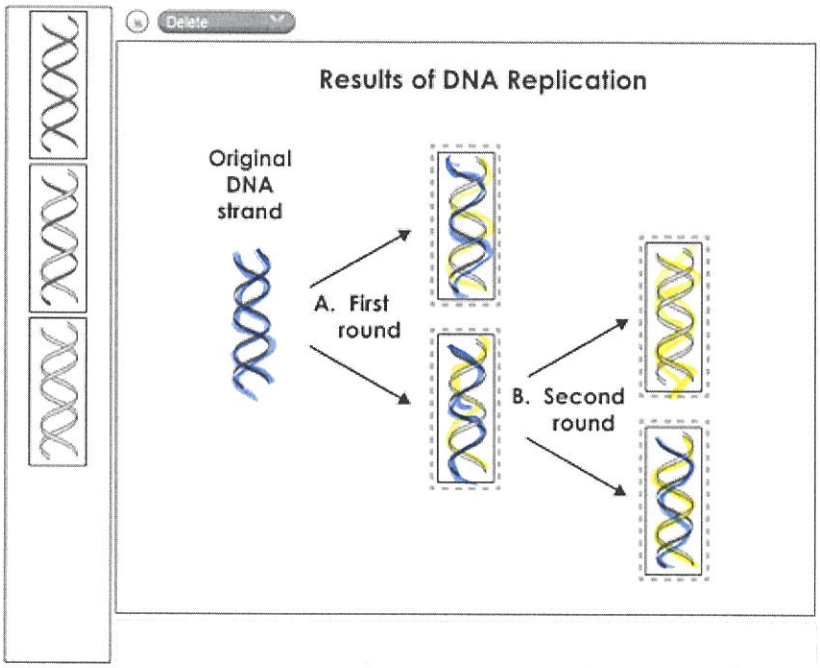
Sample Response: 2 points

The partially completed diagram shows a double-stranded DNA molecule undergoing two rounds of DNA replication. The original DNA strands are shown in blue. Newly formed DNA strands are shown in yellow.

A. Place a DNA molecule into each of the blank boxes to predict the results of the first round of DNA replication.

B. Place a DNA molecule into each of the blank boxes to predict the results of the second round of DNA replication.

- Place only **one** molecule in each blank box.
- You may use each molecule more than once.



Notes on Scoring

This response earns full credit (2 points) because it selected the blue and yellow DNA to illustrate what happens after the first round of replication. The blue strand serves as the template, and the yellow strand is newly formed DNA. The second round of replication correctly illustrates a blue and yellow DNA strand (double helix) and a completely yellow DNA strand (double helix). The placement of the resulting DNA does not impact scoring.

Sample Response: 2 points

Scientists are studying the protein in the Na^+-K^+ pump found in nerve and muscle cells from a pig. They are interested in learning how DNA and proteins from two different types of cells from the same organism compare to one another.

Describe the results scientists should see if they test both cells for the presence of the gene that produces this protein in the Na^+-K^+ pump.

Describe how protein synthesis is required to express the gene that produces this protein in the Na^+-K^+ pump.

Type your answer in the space provided.

The scientist should find that both cells should have the gene needed to produce the protein in the 'na+-K+ pump. In order for that gene to be expressed it must first undergo transcription and become an mRNA which must then undergo translation to be expressed as a protein.

Notes on Scoring

This response earns full credit (2 points) because it correctly states that "both cells should have the gene needed to produce the protein... ." It goes on to explain that the gene "must first undergo transcription and become an mRNA which must then undergo translation to be expressed as a protein."

Sample Response: 2 points

Scientists are studying the protein in the Na^+-K^+ pump found in nerve and muscle cells from a pig. They are interested in learning how DNA and proteins from two different types of cells from the same organism compare to one another.

Describe the results scientists should see if they test both cells for the presence of the gene that produces this protein in the Na^+-K^+ pump.

Describe how protein synthesis is required to express the gene that produces this protein in the Na^+-K^+ pump.

Type your answer in the space provided.

The scientists should see the exact same DNA sequence in each cell. Each cell in the same organism has the same DNA sequnce. This DNA sequnce is used to make proteins though portein synthesis. The DNA is transcribed to mRNA. Then the mRNA moves to a ribosome in the cytoplasm. In the ribosome, it is translated. tRNA brings the correct anti codon for each amino acid, as well as the correct amino acid for the mRNA. Three nucleotide bases on the mRNA acount for one amino acid. As the amino acids continue to come a protein is build by binding the amino acids with peptide bonds. However, not every protein is made every single time. Ou bodies have a way of just using protein synthesis on just a partial part of DNA, so that only a certain protein is synthesized.

Notes on Scoring

This response earns full credit (2 points) because it correctly addresses both tasks of the item. The first: "Each cell in the same organism has the same DNA sequence." The second: "The DNA is transcribed to mRNA. Then the mRNA moves to a ribosome in the cytoplasm. In the ribosome, it is translated. tRNA bring the correct anti codon for each amino acid, as well as the correct amino acid for the mRNA... ." The response goes on to provide more details about protein synthesis.

Sample Response: 2 points

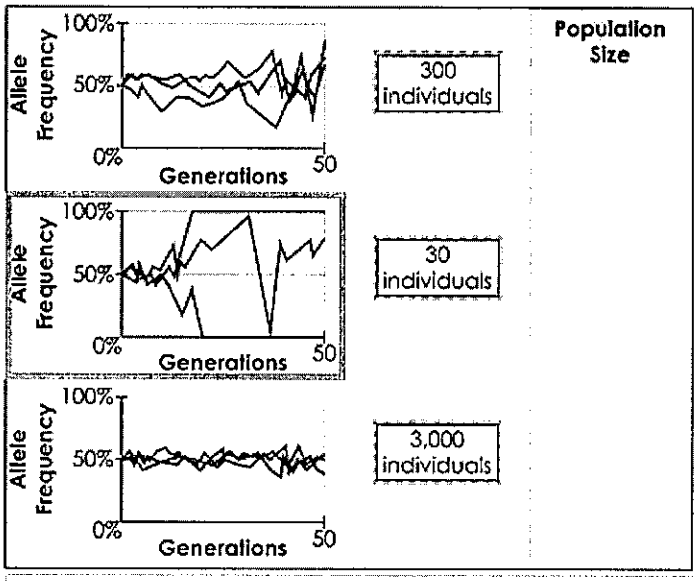
A computer program models the changing frequency of a single allele for three different population sizes. For each population, the program runs three simulations for fifty generations. The changes in allele frequency for each simulation are graphed as shown.

Determine which allele frequency graph matches which population size.

A. Move the correct population size labels into the blank boxes next to the appropriate graphs.

B. Click on the graph that shows the greatest impact on genetic variation from genetic drift.

- Use only one label in each blank box.



Notes on Scoring

This response earns full credit (2 points). It correctly matches the population size with the proper allele frequency graph. In large populations, the effect of genetic drift is minimal, but it has a greater impact in small populations. In a small population, genetic drift can result in some alleles occurring more frequently while others occur less frequently. The response correctly selects the middle graph, which indicates the smallest population that shows the greatest impact on genetic variation from genetic drift.

Sample Response: 2 points

Scientists study the evolutionary relationships of species to better understand the history of life on Earth.

Describe two methods that scientists can use to determine whether two species (modern or extinct) are closely related.

Type your answer in the space provided.

