



**Texas**  
Educator Certification  
Examination Program

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# **Preparation Manual**

## **Life Science 7–12 (238)**

**Overview and Exam Framework**  
**Sample Selected-Response Questions**  
**Sample Selected-Response Answers and Rationales**



















































































**Competency 014—The teacher understands the processes by which organisms maintain homeostasis.**

28. In the flipper of a dolphin, each artery is surrounded by several veins. Which of the following is the best explanation for the arrangement of blood vessels?

- A. Cool blood in the veins receives heat from arterial blood as the venous blood returns to the animal's core.
- B. Oxygen-poor blood in the veins absorbs oxygen from the artery as the blood returns to the animal's core.
- C. The artery is protected from trauma by the surrounding veins.
- D. Flipper movement ensures that the rate of blood flow in the veins equals the rate of flow in the artery.

**Answer**

**Option A is correct** because this is an example of a countercurrent heat exchanger. To conserve body heat, venous blood that has cooled in the flipper and is returning to the body core absorbs heat from arterial blood directed to the flipper. **Option B is incorrect** because there is no gas exchange between blood in the artery and the veins. **Option C is incorrect** because veins do not have strong muscular walls and thus are too soft to provide protection for an artery. **Option D is incorrect** because while flipper movement does help blood flow in veins, it does not ensure a flow rate equal to that of the flow in the artery, and it does not explain the particular arrangement of the vessels.

29. Which THREE of the following best explain how small mammals can survive long periods of hibernation without ingesting food or water?

- A. The production of enzymes that hydrolyze the triglycerides of stored fat in the mammals increases.
- B. The pH of the mammals' blood significantly decreases, except for blood that circulates to the brain.
- C. The heart rate and breathing rate of the mammals decrease.
- D. The core temperature of the mammals decreases.

**Answer**

**Options A, C, and D are correct** because all describe physiological processes that occur during hibernation. There is an increase in the production of enzymes that hydrolyze the triglycerides of the fat stores accumulated by the animal before the start of hibernation. Additionally, the heart rate, breathing rate, and core temperature all decrease in association with a decrease in metabolic rate during hibernation. **Option B is incorrect** because a decrease in the pH of the blood during hibernation would have an adverse effect on the cells of the animal.

**Competency 015—The teacher understands the relationship between biology and behavior.**

30. Which of the following best demonstrates that some behaviors involve both an innate and a learned component?

- A. A pheromone produced by a queen honeybee attracts workers to the queen in the hive.
- B. The females of some cichlid fish species hold fertilized eggs in their mouths until the eggs hatch.
- C. Male weaver birds build similar but not identical nests, and individual birds modify their technique from one nest to the next.
- D. A rat that presses a lever in a box and routinely receives a food reward will continue to press the lever.

## Answer

**Option C is correct** because a bird initially uses instinct to build a nest that is generally characteristic of the species in terms of location and structure. However, there must also be a learned component to nest building because the structure of the nests can improve and become more elaborate with each subsequent nest built by birds of certain species, as exemplified by the nests built by male weaver birds. **Option A is incorrect** because attraction to a pheromone is strictly innate. **Option B is incorrect** because a cichlid does not learn to hold eggs and fry in its mouth but is exhibiting an innate behavior. **Option D is incorrect** because pressing a lever with the expectation of a reward is an example of operant conditioning, in which a behavior may be changed by a consequence; lever-pressing behavior by the rat is reinforced by a food reward.

## Domain V—Interdependence of Life and Environmental Systems

**Competency 016—The teacher understands the relationships between abiotic and biotic factors of terrestrial and aquatic ecosystems, habitats and biomes, including the flow of matter and energy.**

31. The primary productivity of coral reefs is substantially greater than the primary productivity of the open ocean. Which of the following best explains the high primary productivity of coral reefs?

- A. Corals grow in relatively deep water with a low salt concentration and a high concentration of dissolved  $\text{CO}_2$ .
- B. Corals grow in warm water that contains a high plankton count and has a high concentration of nutrients.
- C. Corals grow in shallow, cold water with abundant sunlight and a high concentration of dissolved  $\text{O}_2$ .
- D. Corals grow in relatively shallow, nutrient-poor water that is easily penetrated by sunlight.

