

## **Chapter 01**

### **The Science of Biology**

#### **Multiple Choice Questions**

1. Science is subdivided into specific areas of study termed disciplines. These divisions are artificial but are helpful to narrow the massive scope of scientific knowledge to a manageable amount. Given what you know about each, which scientific division is likely to present the best answer to a question about how fluid dynamics affect blood pressure in mammals?
- A. Bioinformatics – use of technology to study and store biological data
  - B. Biochemistry – study of chemical reactions needed for life function, usually at the cellular level.
  - C. Biology – study of life
  - D.** Biophysics – study of biological processes through physics

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about the differences between different divisions of biological research.
- ***What type of thinking is required?*** This question is asking for you to apply your understanding to identify which areas of research would focus on the movement of fluids.
- ***What key words does the question contain and what do they mean?***
  - o Fluid dynamics refers to the physics of how fluids (liquids) move.

### Gather Content

- ***What do you know about different divisions of biology? How does it relate to the question?***
  - o Bioinformatics is the study of biological data like sequences using computers
  - o Biology is a very broad area of research covering all areas of the study of life
  - o Biochemistry is the study of biological molecules smaller than a cell
  - o Biophysics is the study of how biological molecules move using the laws of physics

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
- In which disciplines are the properties of fluids likely to be studied?
  - o The study of the movement of fluids like blood are not sequence or structural data and not biological molecules, thus bioinformatics and biochemistry are not good answers.
  - o Biology is a very broad heading, and not the best answer.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?*** The best answer is biophysics because the movement of fluids are well described using the laws of physics.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - o This question asked you to apply the definitions different areas of biology to determine which might study fluid dynamics. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you think that fluid dynamics were part of a cell or represented by large data sets? Did you not know that the movement of fluids was an area of study in physics?

## Chapter 01 - The Science of Biology

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.01.01 Compare biology to other natural sciences.*

*Section: 01.01*

*Topic: The Science of Life*

2. Based on hierarchical levels of biological organization, which of these choices represents the broadest level?

- A. Endocrine system
- B. 3 toed sloths
- C. School of piranhas
- D.** Amazon Basin
- E. Jaguars, giant anteaters, macaws, capybaras

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.01.03 Characterize the hierarchical organization of living systems.*

*Section: 01.01*

*Topic: The Science of Life*

3. Experiments are carried out to test a hypothesis by changing one variable at a time and including an unchanged variable termed a(n) \_\_\_\_\_.

- A. experimental variable
- B. altered variable
- C.** control
- D. stable variable

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

4. The method of reasoning that uses construction of general principles by careful examination of many specific cases is called:

- A. experimental reasoning.
- B. theoretical reasoning.
- C. inductive reasoning.**
- D. hypothetical reasoning.
- E. deductive reasoning.

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.02.01 Compare the different types of reasoning used by biologists.*

*Section: 01.02*

*Topic: The Nature of Science*

5. Dr. Ratard was trying to determine the cause of a mysterious epidemic affecting fish in the gulf of New Mexico. His proposal that the deaths were caused by an organism called a protist is considered a(n) \_\_\_\_\_

- A. theory.
- B. data set.
- C. hypothesis.**
- D. conclusion.
- E. experiment.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

6. After Darwin concluded his voyage on the *Beagle*, he proposed that the process of natural selection was a mechanism for:

- A. overpopulation of finches on the Galapagos Islands.
- B. speciation.
- C. artificial selection.
- D. sexual selection.
- E. evolution.**

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.03.01 Examine Darwin's theory of evolution by natural selection as a scientific theory.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

7. A scientific theory is:

- A. a suggested explanation that accounts for observations.
- B. a way to organize how we think about a problem.
- C. a concept that is supported by experimental evidence that explains the facts in an area of study.
- D. a way to understand a complex system by reducing it to its working parts.

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

8. What common life characteristic would cells from a daisy, an apple and a dog all have?

- A. DNA
- B. tissues
- C. organs
- D. viruses

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.01.02 Describe the characteristics of living systems.*

*Section: 01.01*

*Topic: The Science of Life*

9. A yellow jacket, an insect in the order hymenoptera, stung me. A wasp, an insect in hymenoptera, stung me. A hornet, an insect in hymenoptera, stung me. I see a pattern. All insects in this order must have stingers. What type of reasoning does this represent?

