

STUDENTS

This Biology practice book was put together with the purpose of providing you a way to measure what you have learned over the course of a year. Biological concepts will be presented in many forms: text, photos, data and graphs. You will be asked to analyze, and interpret this information, then give responses to questions on the presented information. Many of the questions present a new approach to information where you will have to apply your biology knowledge to that topic. By working diligently through these practice tests, you can assess your knowledge. It is not enough to just do the tests; you must be committed to seriously reviewing each answer and explanation until you feel confident on the concept. Preparing for a Regents should begin a month or two before the actual test. Work on one or two topic sets of questions daily and review your answers with the given explanations. Make note of questions that you do not feel confident in and revisit at a later time. As you become confident in the material and to this new test design, you should be successful on the Biology Regents.

The skills that you gain from analyzing and working through questions will provide you with tools to navigate other biology courses as well.

It is this author's wish that you do well on the Regents and develop a life-long appreciation for Biology.

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Test 1

Answer all questions in this part.

Directions: Use your knowledge of Life Science: Biology to answer all questions in this examination.

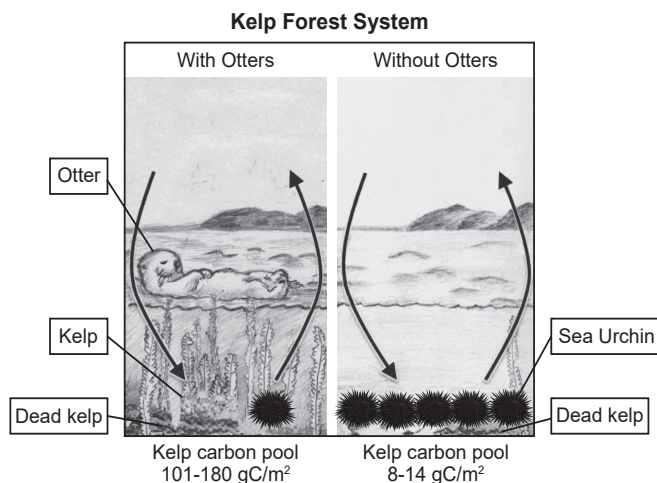
Base your answers to questions 1 through 5 on the information below.

Carbon! Where Does It Come From? Where Does It Go?

On Earth, carbon compounds are found in the oceans, atmosphere, and living organisms, as well as stored in rocks and sediments. Earth and its atmosphere can be considered a closed system. The amount of carbon in different locations within Earth's system is always changing.

Sea otters help maintain the carbon balance in their ecosystem. Otters eat sea urchins. Eating sea urchins is important, as sea urchins are herbivores that can destroy a kelp forest. Kelp are large autotrophic algae that grow much faster than most plants. When kelp die, they sink into the deep ocean. The low oxygen conditions of the sea floor cause decomposition to be slow or incomplete.

Scientists calculated the carbon pool (how much carbon kelp stores) with and without sea otters, as shown in the model.



1. Which claim about the kelp carbon pool is best supported by evidence from the information and the model above?

- (1) The carbon storage is higher with the otters present because the sea otters eat the sea urchins.
- (2) The carbon storage is higher with the sea urchins present because they control the kelp population.
- (3) The carbon storage is lower with the otters present because the sea otters eat the kelp.
- (4) The carbon storage is lower with the sea urchins present because they carry out autotrophic nutrition.

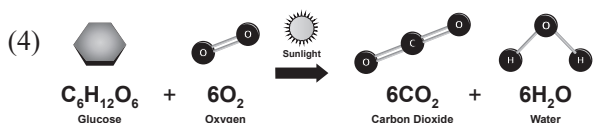
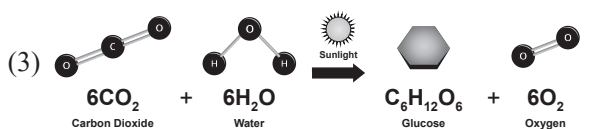
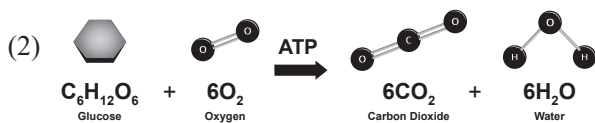
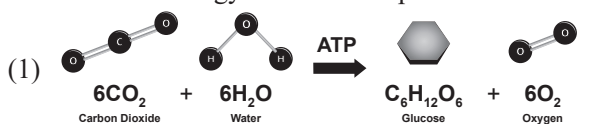
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2. Which statement uses the model to describe how kelp contributes to a reduction of carbon entering the atmosphere?