One method used by scientists to determine relation is the study of skeletal structure, or fossil remains. Related animals will often share many similar body structures, and usually have similar shape. Another method used is the direct comparison of DNA samples. The DNA of related species is often very similar, such as that of a human and a chimpanzee.

Notes on Scoring

This response earns full credit (2 points) because it correctly identifies two methods that scientists can use to determine the relatedness of two species: "...to determine relation is the study of skeletal structure, or fossil remains...Another method used is the direct comparison of DNA samples."

Sample Response: 2 points

Scientists study the evolutionary relationships of species to better understand the history of life on Earth.

Describe two methods that scientists can use to determine whether two species (modern or extinct) are closely related.

Type your answer in the space provided.

Two methods scientists could use to determine if two species (modern or extinct) are closely related would be: examining bone structure and genetic makeup. By examing bone structure from fossils of an animal personally you could determine if the skeletal build of the two are similar. When looking at genetics you could determine how close the two genetic make-ups are ultimately telling you how closely related they are.

Notes on Scoring

This response earns full credit (2 points) by identifying two methods for determining the relatedness of two species: "Two methods scientists could use to determine if two species (modern or extinct) are closely related would be: examining bone structure and genetic makeup."

Sample Response: 2 points

Scientists study the evolutionary relationships of species to better understand the history of life on Earth.

Describe two methods that scientists can use to determine whether two species (modern or extinct) are closely related.

Type your answer in the space provided.

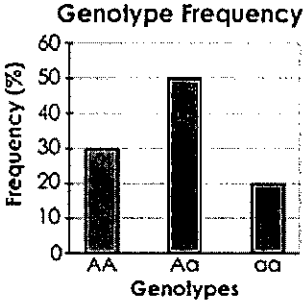
To decide whether two species are closely related, scientists can look at the skeletons of the species and at the species' DNA if available. Similar species have similar bone structure. Changes in bone structure over time can also be seen by the skeleton. For example, the tail cone on a human links us to monkeys. DNA can also be used if it can be found in the bones or something of extinct animals. Comparing strands of DNA can reveal the differences between species, but also illustrated the similarities if a large part of the DNA strands match.

Notes on Scoring

This response earns full credit (2 points) by identifying two methods for determining the relatedness of two species: "...scientists can look at the skeletons of the species and at the species' DNA if available."

Sample Response: 2 points

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.

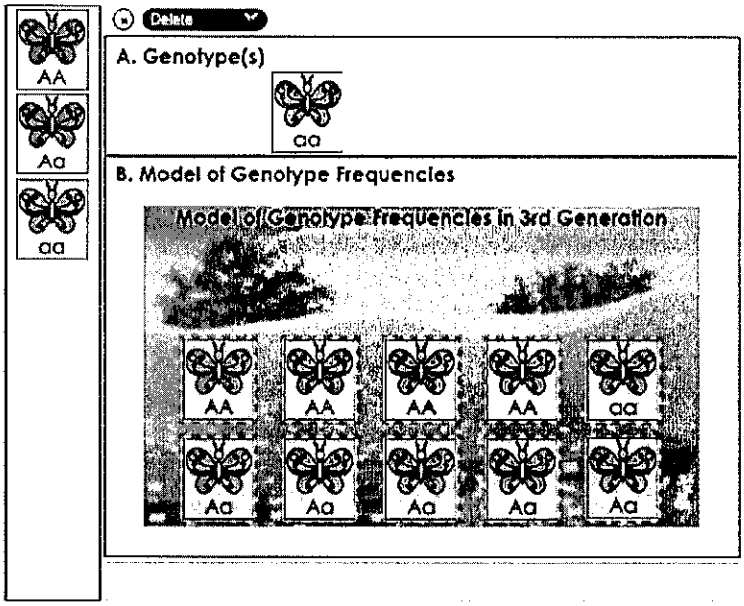


If a predator introduced to the butterfly habitat prefers the yellow trait, predict the genotype frequencies that will occur in the third generation.

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.

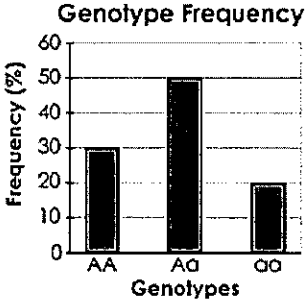


Notes on Scoring

This response earns full credit (2 points). It correctly identifies the genotype that will have the higher rate of predation ("aa") and builds an accurate third generation model of genotypes, which should have ten butterflies with only one genotype "aa"(1), at least one "Aa"(5) and a high number of "AA"(4).

Sample Response: 2 points

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.



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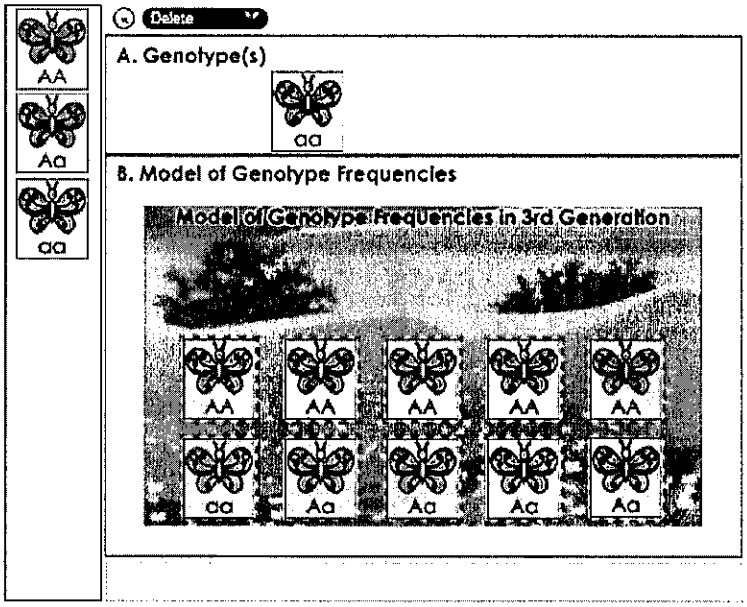
- There may be more than one correct answer.
- You may use each butterfly more than once.

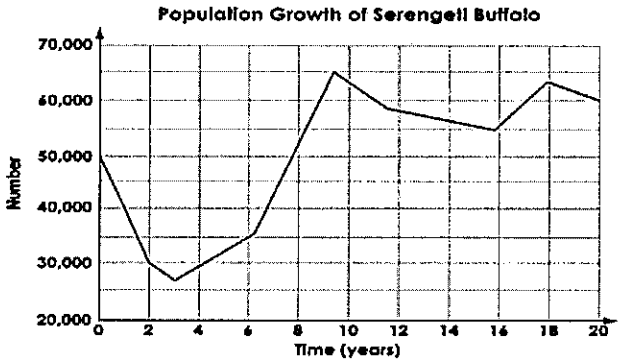


Notes on Scoring

This response earns full credit (2 points). It correctly identifies the genotype that will have the higher rate of predation ("aa") and builds an accurate third generation model of genotypes, which should have ten butterflies with only one genotype "aa"(1), at least one "Aa"(4) and a high number of "AA"(5).

Sample Response: 1 point

The graph shows how a Serengeti buffalo population changed over a period of years. During this time period, the buffalo were affected by the rinderpest virus, a debilitating disease with a high mortality rate. However, within five years, the virus was eliminated.



What was the ecosystem's carrying capacity for buffalo, based on the graph, once rinderpest was eliminated?