## Answer

**Option D is correct** because corals primarily live around islands and along the edges of some continents in a zone of water that exhibits great clarity. The abundant sunlight promotes the growth of photosynthetic algae that live in a symbiotic relationship with the corals, a relationship that contributes to the great productivity of the reefs. Most corals live in warm water, and all appear to be very sensitive to a high concentration of nutrients and have in fact declined in areas exposed to sewage and fertilizer runoff. **Option A is incorrect** because most corals do not live in deep water, where the Sun does not penetrate, and deep water is unlikely to be low in salt and high in  $\text{CO}_2$ . **Option B is incorrect** because high nutrient concentrations that often promote plankton growth kill corals. **Option C is incorrect** because the vast majority of corals grow in warm water, and a very few grow in cool—but not cold—water.

32. If the energy available from all secondary consumers to the next trophic level in a terrestrial food web is  $90 \text{ kcal} / \text{m}^2 / \text{year}$ , then the net primary productivity of the food web is most likely closest to

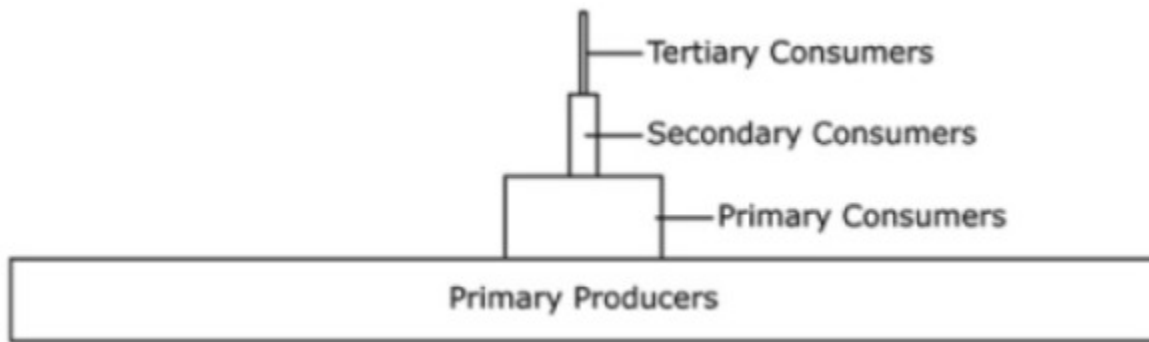
- A.  $0.9 \text{ kcal} / \text{m}^2 / \text{year}$
- B.  $9 \text{ kcal} / \text{m}^2 / \text{year}$
- C.  $900 \text{ kcal} / \text{m}^2 / \text{year}$
- D.  $9,000 \text{ kcal} / \text{m}^2 / \text{year}$



## Answer

**Option D is correct** because  $90 \text{ kcal} / \text{m}^2 / \text{year}$  is 1% of  $9,000 \text{ kcal} / \text{m}^2 / \text{year}$ . It is estimated that approximately 10% of the energy at any trophic level is available to the next trophic level. If the net primary productivity of the food web is closest to  $9,000 \text{ kcal} / \text{m}^2 / \text{year}$ , then the energy available to primary consumers (herbivores) is approximately  $900 \text{ kcal} / \text{m}^2 / \text{year}$ , and the energy available to secondary consumers is approximately  $90 \text{ kcal} / \text{m}^2 / \text{year}$ . **Options A, B, and C are incorrect** because  $90 \text{ kcal} / \text{m}^2 / \text{year}$  is not 1% of the value in any of those options.

**Competency 017—The teacher understands the interdependence and interactions of living things in terrestrial and aquatic ecosystems.**



The longest layer in the first layer with is labeled as primary producers, the second layer is labeled primary consumers, the third layer is labeled secondary consumers, the fourth and last layer is labeled tertiary consumers.

33. Which of the following best explains why each level of a standing crop biomass pyramid such as that shown above is so much smaller than the level immediately below it?

- A. Organisms at higher levels die more rapidly than organisms at lower levels do.
- B. Inefficient energy transfers between levels support fewer organisms at higher levels.
- C. Organisms at higher levels typically require more nutrients per unit mass than organisms at lower levels do.
- D. Recycling of organic matter and essential chemical elements occurs less efficiently at higher levels.