- (1) Kelp produces carbon as it grows within the hydrosphere.
- (2) Some of the carbon stored in the dead kelp is trapped in the geosphere of the sea floor.
- (3) Kelp produces carbon as it sinks into the hydrosphere.
- (4) Some of the carbon stored in kelp is added to the geosphere through cell respiration.

2 _____

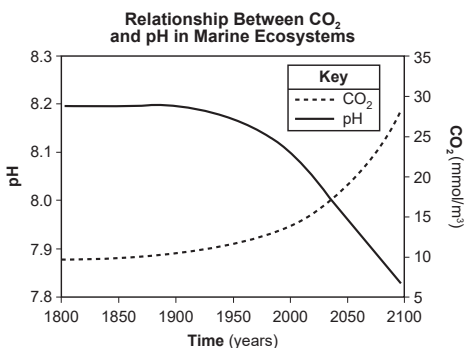
3. Which model identifies the process that converts light energy into chemical energy inside the kelp?



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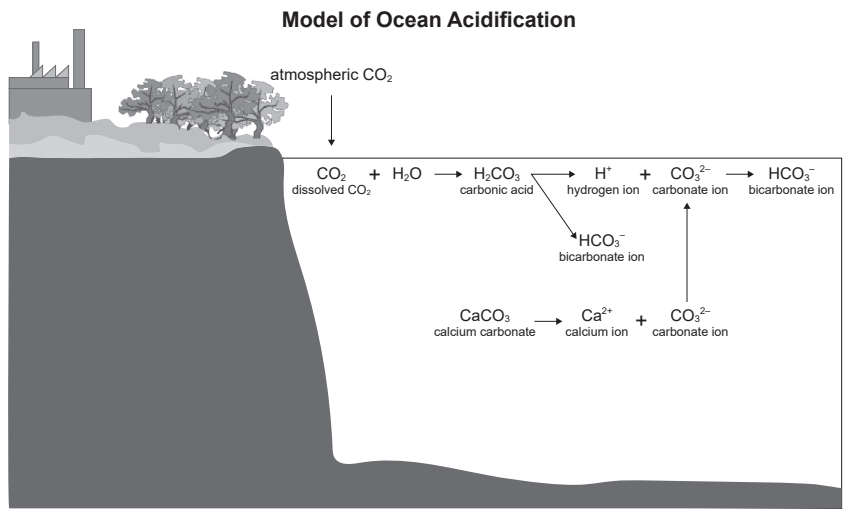
Increased atmospheric carbon dioxide has been linked to changes within marine ecosystems. When CO_2 combines with water, it produces carbonic acid, lowering the water's pH. A pH of less than 7.8 can interfere with the ability of some marine organisms to make shells and skeletons. These organisms include corals, mussels, plankton, seastars, and sea urchins.

The graph below shows the relationship between atmospheric CO_2 concentration and the pH of seawater.

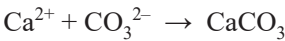


4. If the trend in atmospheric CO₂ levels continues, sea urchin populations may be impacted. Describe evidence from the graph that supports this claim.

The following diagram shows some information about the cycling of carbon.



The model below shows the equation for how sea urchins make their shells.



Calcium ions and carbonate ions produce calcium carbonate.

5. As ocean acidification increases, the amount of available carbonate ions decreases. Use the model and information provided to describe how the cycling of carbon between the biosphere *and* at least one other sphere is affected as environmental conditions change.

Base your answers to questions 6 through 10 on the information below.

Drinking Water Is Just The Beginning!