- Ⓐ 35,000 buffalo
- Ⓑ 55,000 buffalo
- ● 60,000 buffalo
- Ⓓ 65,000 buffalo

Question 2

The table compares structures found in several groups of photosynthetic organisms. The presence of a structure is symbolized by a (+) symbol, while the absence of a structure is symbolized by a (-) symbol.

Using the data in the table, determine where on the cladogram some of the structures evolved.

Place a structure number label into each blank box.

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

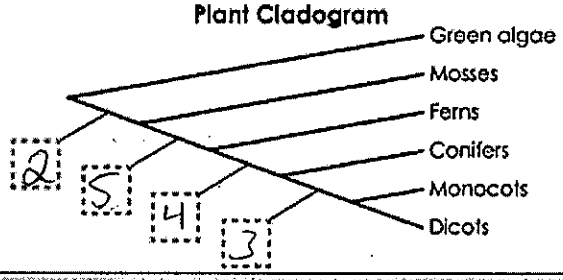
1
2
3
4
5

Delete

Structures of Photosynthetic Organisms

	Green Algae	Moss	Fern	Conifer	Monocot	Dicot
1. Chloroplasts	+	+	+	+	+	+
2. Cuticle	-	+	+	+	+	+
3. Flowers	-	-	-	-	+	+
4. Seeds	-	-	-	+	+	+
5. Vascular Tissue	-	-	+	+	+	+

Plant Cladogram



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

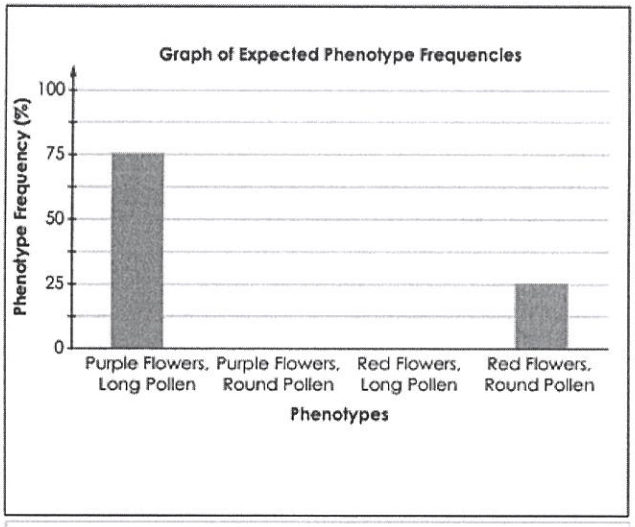
- Labels placed from Left to Right: "2," "5," "4," "3" (1 point).

Sample Response: 1 point

Students conduct an experiment to test whether or not the trait for pollen shape and the trait for flower color are next to each other on the same chromosome in pea plants. They cross two plants that are known to be heterozygous for both traits to produce offspring.

Long pollen shape (L) is dominant over round pollen shape (l). Purple flower color (P) is dominant over red flower color (p).

Click on the value of each phenotype frequency on the graph that would be expected if the traits are linked and the dominant traits are next to each other on the same chromosome for both plants.



Notes on Scoring

This response earns full credit (1 point) because it correctly indicates the value of each phenotype frequency on the graph: "75" for Purple Flowers, Long Pollen and "25" for Red Flowers, Round Pollen. The response also indicates "0" for Purple Flowers, Round Pollen and "0" for Red Flowers, Long Pollen.

If linked

LP lp x LP lp

	LP	lp
LP	LLPP	LlPp
lp	LlPp	llpp

75/25

If unlinked

LlPp x LlPp

	LP	Lp	lP	lp
LP	LLPP	LLPp	LlPP	LlPp
Lp	LLPp	LLpp	LlPp	Llpp
lP	LlPP	LlPp	llPP	llPp
lp	LlPp	Llpp	llPp	llpp

L = long
l = round
P = purple
p = red

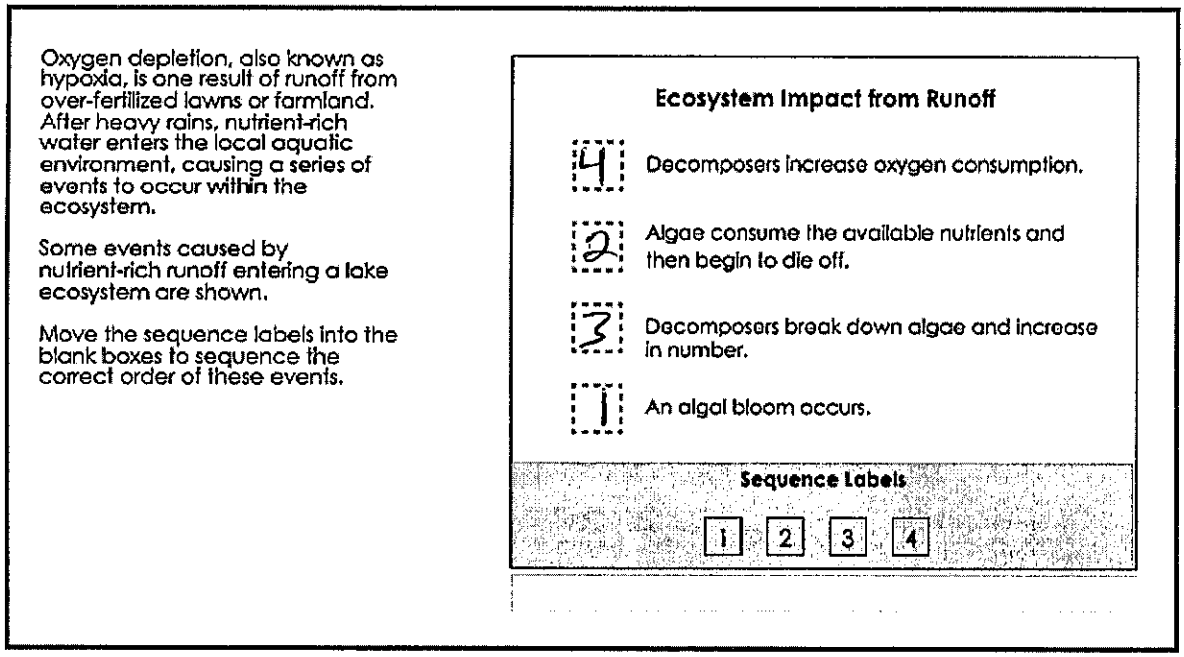
P = long, purple 9
long, red 3
short, purple 3
short, red 1

Sample Response: 1 point

A scientist isolates a number of non-photosynthetic prokaryotes. Which structure would be found in these cells?

- ● cell walls
- Ⓑ chloroplast
- Ⓒ golgi
- Ⓓ nucleus

Question 5



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- "4" placed next to "Decomposers increase oxygen consumption";

  AND
- "2" placed next to "Algae consume the available nutrients and the begin to die off";

  AND
- "3" placed next to "Decomposers break down algae and increase in number";

  AND
- "1" placed next to "An algal bloom occurs (1 point)."

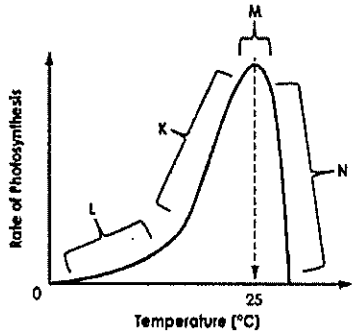
Question 6

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

Part A

Students in a biology class conduct an experiment to determine the effect of temperature on the rate of photosynthesis in a plant. They place an *Elodea* plant into a test tube filled with water. Then, the students place the test tube under a light and slowly increase the temperature of the water. They record their results and display them on a graph as shown.