## Answer

**Option B is correct** because trophic efficiencies generally range from 5% to 20%. Energy is lost between trophic levels through respiration and feces as well as through energy in the lower trophic level that is not consumed by organisms in the next trophic level. **Option A is incorrect** because organisms at higher trophic levels often live as long as or longer than organisms at lower trophic levels. **Option C is incorrect** because organisms at higher trophic levels typically do not require more nutrients per unit mass than organisms at lower trophic levels do. **Option D is incorrect** because recycling occurs with about the same efficiency at all trophic levels, but there is simply less energy to recycle at higher levels.

34. Truffles are fungi that grow underground. Truffles produce chemicals with an aroma that attracts pigs and helps them detect the truffles. The pigs sometimes eat the truffles they find. Which of the following best describes why the relationship between a pig and a truffle can be considered mutualistic?

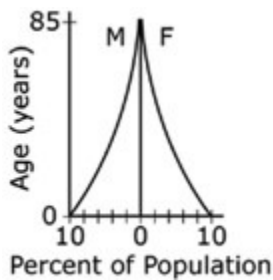
- A. The pig eats the truffle and gains chemical energy from it.
- B. The pig eats the truffle, and the truffle remnants benefit scavengers in the soil.
- C. The pig eats the truffle, and the pig's feces contain digested components that decomposers return to the soil.
- D. The pig eats the truffle and spreads fungal spores as it digs the truffle out of the ground.

**Answer**

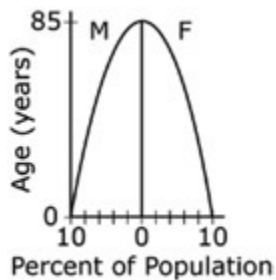
**Option D is correct** because both the pig and truffle benefit: the pig gains a source of chemical energy when it eats the truffle, and the spores of the truffle are dispersed by the pig, facilitating the growth of more truffles. **Option A is incorrect** because this activity benefits the pig but not the truffle. **Options B and C are incorrect** because both activities benefit the pig and other organisms but do not directly benefit the truffle.

**Competency 018—The teacher understands the relationship between carrying capacity and changes in populations and ecosystems.**

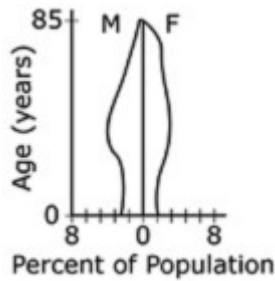
35. Assuming that no emigration, immigration, or catastrophic event occurs, which of the following graphs best illustrates a human population that is likely to decrease in size over the next 25 years?



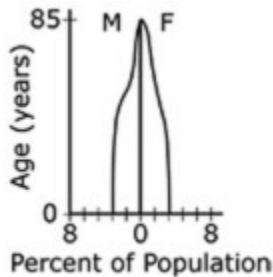
A.



B.



C.



D.

### Answer

**Option C is correct** because the size of the child-bearing population in 25 years will be smaller than the size of the current child-bearing population. **Option A is incorrect** because the population is heavily weighted toward individuals who will be of child-bearing age in 25 years. **Option B is incorrect** because there are more individuals who will be of child-bearing age in 25 years than are currently of child-bearing years. **Option D is incorrect** because the number of individuals of child-bearing age is fairly constant for the next 25 years and is greater than the current older population; the population will probably grow slowly over the next 25 years.

36. The reproductive strategies of organisms are often described as being primarily *r*-selected or *K*-selected. Organisms with *r*-selected reproductive strategies often have shorter life expectancies and produce many more offspring than organisms with *K*-selected reproductive strategies do. Which of the following is more likely to be true of a population of organisms with a *K*-selected reproductive strategy than of a population with an *r*-selected reproductive strategy?

- A. The population size is near the carrying capacity of the environment.
- B. The population lives in an unstable environment.
- C. The population lives in an environment with a temperate climate.
- D. The population is made up of organisms that are keystone species.

### Answer

**Option A is correct** because the population size of organisms with a *K*-selected reproductive strategy is typically close to the carrying capacity of the environment. **Option B is incorrect** because organisms with a *K*-selected reproductive strategy typically live in a stable environment. **Option C is incorrect** because organisms with a *K*-selected reproductive strategy are found in a variety of climates. **Option D is incorrect** because organisms with a *K*-selected reproductive strategy need not be keystone species.