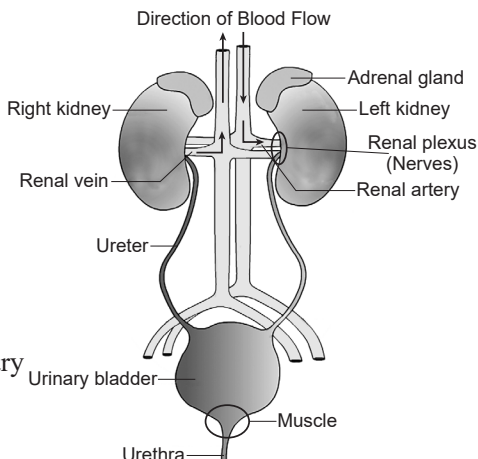
The amount of water taken in must be in balance with the amount lost. The urinary system is involved in maintaining the salt and water balances within the body.

6. Which statement describes how the organization of the urinary system and *one* other system interact to maintain homeostasis in the human body?

- (1) The adrenal gland, part of the endocrine system, delivers nutrients to the cells of the urinary system to remove carbon dioxide from the blood.
- (2) The internal urethral sphincter muscle, part of the muscular system, contracts to signal the cells of the urinary system to regulate blood sugar.
- (3) The brain, part of the nervous system, sends messages to the renal plexus (nerves) to signal the cells of the urinary system to deliver oxygen to the blood.
- (4) The arteries, part of the circulatory system, deliver unfiltered blood to the cells of the urinary system to remove wastes.

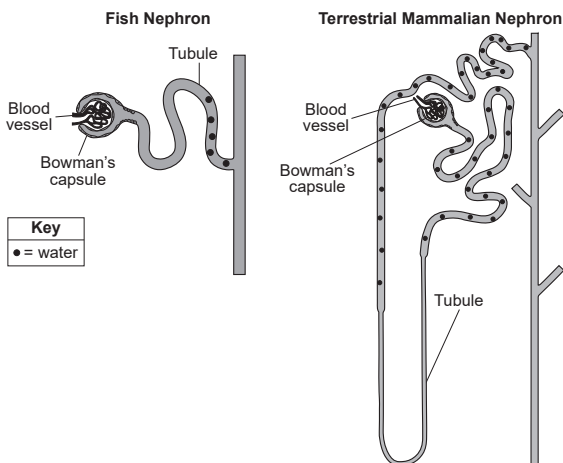
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Human Urinary System



Each kidney is composed of about a million waste-filtering structures known as nephrons. Water is reabsorbed through some parts of the nephron, such as the tubule. The model below shows the structure of a nephron in two organisms.

Nephrons of Various Organisms

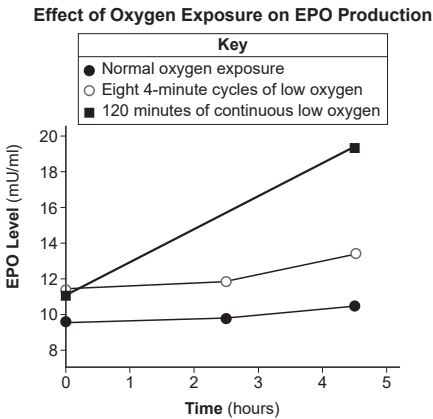


7. Based on evidence in the model, which statement explains that natural selection led to the evolution of the nephron’s structure and function in terrestrial mammals?

- (1) The development of the Bowman’s capsule in animal kidneys was more advantageous to mammals than fish.
 - (2) Nephrons with longer tubules were selected for in organisms that lived on land to conserve the water they drank.
 - (3) The longer nephron tubule was selected for in animals that lived in oceans, rivers and lakes to filter the excess water absorbed.
 - (4) The number of nephrons is more important in the evolution of mammals than it is to the evolution of fish.
- 7 _____

Another function of the kidney is to aid in regulating the number of red blood cells. The kidneys produce a protein known as Erythropoietin (EPO) that stimulates the increased production of red blood cells.

The graph shows the results of a study. Participants were exposed to different conditions prior to time zero, then EPO levels were measured over a 4.5-hour time period.



8. Using the information provided, describe the evidence to support the claim that exposure to low oxygen levels results in a feedback mechanism that allows the body to maintain homeostasis.