Photosynthesis vs. Temperature Experiment



Which statement is supported by the data in the graph?

Ⓐ The rate of oxygen production is lowest in section M.

Ⓑ The rate of oxygen production is greatest in section M.

Ⓒ The production of water molecules is greatest in section L.

Ⓓ The number of carbon dioxide molecules in the beaker is greatest in section K.

Part B

Which statement explains the effect of temperature on the rate of photosynthesis?

Ⓐ Oxygen molecules break down at temperatures above 25°C.

Ⓑ The rate of photosynthesis is unaffected by the temperature of the water.

Ⓒ The number of chloroplasts in the cell decreases as temperature increases.

Ⓓ Enzymes involved with plant photosynthesis are disrupted at temperatures above 25°C.

Points Possible: 1

See **Alignment** for more detail.

Question 7

A scientist is examining a pedigree that includes several generations of an organism with XX/XY chromosome sex determination.

Which pattern of inheritance would support the hypothesis that the trait being studied is a recessive sex-linked trait found on the X chromosome?

(A) The trait is only expressed in males who have a father with the trait.

(B) The trait is expressed in half of the female organisms and all of the male organisms.

(C) The trait is mostly expressed in males who have a maternal grandfather with the trait.

(D) The trait is mostly expressed in females who have a paternal grandmother with the trait.

$X^R X^r$

$X^r R r$ rr

Y R r

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. A son can only inherit an X-linked trait from his mother. A father only contributes a Y chromosome to his sons.

Rationale for Option B: This is incorrect. Sex-linked traits are typically expressed in higher frequency in males than females. However, it would not be typical for all of the males to express the trait.

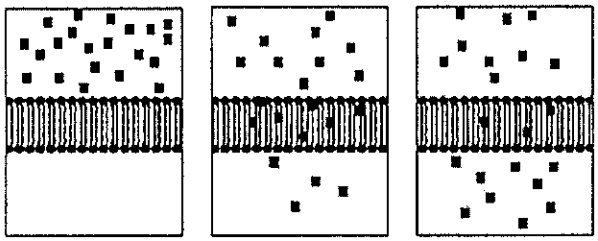
Rationale for Option C: **Key** – The maternal grandfather passes the X-linked trait to the mother and the mother passes the X-linked trait to the son. This is a typical pattern of inheritance for an X-linked trait.

Rationale for Option D: This is incorrect. Since the X-linked trait is recessive, females would have to inherit the trait from both mother and father in order to express the trait.

Question 8

The diagram models the time-lapse movement of particles across a cell membrane. The particles have characteristics that allow them to pass freely across the membrane.

Particles Crossing a Membrane over Time



Time 1 Time 2 Time 3

Select all of the statements that describe the particles or their movement based on the time-lapse diagram.

- [x] The particles crossing the membrane do not have a charge.
- [ ] The movement across the membrane requires energy from ATP.
- [ ] The movement across the membrane requires energy from glucose.
- [x] The movement across the membrane does not require added energy.
- [ ] The particles crossing the membrane could be proteins or carbohydrates.
- [x] The particles crossing the membrane could be water (H_2O) or oxygen (O_2).
- [ ] The particles crossing the membrane have a strong positive or negative charge.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: **Key** – Only small, uncharged particles like water and oxygen can diffuse across the cell membrane.

Rationale for Option B: This is incorrect. Diffusion does not require ATP.

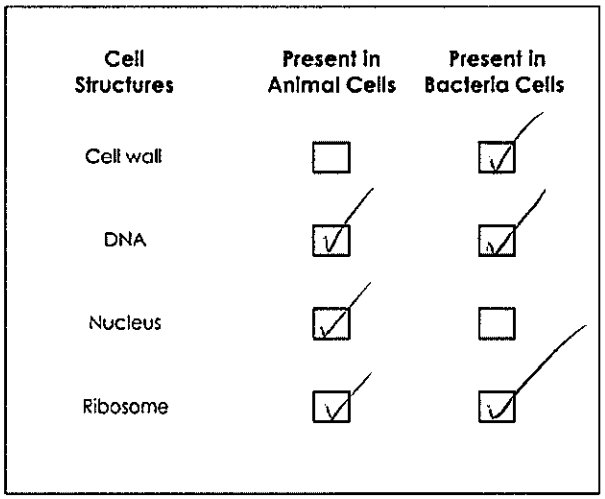
Rationale for Option C: This is incorrect. Diffusion is not powered by glucose.

Rationale for Option D: **Key** – Diffusion or osmosis does not require additional energy from ATP.

Question 9

Identify which structures are present in animal cells and which structures are present in bacteria cells.

Click on the blank box next to a structure to mark it as present in each of the two cell types.



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- "Cell wall" selected for "Bacteria Cells;"

  AND

- "DNA" selected for both;

  AND

- "Nucleus" selected for "Animal Cells;"

  AND

- "Ribosome" selected for both (1 point).

Question 10

The table shows sample cells taken from tissues of two individuals of the same species. DNA from each cell is analyzed using gel electrophoresis.

Gel Electrophoresis Cell Comparison

Cell	Tissue Source Individual A	Tissue Source Individual B
1	Liver	Liver
2	Lung	Skin
3	Muscle	Muscle
4	Blood	Pancreas

Which prediction will be supported by the results of the gel electrophoresis analysis?

Ⓐ Cell 1 from Individual A will have an identical banding pattern compared to Cell 1 from Individual B.

Ⓑ Cell 1 from Individual A will have an identical banding pattern compared to Cell 2 from Individual A.

Ⓒ Cell 1 from Individual A will have a different banding pattern compared to Cell 3 from Individual A.

Ⓓ Cell 1 from Individual A will have a different banding pattern compared to Cell 4 from Individual A.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. DNA taken from different individuals will produce different gel banding patterns.

Rationale for Option B: **Key** – Diploid cells taken from the same individual will produce almost identical gel electrophoresis patterns since each cell has the identical genetic make-up.

Rationale for Option C: This is incorrect. Diploid cells taken from the same individual will produce almost identical gel electrophoresis patterns since each cell has the identical genetic make-up.

Rationale for Option D: This is incorrect. Diploid cells taken from the same individual will produce almost identical gel electrophoresis patterns since each cell has the identical genetic make-up.

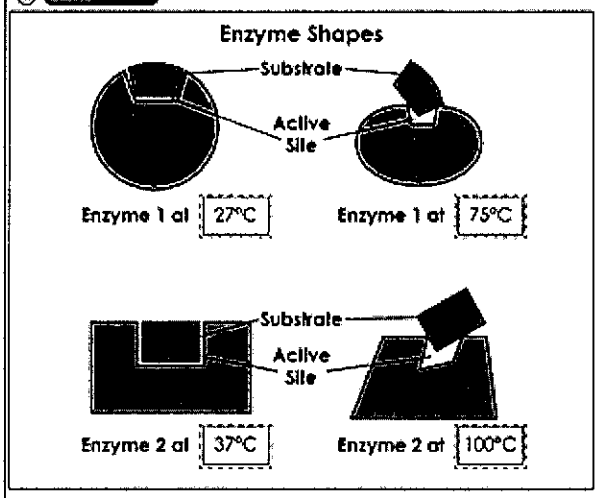
Sample Response: 1 point

The diagram models the shapes of Enzyme 1 and Enzyme 2 at different temperatures. Use data from the simulation to predict the effects of different temperatures on each enzyme's shape.