- A. inductive reasoning
- B. deductive reasoning
- C. reductionism
- D. comparative reasoning

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.02.01 Compare the different types of reasoning used by biologists.*

*Section: 01.02*

*Topic: The Nature of Science*

10. You explain to your study group that a hypothesis is:
- A. constant over time.
  - B. a proposition that will be true and fits the known facts.
  - C. an explanation that accounts for careful observations.
  - D. a theory.

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

11. A suggested explanation that might be true and is subject to testing by further observations is a(n):
- A. hypothesis.
  - B. experiment.
  - C. scientific principle.
  - D. generality.
  - E. theory.

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

12. Based on the literature, you hypothesize that students in traditional biology lectures will have the same grades as students in online biology lectures. You decide to test your hypothesis by comparing grades of students in traditional and online biology lectures over a semester. As a result of the experiment, you observe that the grades in the traditional lectures and the grades in the online lectures are not significantly different. What do these observations allow you to do?

- A. develop a scientific theory
- B. reject the hypothesis
- C. accept the hypothesis without further question
- D.** reject the null hypotheses

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about hypotheses.
- ***What type of thinking is required?*** This question is asking to apply your knowledge of a hypothesis to interpret the results of an experiment.
- ***What key words does the question contain and what do they mean?***
  - o You hypothesize that students in traditional biology lectures will have the same grades as students in online biology lectures
  - o the grades in the traditional lectures and the grades in the online lectures are not significantly different

### Gather Content

- ***What do you know about hypotheses? How does it relate to the question?***  
Can you accept or reject a hypothesis? A null hypothesis is the opposite of your hypothesis. In this case it would be that the scores of the two groups of students will be different.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
- Do you accept a hypothesis or reject a null hypothesis?
  - o Your results support your hypothesis, so you do not reject the hypothesis.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?*** The correct answer is to reject the null hypothesis which is the opposite of what you wrote in your hypothesis.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - o This question asked you to apply the definition of a hypothesis to a specific example. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you think that you could accept your hypothesis instead of rejecting the null hypothesis?

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*



13. Your microwave will not turn on, and you speculate that a circuit breaker in the house has been tripped. In scientific terminology, the steps would be described as:

- A. forming conclusions from the results of experiments.
- B. developing an observation based on a hypothesis.
- C.** developing a hypothesis based on an observation.
- D. testing a prediction generated from a hypothesis.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

14. A student poses the question: How does the presence of dissolved salt affect the freezing point of water? To answer this question, the student set up two conditions. In the first condition, the student added salt to water in a container and referred to this condition as the variable. In the second condition, the student did not add any salt to water in a second container and referred to this condition as the control. The student took both containers and attempted to freeze the water at various temperatures to assess the freezing point. Would this be a valid experiment?

- A. Yes, because there is more than one variable.
- B.** Yes, because there is one variable and a control
- C. No, because there is not more than one variable
- D. No because there is only one variable and a control

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

15. Karl Popper suggested that scientists use "imaginative preconception," which means that successful scientists:

- A. do not keep records of experiments that fail.
- B. do not need to do experiments to test their ideas.
- C. only perform applied research.
- D.** often predict the outcome of experiments.
- E. cannot predict the outcome of experiments.

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

16. The proposal that one type of organism can change gradually into another type over a long period of time is known as:

- A. preconception.
- B. preservation.
- C. natural history.
- D.** evolution.

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.03.01 Examine Darwin's theory of evolution by natural selection as a scientific theory.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

17. Darwin's ideas on evolution were advanced for his time. His approach to science and natural selection were supported by what main tenet?

- A. Species were unchangeable over the course of time.
- B.** Operation of natural laws produces constant change and improvement.
- C. Various organisms and their structures resulted from a spontaneous action.
- D. The world is fixed and constant.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.03.01 Examine Darwin's theory of evolution by natural selection as a scientific theory.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

18. Besides Darwin, the theory of evolution by means of natural selection was also independently proposed by:

- A. Charles Lyell.
- B. Karl Popper.
- C. Thomas Malthus.
- D. Peter Raven.
- E.** Alfred Wallace.