In addition to their other functions, red blood cells (RBCs) have the capacity to carry water. The surface of the cell contains structures called aquaporins, which transport water across cell membranes. Due to their unique cell structure, RBCs are able to expand up to 74% or shrink up to 40% compared to the original cell size.

June 2026

Answer all questions in this part.

Directions: Use your knowledge of Life Science: Biology to answer all questions in this examination.

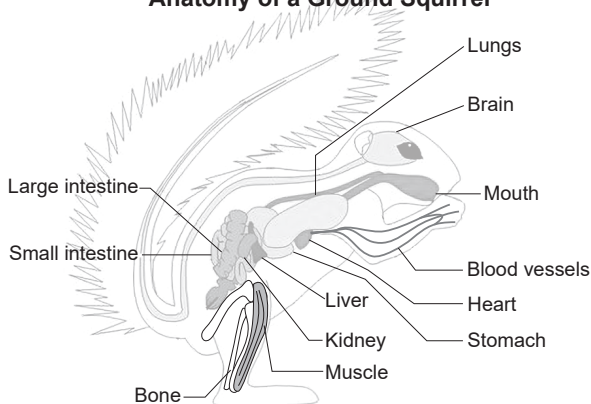
Base your answers to questions 1 through 5 on the information below.

A Seasonal Strategy for Survival

Certain species of organisms living in colder climates have evolved unique adaptations to conserve energy during winter months. These organisms enter a state of hibernation, a period of inactivity that causes life processes to slow down. It has been estimated that this period of inactivity allows organisms to use nearly 70 to 100 times less energy when resources are limited. Some species of ground squirrels hibernate.

The model below includes some components of squirrel body systems.

Anatomy of a Ground Squirrel



Researchers studying animals that hibernate discovered that some of the physiological changes associated with hibernation could also lead to the development of blood clots. These animals had a significant difference in their platelet count when hibernating, compared to when they were not hibernating.

Platelets are a component of blood that are formed within the marrow of bones, such as those in the legs. They help with the clotting of blood.

The information below summarizes some of the changes that occur in hibernating animals.

Sample Physiological Changes in Hibernating Animals

Animal	Condition	Avg Heart Rate (BPM)	Avg Breathing Rate (Breath/min)	Avg Body Temperature (°C)	Platelet Count (#/L)
13-Lined Ground Squirrel	Not Hibernating	250	100	37	445×10^9
	Hibernating	5	3	6	47.9×10^9
Scandinavian Brown Bear	Not Hibernating	45	6	37	262×10^9
	Hibernating	10	1	32	174×10^9

1. Which statement best describes the interactions between body systems found in the *Anatomy of a Ground Squirrel* model that are used to protect the squirrel from blood clot formation during hibernation?

(1) The muscles of the muscular system must be provided with more CO₂ by the lungs of the respiratory system to increase movement and prevent clot formation.

(2) The blood transported by the circulatory system must have an increased number of platelets, produced by the bones of the skeletal system, to prevent clots from forming.

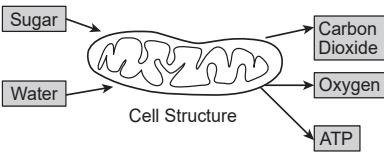
(3) The bone marrow of the skeletal system decreases the production of platelets being released into the circulatory system, preventing clots from disrupting blood flow.

(4) The nervous system increases body temperature, causing the amount of O₂ taken in by the lungs of the respiratory system to decrease, preventing the formation of blood clots.

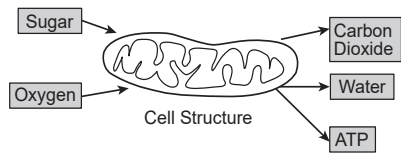
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2. Using the data compiled by the researchers, provide evidence that supports the claim that as environmental temperature drops, feedback mechanisms maintain homeostasis in hibernating animals. [1]

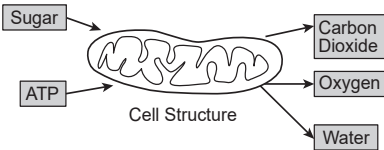
3. Which model below best represents the inputs and outputs of the chemical process by which matter and energy are converted into forms that are usable for the ground squirrel cells?