Place a temperature label into each blank box to indicate how temperature would affect the shape of the enzymes.

- Place only **one** temperature label in each box.
- You may use each temperature label more than once.
- There may be more than one correct answer.
- You do not need to use all the temperature labels.

27°C
37°C
75°C
100°C



Notes on Scoring

This response earns full credit (1 point) because for Enzyme 1 it indicates "27°C" and "75°C," and for Enzyme 2, "37°C" and "100°C." For this item, for Enzyme 1, a full-credit response includes "27°C" or "37°C" placed in the left box and "75°C" or "100°C" placed in the right box. For Enzyme 2, a full-credit response includes "27°C" or "37°C" or "75°C" placed in the left box and ONLY "100°C" placed in the right box.

Sample Responses: 1 point

A scientist concludes that the bacteria from which Enzyme 1 was isolated are at risk because of significant temperature increases in their environment.

Explain how data from the simulation on enzyme activity support this conclusion.

Type your answer in the space provided.

When the temperature increased above 37 degrees C, there was no mater displacement and no bubbles, signalling that there had been no reaction.

Notes on Scoring

This response earns full credit (1 point) because the student explains that when the temperature increased "...there had been no reaction."

A scientist concludes that the bacteria from which Enzyme 1 was isolated are at risk because of significant temperature increases in their environment.

Explain how data from the simulation on enzyme activity support this conclusion.

Type your answer in the space provided.

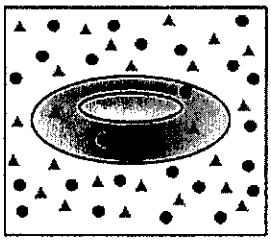
The data from the enzyme activity prove this due to how as the tempature exceded 37 degrees celcius the enzymes ceased to function and therefore would not be able to perform their duties inside the bacteria.

Notes on Scoring

This response earns full credit (1 point) because it explains that when the temperature increased "...the enzymes ceased to function."

Question 14

A red blood cell is placed into an aqueous solution. The red blood cell has a lower concentration of protein and sugar than the aqueous solution, as shown in the diagram. In the diagram, the volume of the cell is equal to the volume outside the cell.



Key	
▲	Protein
	Red Blood Cell
●	Sugar

What is most likely to occur?

Ⓐ Water from the solution will diffuse into the red blood cell.

Ⓑ Water from the red blood cell will diffuse into the solution.

Ⓒ Protein and sugar from the solution will diffuse into the red blood cell.

Ⓓ Protein and sugar from the red blood cell will diffuse into the solution.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. Water will diffuse out of the cell.

Rationale for Option B: **Key** – Water will diffuse from high concentration (in the cell) to low concentration (out of the cell).

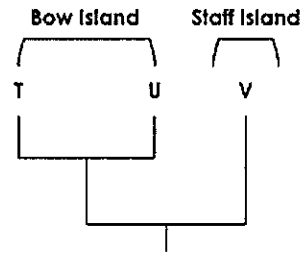
Rationale for Option C: This is incorrect. Sugar and proteins cannot diffuse into a red blood cell.

Rationale for Option D: This is incorrect. Sugar and proteins cannot diffuse into a red blood cell.

Question 15

Speciation is occurring in lizard populations on two isolated islands, Staff Island and Bow Island. Based on evidence collected over a long period of time, biologists create the lizard species cladogram shown.

Island Lizard Cladogram



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

Event Order	Statement
2	Biologists observe lizard breeding pairs from Staff Island arriving on Bow Island.
1	Biologists observe a population of lizards that inhabits Staff Island, but that no lizards are present on Bow Island.
4	Biologists determine that experimental matings of lizards from different island lizard populations are unable to produce offspring.
3	The lizards on Bow Island experience different selection pressures, and begin to occupy different niches over a number of generations.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- Statements ordered 2, 1, 4, 3 (1 point).

Question 16

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

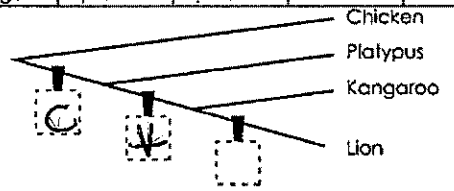
Use the data in the table to determine when the genes for these proteins appeared or were lost within the cladogram shown.

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

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- "Gain of casein" placed in the left box;

  AND

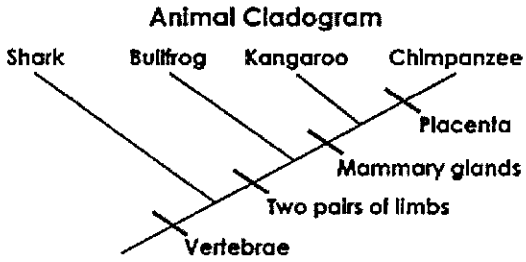
- "Loss of vitellogenin" placed in the middle box;

  AND

- Nothing placed in the right box (1 point).

Question 17

The evolutionary relationships among four animals and four animal traits are shown in the cladogram.



Select the boxes to identify the trait(s) that each animal possesses.

	Bullfrog	Chimpanzee	Kangaroo	Shark
Placenta	☐	☑	☐	☐
Vertebrae	☑	☑	☑	☑
Mammary glands	☐	☑	☑	☐
Two pairs of limbs	☑	☑	☑	☐

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- "Placenta" selected for "Chimpanzee"

  AND

- "Vertebrae" selected for "Bullfrog," "Chimpanzee," "Kangaroo" and "Shark"

  AND

Question 18

When DNA mutations occur, they can have a variety of effects on an organism.

A. Place a nucleotide in the DNA sequence to create a point mutation that would shorten the protein.

B. Place a nucleotide in the DNA sequence to create a point mutation that would **not** produce a change in the protein.

- You do **not** need to use all the nucleotides.
- You may use a nucleotide more than once.
- There may be more than one correct answer.

A C G T U

Delete

Universal Genetic Code Chart

Messenger RNA Codons and Amino Acids for Which They Code

First base	Second base: U	Second base: C	Second base: A	Second base: G	Third base
U	UUU, UUC: PHE; UUA, UUG: LEU	UCU, UCC, UCA, UCG: SER	UAU, UAC: TYR; UAA, UAG: STOP	UGU, UGC: CYS; UGA: STOP; UGG: TRP	U C A G
C	CUU, CUC, CUA, CUG: LEU	CCU, CCC, CCA, CCG: PRO	CAU, CAC: HIS; CAA, CAG: GLN	CGU, CGC, CGA, CGG: ARG	U C A G
A	AUU, AUC, AUA: ILE; AUG: MET or START	ACU, ACC, ACA, ACG: THR	AAU, AAC: ASN; AAA, AAG: LYS	ACU, ACC: SER; ACA, ACG: ARG	U C A G
G	GUU, GUC, GUA, GUG: VAL	GCU, GCC, GCA, GCG: ALA	GAU, GAC: ASP; GAA, GAG: GLU	GGU, GGC, GGA, GGG: GLY	U C A G

DNA	T	A	C	C	G	A	C	C	G	A	C	C	T	T	A

A U G G C U G G C U G G A A U – mRNA

C G G
G C C

A T C A
U A G

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- "T" placed at position 11 or 12

  AND

- "G," "T" or "C" placed at position 6

  OR

- "A," "T" or "C" placed at position 9

  OR

- "G" placed at position 15 (1 point).

Sample Response: 1 point

When DNA mutations occur, they can have a variety of effects on an organism.