## Domain VI—Science Learning, Instruction and Assessment

**Competency 019—The teacher understands research-based theoretical and practical knowledge about teaching science, how students learn science and the role of scientific inquiry in science instruction.**

37. Which of the following procedures is most likely to engage and motivate students to learn about regulation of cell growth?
- A. Playing a game in which teams of students compete to see who can correctly answer the most questions about organelle function in cell growth
  - B. Directing students to Internet sites on which they can watch animations of cells as they grow and divide
  - C. Having students read short biographies of scientists who are engaged in research about cell-growth regulation
  - D. Having students use a microscope to examine cultured cells before and after they add substances to the cells that affect cell growth and division

### Answer

**Option D is correct** because students who use microscopes to observe the effects of adding substances to cells are likely to be engaged and motivated to learn more about factors that can affect cell growth. **Option A is incorrect** because competing to see who can answer the most questions about organelle function is less engaging than observing cells through a microscope. **Option B is incorrect** because watching animations is passive rather than engaging. **Option C is incorrect** because reading biographies of scientists is also passive.

38. Students in a biology laboratory class will work in groups using the enzyme catalase to study factors that affect the activity of enzymes. Which of the following strategies by the teacher is the most effective inquiry-based learning approach?
- A. Ask the students first to develop a hypothesis related to catalysis and then to design and perform an experiment with catalase to investigate the hypothesis.
  - B. Give the students several hypotheses about factors that affect catalase activity and help them to design a single experiment that addresses all the hypotheses.
  - C. Give the students a protocol that has been used to investigate catalysis by catalase and ask them to carefully follow and then evaluate the protocol.
  - D. Tell the students to read research papers about catalase and its activity, then have them select one paper and attempt to reproduce the methods and results.

### Answer

**Option A is correct** because asking the students to develop a hypothesis as well as perform an experiment that they design to investigate the hypothesis is a learning approach that is entirely inquiry based. **Option B is incorrect** because giving the students hypotheses and helping them to design an experiment does not provide much opportunity to develop independent-inquiry skills. **Option C is incorrect** because giving the students a protocol to follow and evaluate provides little opportunity to develop independent-inquiry skills. **Option D is incorrect** because reproducing published methods to obtain published results does not provide much opportunity to develop independent-inquiry skills.

**Competency 020—The teacher knows how to monitor and assess science learning in laboratory, field and classroom settings.**

39. Students perform a laboratory exercise to investigate how cell membranes regulate the movement of materials into and out of cells. They expose both live cells and artificial membranes to several different solutions and monitor the effects of the solutions on the cells and membranes. Which of the following methods will best allow the teacher to assess understanding by each student of the significance of the results?

- A. After completing the exercise, have the students write individual reports in which they use their results to propose mechanisms by which various materials cross cell membranes.
- B. As they perform the exercise, have the students work in pairs and discuss the procedure and data with each other.
- C. After completing the exercise, select several volunteers to stand up and summarize the significance of the results to the rest of the class.
- D. After completing the exercise, give the students a multiple-choice quiz with questions about the procedure and the results they obtained.

#### Answer

**Option A is correct** because the ability to write a report and, based on the experimental results, propose mechanisms by which materials, including some the student did not test, cross cell membranes suggests that a student truly understands the significance of the results. **Option B is incorrect** because it is difficult to determine how much the students understand if they are only talking with one another. **Option C is incorrect** because the process does not assess the understanding of all students but only of those few who volunteer to speak to the class. **Option D is incorrect** because a quiz on the procedure and results, particularly a multiple-choice quiz, does not allow the students to describe the broader significance of the results.

40. Which of the following is the best example of a summative assessment?

- A. Asking students who have presented independent experiments at a science fair to describe their science fair experiences to their classmates
- B. Asking students at the end of a physiology unit to identify and give the function of structures identified by flags in dissected organisms
- C. Asking students who worked in assigned groups for an activity to evaluate the work of the other members of the group
- D. Asking students at the beginning of a unit on ecology to describe the biological basis for succession and niche partitioning

#### Answer

**Option B is correct** because testing student knowledge at the end of a unit or course is a summative assessment. **Option A is incorrect** because asking students to describe science fair experiences does not directly assess knowledge or skills. **Option C is incorrect** because asking students to evaluate the work of other group members is a peer assessment. **Option D is incorrect** because assessing prior knowledge at the beginning of a unit is typically part of a formative assessment.