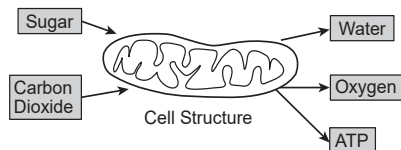
(1)



(3)



(2)



(4)

3 _____

During hibernation studies, researchers have also found that the function of the immune system may be affected in mammals.

The chart below shows the data collected from the investigations.

Approximate White Blood Cell Reduction During Hibernation

Animal	Percent Reduction
Scandinavian Brown Bear	40%
13-Lined Ground Squirrel	90%
Northern Long-Eared Bat	45%

4. Given the data provided, which explanation best identifies how changes in the immune system allow animals, such as squirrels and bears, to maintain homeostasis during hibernation?

(1) When animals hibernate, white blood cell production increases, which uses more energy to maintain homeostasis.

(2) White blood cell production decreases in the hibernating animals, which allows for the conservation of energy.

(3) During hibernation, white blood cell production in animals decreases, which increases their ability to fight off disease.

(4) When animals hibernate, white blood cell production is not affected and their ability to fight off diseases decreases.

4 _____

A similar immune response is seen in bats, another mammal, during hibernation. This could affect how the bats fight infections.

A fungus has impacted some colonies of bats, causing massive losses in their populations. It has been suggested that those bats that awaken periodically during hibernation reactivate their immune systems.

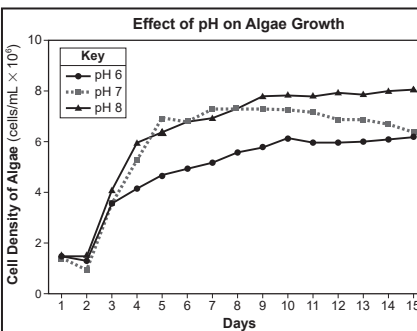
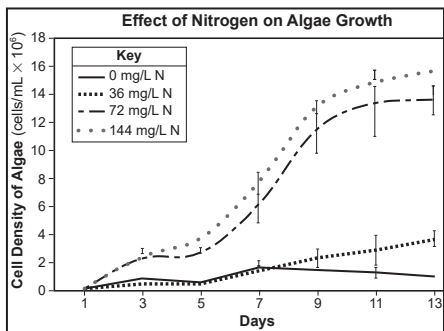
5. Construct an explanation using evidence that bats that awaken periodically will increase in the population as a result of the process of evolution. [1]

Base your answers to questions 6 through 9 on the information below and the two graphs at the top of following page.

Nitrogen: Friend or Foe?

Algae are simple, plant-like organisms that play an essential role in many aquatic ecosystems. However, not all algae growth is beneficial to the ecosystem.

Researchers tested the effect of nitrogen (N) on algae growth by adding varying amounts of nitrogen to water samples containing algae. The data they collected are shown in the graphs at the top of the following page.



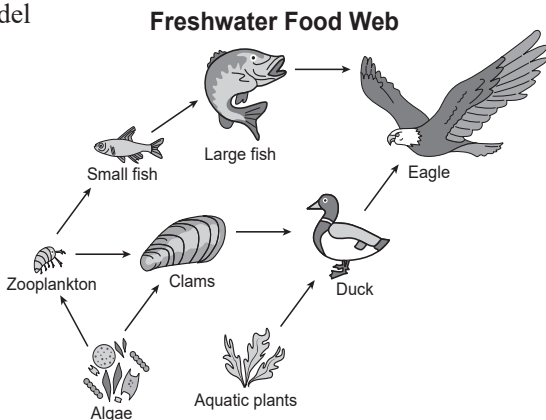
6. Using data from the graphs, which factor has the greatest effect on the size of the algae population?

- (1) The algae population exposed to 36 mg/L of nitrogen showed the most growth over the 13 days.
- (2) The algae population exposed to a pH of 8 reached the greatest density before seven days.
- (3) The algae population exposed to 144 mg/L of nitrogen reached the greatest density at 13 days.
- (4) The algae population exposed to a pH of 7 steadily increased after seven days.

6 _____

The accompanying model shows an example of a freshwater food web.