A. Place a nucleotide in the DNA sequence to create a point mutation that would shorten the protein.

B. Place a nucleotide in the DNA sequence to create a point mutation that would **not** produce a change in the protein.

- You do **not** need to use all the nucleotides.
- You may use a nucleotide more than once.
- There may be more than one correct answer.

A C G T U

Delete

Universal Genetic Code Chart

Messenger RNA Codons and Amino Acids for Which They Code

First base	Second base U	Second base C	Second base A	Second base G	Third base
U	UUU, UUC: PHE; UUA, UUG: LEU	UCU, UCC, UCA, UCG: SER	UAU, UAC: TYR; UAA, UAG: STOP	UGU, UGC: CYS; UGA: STOP; UGG: TRP	U C A G
C	CUU, CUC, CUA, CUG: LEU	CCU, CCC, CCA, CCG: PRO	CAU, CAC: HIS; CAA, CAG: GLN	CGU, CGC, CGA, CGG: ARG	U C A G
A	AUU, AUC: ILE; AUA: MET or START; AUG: MET or START	ACU, ACC, ACA, ACG: THR	AAU, AAC: ASN; AAA, AAG: LYS	ACU, ACC: SER; ACA, ACG: ARG	U C A G
G	GUU, GUC, GUA, GUG: VAL	GCU, GCC, GCA, GCG: ALA	GAU, GAC: ASP; GAA, GAG: GLU	GGU, GGC, GGA, GGG: GLY	U C A G

DNA	T	A	C	C	G	G	C	C	A	A	C	T	T	T	G

Notes on Scoring

This response earns full credit (1 point) because it correctly places "G" at position 6, "A" at position 9, "T" at position 12 and "G" at position 15. A full-credit response includes "T" placed at position 11 or 12 AND "G," "T" or "C" placed at position 6, OR "A," "T" or "C" placed at position 9, OR "G" placed at position 15.

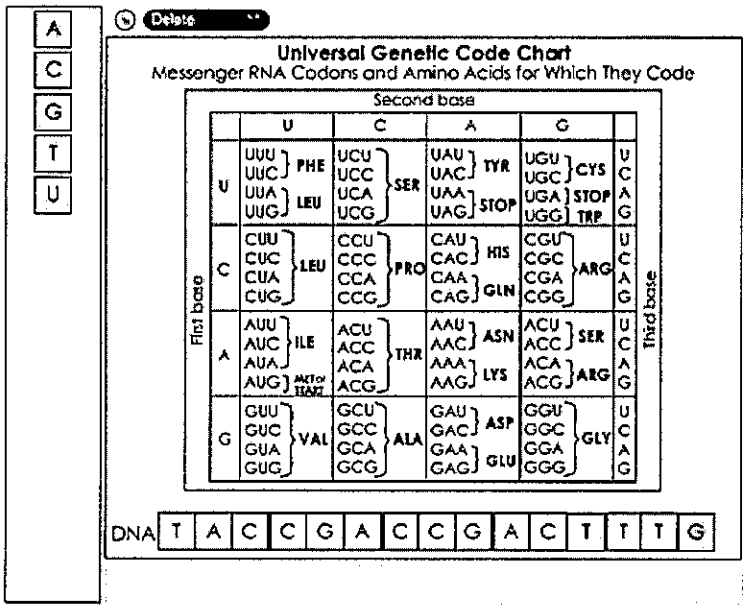
Sample Response: 1 point

When DNA mutations occur, they can have a variety of effects on an organism.

A. Place a nucleotide in the DNA sequence to create a point mutation that would shorten the protein.

B. Place a nucleotide in the DNA sequence to create a point mutation that would **not** produce a change in the protein.

- You do **not** need to use all the nucleotides.
- You may use a nucleotide more than once.
- There may be more than one correct answer.



Notes on Scoring

This response earns full credit (1 point) because it correctly places "T" at position 12 and "G" at position 15. A full-credit response includes "T" placed at position 11 or 12 AND "G," "T" or "C" placed at position 6, OR "A," "T" or "C" placed at position 9, OR "G" placed at position 15.

Question 19

A scientist is trying to determine the evolutionary relationships among species with very similar physical characteristics. One method to determine the relationships is by comparing amino acid sequences of proteins.

Why would the scientist compare the amino acid sequences of proteins common to those similar species?

Ⓐ Amino acid sequence differences provide evidence of gene flow among the species.

● Amino acid sequence differences reflect the accumulated differences in the DNA of the species.

Ⓒ Amino acid sequence differences are the only useful data for constructing accurate cladograms of the species.

Ⓓ Amino acid sequence differences are the result of mutations caused by different selection pressures experienced by the species.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. Amino acid sequence comparison does not provide any evidence of gene flow.

Rationale for Option B: **Key** – Amino acid sequence differences are based on differences in DNA base sequences due to accumulated mutations.

Rationale for Option C: This is incorrect. Amino acid sequence comparison is one of many data sources useful in constructing cladograms.

Rationale for Option D: This is incorrect. Amino acid sequence differences are not caused by selection pressures.

Key

https://sat12.cloud2.tds.airast.org/student/V413/Pages/TestShell.aspx

Questions: 1 | Biology Spr16 Released Items (0 out of 21) GUEST, GUEST (SSID: GUEST) GUEST SESSION

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1

DNA samples taken from rats from the same colony produce the four gel electrophoresis banding patterns shown. Determine the relationships between Rat A and the other three rats tested: B, C, and D.

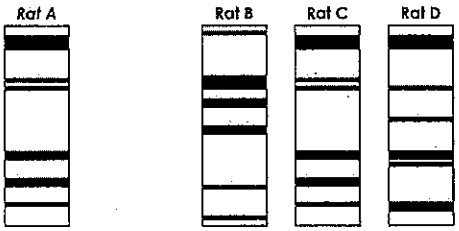
Place relationship labels into the blank boxes under the electrophoresis patterns for rats B, C, and D.

- Place only one label in each blank box.
- You may use each label more than once.

Identical Sibling
Sibling or parent
Unrelated

Delete

Gel Electrophoresis Patterns



Relationship to Rat A: not | identical | sib

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2

The table shows the number of amino acid differences among organisms A through E for a common protein with 113 amino acids.

Use the data in the table to complete the cladogram by placing an organism label in each blank box.

- Place only one organism label in each blank box.
- There may be more than one correct answer.