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.03.01 Examine Darwin's theory of evolution by natural selection as a scientific theory.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

19. The term that Darwin used to describe the concept that those with superior physical, behavior or other attributes are more likely to survive than those that are not so well endowed, and thus are more likely to pass their traits to the next generation, is called:

- A. geometric progression
- B.** natural selection
- C. superior beings
- D. survival of modifications
- E. biological diversity

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.03.01 Examine Darwin's theory of evolution by natural selection as a scientific theory.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

20. A key contribution to Darwin's thinking was the concept of limits put on the geometric growth of populations by nature, originally proposed by:

- A. Charles Lyell.
- B. Karl Popper.
- C. Russel Wallace.
- D.** Thomas Malthus.
- E. Peter Raven.

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.03.01 Examine Darwin's theory of evolution by natural selection as a scientific theory.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

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21. Darwin's book in which he described his views on evolution is:

- A. Principles of Geology.
- B. Survival of the Fittest.
- C. On the Origin of Species.
- D. On the Principle of Population.

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.03.01 Examine Darwin's theory of evolution by natural selection as a scientific theory.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

22. Recent discoveries of microscopic fossils have extended the known history of life to about:

- A. 1 billion years ago.
- B. 2 billion years ago.
- C. 3.5 billion years ago.
- D. 4.5 billion years ago.

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.03.02 Describe the evidence that supports the theory of evolution.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

23. In California, a species of salamanders were geographically separated over time. The group that lived in southern California relied heavily on large gold blotches on their skin that helped to camouflage them from predators. The group that lived along the coast adopted a color pattern that mimicked a poisonous, colorful newt common to that area. Instead of being camouflaged, these salamanders advertised their colors. What type of selection process has occurred over time?

- A. theoretical selection
- B. artificial selection
- C. experimental selection
- D.** natural selection

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about different forms of selection.
- ***What type of thinking is required?*** This question is asking you to apply the definition of different forms of selection to a specific example.
- ***What key words does the question contain and what do they mean?***
  - o Geographic separation means that members of those two populations could no longer interbreed which can drive the evolution of new species.
  - o One group of salamanders hides by being camouflaged while the other has bright colors that mimic another poisonous species.

### Gather Content

- ***What do you know about selection? How does it relate to the question?*** Selection works on the phenotype of an organism, with beneficial traits being more likely to be passed on to the next generation.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
- Which types of selection make sense?
  - o Artificial selection requires humans to be involved to make the selection.
  - o Theoretical and experimental selection are part of an experiment. The selection in this example did not involve humans or any experiments.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?*** This is an example of natural selection due to geographic separation. Once the two groups of salamanders became separated they could no longer interbreed and developed different adaptations to their local environments.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - o This question asked you to apply the definitions selection to a specific example. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you think that natural selection would not occur with geographical separation, or that humans were involved in the speciation in some way?

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*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.03.01 Examine Darwin's theory of evolution by natural selection as a scientific theory.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

24. The same basic array of bones is modified to give rise to the wing of a bat and the fin of a porpoise. Such anatomical structures are called:

- A. uniform.
- B. inherited.
- C. homologous.
- D. analogous.
- E. evolutionary modifications.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.03.02 Describe the evidence that supports the theory of evolution.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

25. Structures that have similar structure and function but different evolutionary origins are called:

- A. inherited.
- B. evolutionary modifications.
- C. analogous.
- D. homologous.
- E. uniform.

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.03.02 Describe the evidence that supports the theory of evolution.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

26. The rate at which evolution is occurring cannot be estimated by:

- A. studying comparative anatomy.
- B. inferring that apes are related to humans.**
- C. measuring the degree of difference in genetic coding.
- D. interpretation of the fossil record.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.03.02 Describe the evidence that supports the theory of evolution.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

27. Differences in domesticated animals over relatively short periods of time most likely occur through:

- A. natural selection
- B. artificial selection**
- C. adaptation
- D. experimental selection
- E. evolution

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.03.02 Describe the evidence that supports the theory of evolution.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*



