUTION
OH.2016.Q4

Scientists have found an allele of a plant gene that may protect plants from some types of insects. To determine whether this allele is present in other plants of the species or is a recent mutation, they conducted the following experiment:

- Isolate a sample of deoxyribonucleic acid (DNA) known to contain the allele from one plant that is unaffected by insects.
- Isolate a sample of DNA that may contain the allele from three plants of the same species growing in the same location.
- Treat the resistant DNA sample and the three DNA samples from the other plants with the same restriction enzymes to generate smaller segments of DNA.
- Load and run a gel electrophoresis to separate the DNA segments.
- Analyze the results of the gel electrophoresis.

Click on the DNA sample(s) that has the same allele as the resistant plant.



BIOLOGY.EVOLUTION
OH.2016.Q16

In most species, scientists have observed that related individuals share about 80% of the same genes. Cheetahs today, however, are known to share 99% of the same genes.

What does this lack of genetic diversity imply about the history of the cheetah population?

(A) Cheetahs never have experienced mutations.

(B) Cheetahs have experienced reproductive isolation.

(C) Cheetahs interbred with other large cat species.

(D) Cheetahs share a common ancestor with other large cat species.

BIOLOGY.EVOLUTION
OH.2016.Q20

A population of stone crabs is composed equally of three phenotypes:

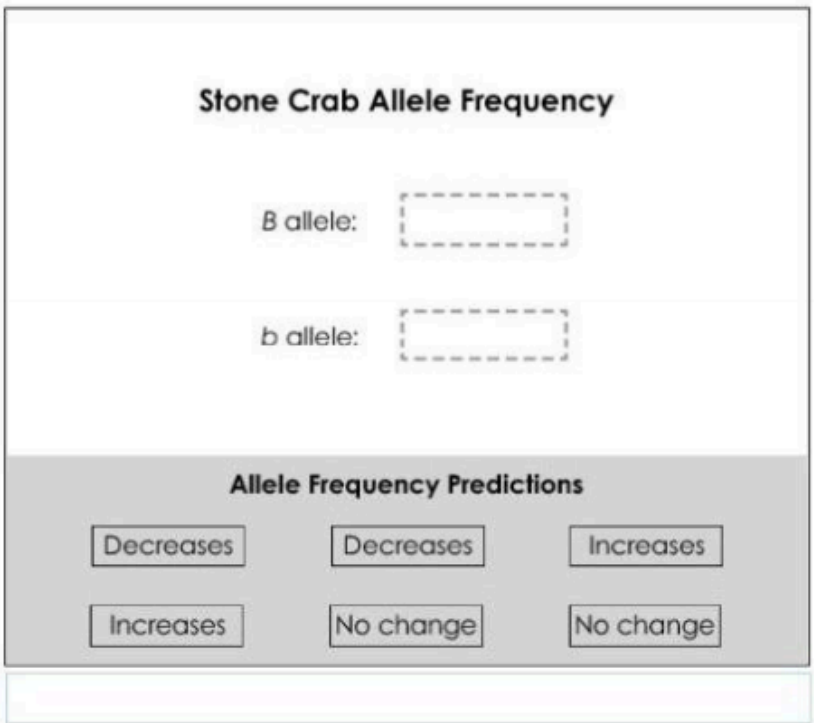
- dark brown (BB)
- medium brown (Bb)
- light brown (bb)

The crabs' color is controlled by incomplete dominance.

An introduced crab predator favors medium brown crabs, while avoiding the dark brown and light brown crabs. Predict how this selection pressure will affect the relative frequencies of the *B* and *b* alleles in future generations of crabs. Assume all other selection pressures remain the same, and that there is no migration of crabs into or out of the population.

Move a prediction label into the blank box next to each allele.

- Move only **one** label into each blank box.
- You do **not** need to use all the labels.



BIOLOGY.EVOLUTION

OH.2016.Q21

Rabbits were introduced to Australia in the 1800s. They rapidly overpopulated because they had few natural predators in the area. To control their population, scientists introduced a rabbit-specific virus into the population, and their numbers greatly decreased. However, after several generations, the rabbit population began to increase again.

Which statement explains the new increase in the number of rabbits?

(A) The rabbits interbred with native rabbit species.

(B) Some of the rabbits had a natural immunity to the virus.

(C) Some of the rabbits learned to survive even though they were sick.

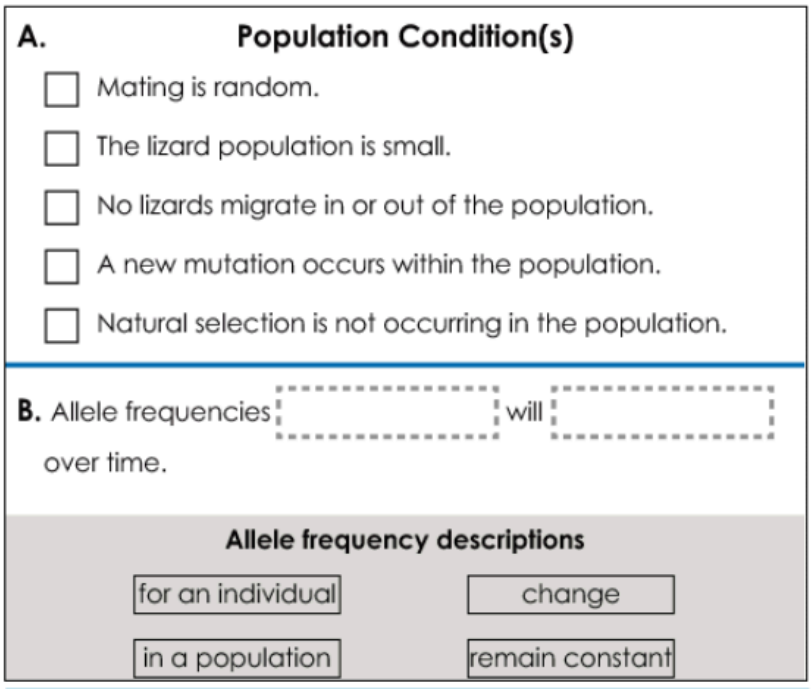
(D) The rabbits were able to have more offspring by changing their reproductive cycles.

BIOLOGY. EVOLUTION
OH.2017.Q13

A scientist studies a population of lizards to determine whether or not the population is evolving.

A. Click on the condition(s) that would cause the population to be in Hardy-Weinberg equilibrium.

B. Move the correct word or phrase into the blank boxes to describe what occurs when Hardy-Weinberg conditions are met.



BIOLOGY. EVOLUTION
OH.2017.Q46

A biologist sequences a gene shared by five different species. The percentage of sequence similarity for four different gene segments, A, B, C, and D, are shown in the table.

Percentages of Gene Sequence Similarities

Species	A	B	C	D
1	100	100	100	100
2	97	93	98	97
3	99	98	99	99
4	99	99	99	99
5	90	87	81	93

Using the data in the table, move the species labels into the blank boxes of the cladogram to show the relationships among the species.

- Use only **one** species label in each blank box you fill in.