A
B
C
E

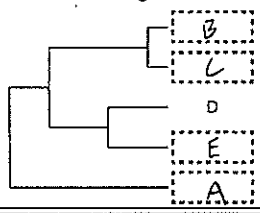
Delete

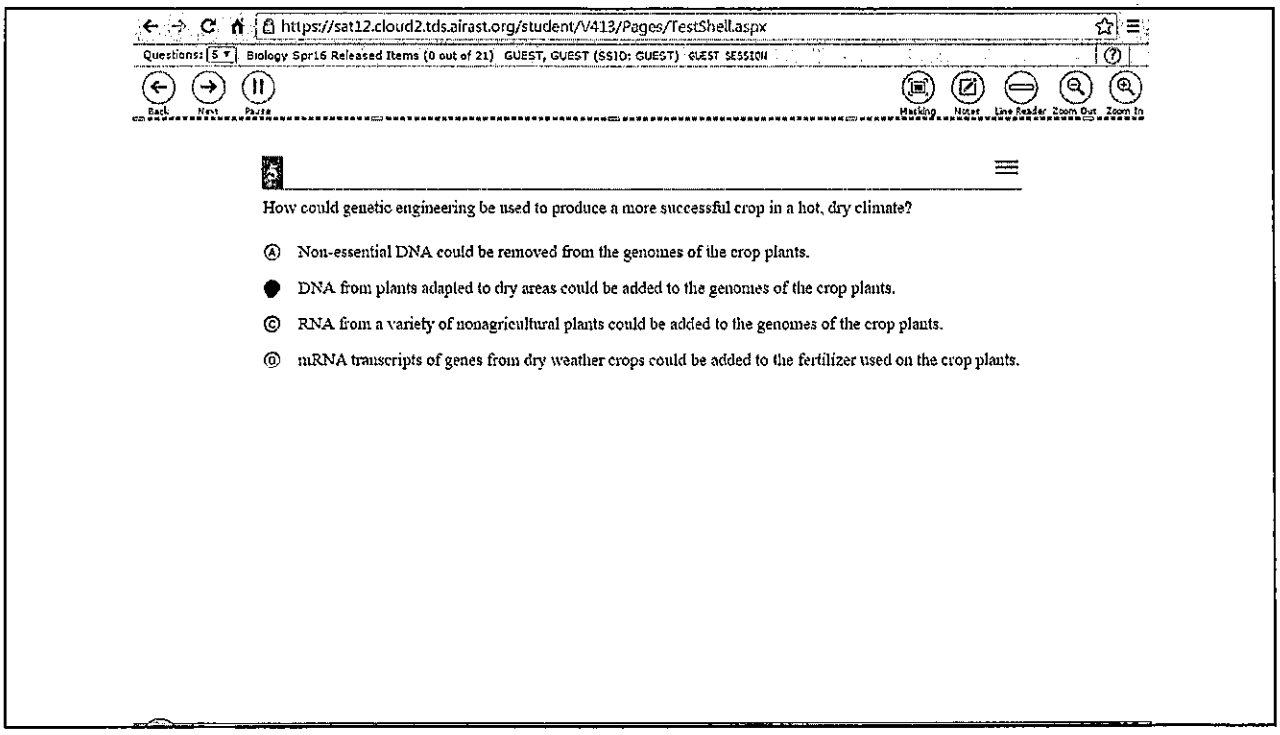
Differences in 113-Amino Acid Sequence

	A	B	C	D	E
A	—	11	10	11	14
B		—	1	9	11
C			—	8	10
D				—	3
E					—

11 11 8 8 3 8

Cladogram

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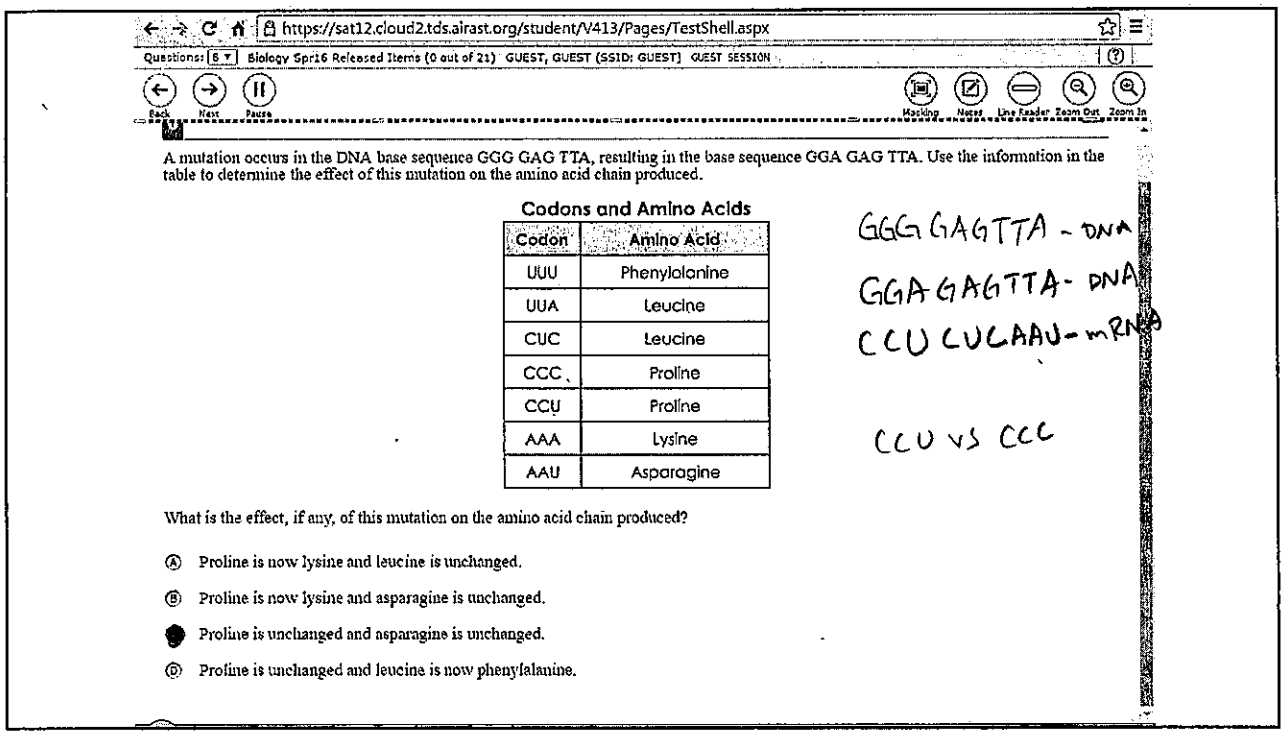
How could genetic engineering be used to produce a more successful crop in a hot, dry climate?
Ⓐ Non-essential DNA could be removed from the genomes of the crop plants.
● DNA from plants adapted to dry areas could be added to the genomes of the crop plants.
Ⓒ RNA from a variety of nonagricultural plants could be added to the genomes of the crop plants.
Ⓓ mRNA transcripts of genes from dry weather crops could be added to the fertilizer used on the crop plants.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A mutation occurs in the DNA base sequence GGG GAG TTA, resulting in the base sequence GGA GAG TTA. Use the information in the table to determine the effect of this mutation on the amino acid chain produced.
Codons and Amino Acids
Codon | Amino Acid
UUU | Phenylalanine
UUA | Leucine
CUC | Leucine
CCC | Proline
CCU | Proline
AAA | Lysine
AAU | Asparagine
GGG GAG TTA - DNA
GGA GAG TTA - DNA
CCU CUC AAU - mRNA
CCU vs CCC
What is the effect, if any, of this mutation on the amino acid chain produced?
Ⓐ Proline is now lysine and leucine is unchanged.
Ⓑ Proline is now lysine and asparagine is unchanged.
● Proline is unchanged and asparagine is unchanged.
Ⓓ Proline is unchanged and leucine is now phenylalanine.

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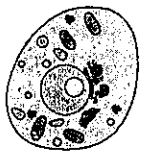
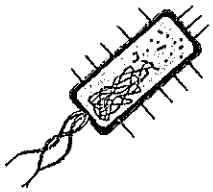
10

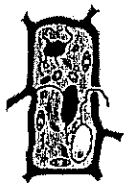
A student is asked to draw four cells.

Which drawing is a representation of a prokaryotic cell?