7. Scientists claim that the addition of low amounts of nitrogen will affect the carrying capacity of all of the species in the entire food web. Using the given information, which explanation best supports the scientists' claim?



- (1) Producers would increase, resulting in a greater amount of energy available for the rest of the food web, increasing their carrying capacities.
- (2) Algae populations would have a decreased carrying capacity, resulting in aquatic plants having more energy available, and increasing carrying capacity for the plants and consumers.
- (3) The carrying capacity of every organism in the food web will decrease, with the exception of producers, due to the increased algae populations taking in all of the energy available.
- (4) There will be an increase in the carrying capacity of the predators because algae is a major component of a predator's diet.

7 _____

LIFE SCIENCE
BIOLOGY
ANSWERS
AND
EXPLANATIONS

TEST 1

1. Answer: 1

With otters present, the kelp carbon pool measures 101-180 gC/m², without otters present the kelp carbon pool is 8-14 gC/m². Otters feed on kelp-eating sea urchins allowing kelp forests to grow and store carbon.

2. Answer: 2

As kelp dies, it moves to the sea floor where it decomposes. The decomposed stored carbon is incorporated within the ocean floor (geosphere).

3. Answer: 3

This model reflects the photosynthetic process where carbon dioxide and water are taken in by autotrophs and transformed, using the energy of the Sun, into glucose. Oxygen is released as a byproduct.

4. Acceptable responses include, but are not limited to: As CO₂ increases, pH decreases. Less than 7.8 would prevent sea urchins from making skeletons, causing their population to decrease.

or The graph projects that shortly after 2100 ocean pH may be under 7.8, the level at which organisms like sea urchins can't build shells/skeletons.

Explanation: Many marine organisms are impacted by changes in pH. With increasing CO₂ levels, ocean waters are showing decreases in pH from 8.2 to 7.8. These lower pH levels disrupt the ability of sea urchins to form exoskeletons and their populations may decrease.

5. Acceptable responses include, but are not limited to: As atmospheric CO₂ increases, the carbonate ions in the hydrosphere are used up and the urchins will not have the resources needed to make their shells, reducing the number of urchins in the biosphere. *or* As carbonate ions are used to form bicarbonate in the hydrosphere, they are no longer available for sea urchin skeletons in the biosphere.

or Increased CO₂ in the atmosphere causes the oceans in the hydrosphere to be more acidic from carbonic acid. The decrease in pH affects the organisms in the biosphere that need a certain pH range to survive.

Explanation: As increasing CO₂ in the atmosphere enters the hydrosphere, carbonic acid is formed in the hydrosphere, leading to acidic conditions that do not favor sea urchin survival. Conditions also favor carbonate ions forming other compounds and not being available to combine with calcium ions to form calcium carbonate, the material that sea urchins use to make their exoskeleton.

6. Answer: 4

The function of the urinary system is to remove harmful wastes from blood. To deliver the blood to the urinary system, arteries of the circulatory system direct blood into the kidneys where it is filtered. Filtered blood leaves the kidneys through the renal vein, returning to the circulatory system to pick up metabolic wastes that are continuously produced.

7. Answer: 2

Longer nephron tubules allow for more surface area and opportunity for water to be reabsorbed and not removed from the body. Terrestrial or land mammals with favorable longer tubules adapted through natural selection to life on dry land where water regulation is a struggle.

8. Acceptable responses include, but are not limited to: When participants were exposed to 120 minutes of low oxygen, their EPO levels increased from about 11 m/u/ml to 19 m/u/ml over 4.5 hours. More red blood cells make it possible to transport more oxygen until the appropriate blood oxygen level (set point) is reached.

or When there is a decrease in the amount of oxygen the blood is carrying to the kidney, the cells of the kidney release the EPO protein, which causes an increase in red blood cell production. This causes oxygen levels to increase back to normal.

or The graph shows that the longer a person is exposed to low oxygen levels, the more EPO is released. More red blood cells are produced to carry more oxygen until the normal oxygen level is reached

Explanation: Individuals exposed to 120 minutes of lower oxygen levels demonstrated an increase in EPO levels from 11 m/u/ml to 19 m/u/ml. Individuals exposed to normal oxygen levels and intermittent low oxygen showed much lower increases, 10 m/u/ml to 10.8 m/u/ml and 11.5m/u/ml to 13m/u/ml respectively. Greater levels of EPO allow those with lower oxygen levels to increase their red blood cell numbers and deliver more oxygen.