Ⓐ 

Ⓑ 

Ⓒ 

Ⓓ 

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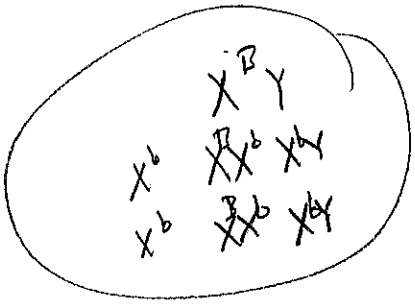
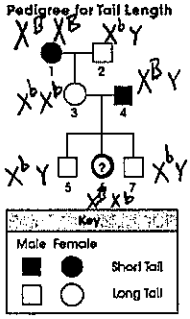
9

In a particular species of mice, a single gene (B or b) determines tail length. The short-tail allele is sex-linked and dominant. Shading in the pedigree below indicates that an individual has a short tail. The pedigree shows the pattern of inheritance of the short-tail allele over three generations of mice.



Pedigree for Tail Length



Individual 6 is female. What is the genotype of individual 6?

● $X^B X^b$

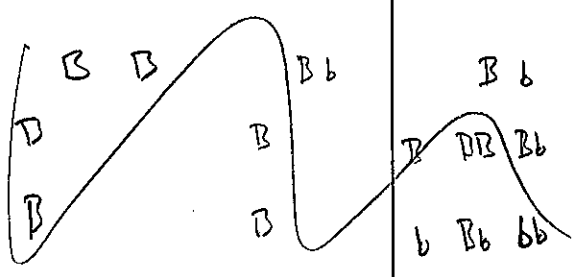
Ⓑ $X^b X^b$

Ⓒ $X^B Y$

Ⓓ $X^b Y$

B = Short tail

b = long tail



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13

A biologist conducting a long-term field study noticed there were two types of mice in a valley. One type of mouse had webbed toes, and one type of mouse lacked webbed toes. A dam was built in the valley turning the land into a wetland. As the years passed, all mice living in the valley were found to have webbed toes. No mice were found with non-webbed toes.

Which statement best explains the observed change in the mouse population?

Ⓐ Webbed toes in mice are controlled by the environment.

Ⓑ The mice grew webbing to move more efficiently in the new environment.

● Webbed-toed mice survived better and reproduced more than mice without webbed toes.

Ⓓ The increased water levels in the valley increased the mutation rate in the mouse population.

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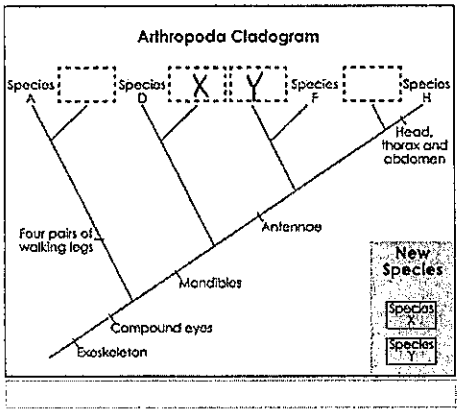
14

A cladogram of several members of the phylum Arthropoda is shown. Two new species, X and Y, have recently been discovered. The table shows the traits that these two new species possess.

Trait	Species X	Species Y
Exoskeleton	Yes	Yes
Compound Eyes	Yes	Yes
Mandibles	Yes	Yes
Antennae	No	Yes

Move the Species X and Y labels into the appropriate blank boxes in the cladogram.

- There may be more than one correct answer.
- You do not need to fill all the boxes.



17

A group of students studied four different cell specimens under a microscope and recorded information about each cell in this table.

Characteristics of Four Cell Specimens

Cell Specimen	Cell Wall	Cell Membrane	Chloroplasts	DNA in Nucleus
Cell 1	Yes	Yes	Yes	Yes
Cell 2	No	Yes	No	Yes
Cell 3	Yes	Yes	No	No
Cell 4	No	Yes	No	Yes

Which cell specimen is a prokaryote?

Ⓐ Cell 1
Ⓑ Cell 2
Ⓒ Cell 3
Ⓓ Cell 4

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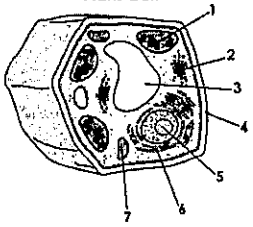
18

The diagram shows a plant cell with several structures numbered.

Plant Cell



Identify two cell structures involved in the function described.

Place a structure number into each of the blank boxes.

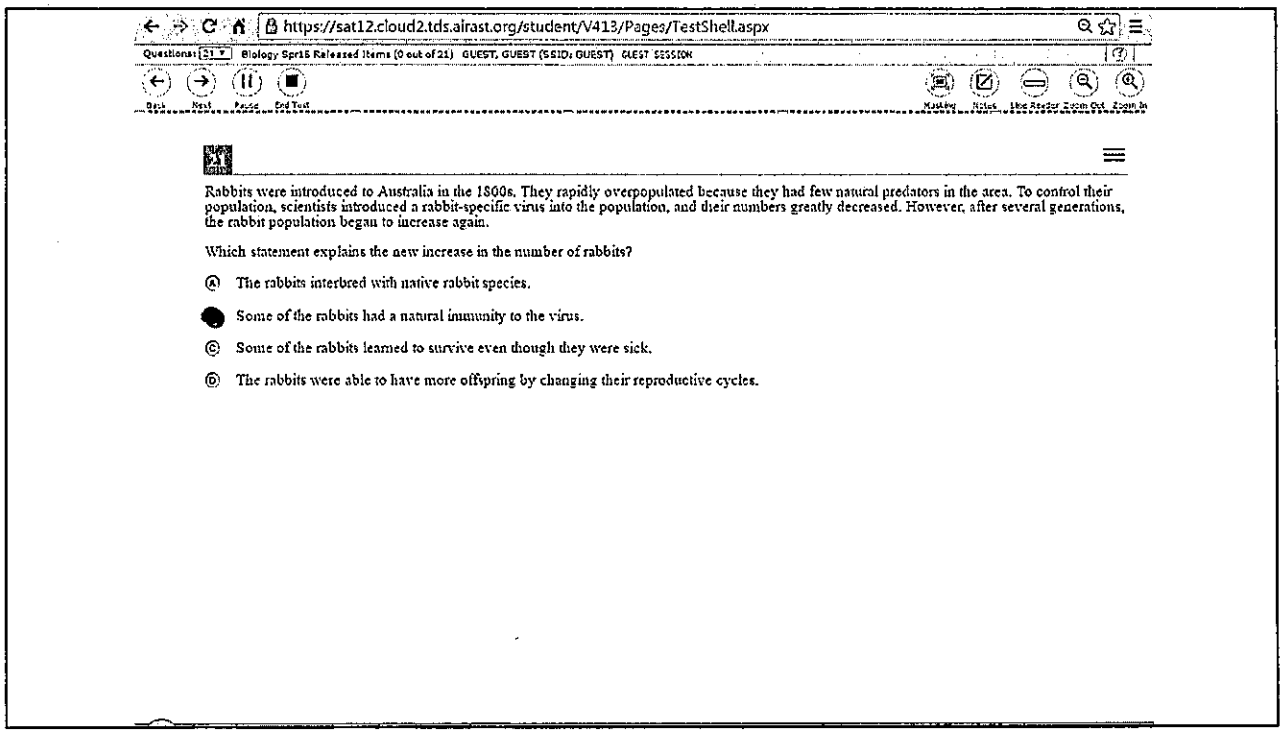
- You do not need to use all the numbers.
- Place only one number in each blank box.

1
2
3
4
5
6
7

Delete

Function of Plant Cell Organelles

2 6 Modify proteins and transport them out of the cell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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.