9. Answer: 1

The presence of aquaporins on red blood cell membranes allow these cells to expand or deflate depending on concentrations of water and salt, and therefore aid in water regulation in kidneys.

- 10 Answer: 2

As RBC's initially take on water, they become more flexible, increasing the rate of oxygen transfer. Drinking water after exercise would help an athlete's body return to a homeostatic state, by allowing RBCs to carry more oxygen.

11. Answer: 3

In order to be an inherited abnormality, the mutation in the DNA would have to be in the sex cells of the parent frogs. This mutation could then be passed on to offspring.

12. Answer: 1

Deformed frogs with leg abnormalities are less mobile and will have greater difficulty moving and escaping predator birds. When frogs are eaten by birds, it allows the Ribeiroia to reproduce and complete its life cycle.

13. Answer: 2

The introduction of parasites in the frog may have increased the amount of retinoic acid. Extra retinoic acid could promote increased activity of Hox genes which make proteins that attach to the DNA and activate leg producing genes. This increased activity may have promoted extra limb development.

14. Answer: 1

Scientist would be interested in the effect of increased levels of retinoic acid on Hox gene inheritance as these genes produce the proteins that influence limb development. Non-coding areas of DNA would not impact limb development.

15. Acceptable responses include, but are not limited to: They came from a similar ancestry because they all have similar Hox genes resulting in similar segmentation.
or The head (or thorax, or abdomen) in all organisms is coded for by the same Hox gene.
or The Hox gene makes the body plan follow the head, thorax, abdomen pattern.

Explanation: The body plans for all of these arthropods all exhibit similar patterns of development based on Hox gene activity. Each arthropod has a head, thorax and abdomen region suggesting common ancestry.

16. Acceptable responses include, but are not limited to: The Hox genes are the same and are interchangeable because their DNA is the same, producing the right proteins to turn on the correct genes in the given animal.
or The Hox genes are so similar that they will switch on the correct genes for producing eyes in either animal.

Explanation: The DNA found within these interchangeable Hox genes of mice and fruit flies must be similar, producing the proteins that code for eye development, regardless of organism.

17. Acceptable answers include, but are not limited to: Yaks with large hearts that pump more oxygenated blood to the cells were better able to survive and reproduce in high altitudes.
or Yaks that have small lungs and are less able to take in oxygen are more likely to die and less likely to pass on their traits.
or Yaks with specialized hemoglobin that can extract more oxygen from the air can survive in high-altitude environments. Since the altitude between 3000 and 5000 m above sea level has only 52% to 66% of the normal amount of oxygen, they are better adapted to this environment. They will pass on this trait to offspring.

Explanation: Yaks with favorable traits such as large heart and lungs as well as hemoglobin that allowed for higher oxygen carrying capacity adapted to extreme altitude conditions of low oxygen. These yaks had a higher survival rate and passed these traits on to offspring. Over time, the yak population was made up of yaks with these favorable traits.

18. Answer: 3

Changes in gene sequences occur during meiosis when sorting of alleles happens in the formation of gametes or sex cells. This change in sequence could then be passed on to an offspring.

19. Answer: 2

Producers use carbon dioxide during the process of photosynthesis. At higher altitudes, the molecules of carbon dioxide gas spread out and are less available. With less available resources, the carrying capacity for producers would be reduced.

20. Acceptable responses include, but are not limited to: At altitudes of 3500 m and above, where the pika lives, temperatures are less than 6°C, so living underground would help them survive.
or They live in tunnels/burrows that protect them from the extreme cold of the Tibetan Plateau.
or The faster-moving pikas can quickly escape predators by running into tunnels.

Explanation: Behavioral adaptations of tunnel digging and moving fast allowed some pikas to better survive the extreme cold temperatures of the Tibetan Plateau as well as avoid predators. These favorable traits were then passed on to offspring and tunnel inhabiting, fast moving pika populations increased.