## Chapter 01 - The Science of Biology

As part of your research project, you travel to an island to learn more about the habitats and relationships of flies, spiders, and centipedes. You and your assistant plot out five different areas on the island and count the numbers of flies, spiders, and centipedes living in each plot. Your results show the following:

| Plot | Flies | Spiders | Centipedes |
|------|-------|---------|------------|
| 1    | 300   | 25      | 4          |
| 2    | 426   | 17      | 10         |
| 3    | 147   | 15      | 21         |
| 4    | 739   | 78      | 0          |
| 5    | 79    | 13      | 93         |

*LO: 01.02.01 Compare the different types of reasoning used by biologists.*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

28. The most plausible explanation for the high number of spiders in plot 4 is:

A. there are too many flies overall.

**B.** there are no centipedes to prey on the spiders and there are abundant flies upon which to feed.

C. the spiders preyed on the centipedes and ignored the flies.

D. the flies and spiders worked together to eliminate the centipedes.

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about a food web.
- ***What type of thinking is required?*** This question is asking to analyze data on a food web.
- ***What key words does the question contain and what do they mean?***
  - o Flies – prey for spiders
  - o Spiders – prey for centipedes and predators of flies
  - o Centipedes – predators of flies and spiders

### Gather Content

- ***What do you know about food webs? How does it relate to the question?*** In a food web an organism will often be prey for some species and a predator of others. As a result the abundance of prey and predators can both influence the numbers of a specific species.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
- Which food webs make sense?
  - o If flies are at the bottom of the food web they will not consume other species, but serve as a food supply for them. Spiders are in the middle of the food web and their numbers are influenced by the levels of prey (flies) and predators (centipedes). Centipedes are the top predators in this food web and their numbers can be affected by the abundance of prey (flies and spiders).

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?*** The best answer is that there are a lot of flies (prey) and few predators (centipedes) which leads to an abundance of spiders.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - o This question asked you to analyze data on a food web to draw specific explanations for the results. To do this you needed to recognize which species were predators and which were prey. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you think that flies were not at the bottom of the food web, or centipedes were not at the top of the food web?

## Chapter 01 - The Science of Biology

*Blooms Level: 4. Analyze*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

29. The plots that were staked out on the island were part of the:

- A. applied research.
- B. basic research.
- C. experimental design.**
- D. constructed model.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.02.01 Compare the different types of reasoning used by biologists.*

*Section: 01.02*

*Topic: The Nature of Science*

30. Based in the information provided, the best explanation for the low numbers of spiders and flies in plot 5 is:

- A. centipedes are actively consuming flies and spiders.
- B. there were not enough spiders to catch and consume all the flies.
- C. there were not enough flies to support a large centipede population.
- D. centipedes prefer spiders to flies.

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about a food web, specifically why flies and spiders are less abundant.
- ***What type of thinking is required?*** This question is asking to evaluate explanations about a food web.
- ***What key words does the question contain and what do they mean?***
  - o Flies – prey for spiders
  - o Spiders – prey for centipedes and predators of flies
  - o Centipedes – predators of flies and spiders

### Gather Content

- ***What do you know about food webs? How does it relate to the question?*** In a food web an organism will often be prey for some species and a predator of others. As a result the abundance of prey and predators can both influence the numbers of a specific species.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
- Which food webs make sense? Both spiders and flies are decreased in number, while centipedes are increased in plot 5.
  - o If centipedes preferred spiders over flies then the numbers of flies would be more similar to those in plots 1-4.
  - o The centipede population is larger than in the other plots, so there must have been enough flies to support them.
  - o If there were not enough spiders to consume all of the flies then the number of flies would be increased.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?*** Which food webs would be consistent with these results? The best answer is that the abundant centipedes ate a lot of flies and spiders, reducing their number in plot 5.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - o This question asked you to apply the definitions of deductive and inductive reasoning to specific examples. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you think that flies were not at the bottom of the food web, or centipedes were not at the top of the food web?

## Chapter 01 - The Science of Biology

*Blooms Level: 5. Evaluate*

*Gradable: automatic*

*LO: 01.02.01 Compare the different types of reasoning used by biologists.*

*Section: 01.02*

*Topic: The Nature of Science*

31. The hypothesis that closely matches the data provided is:

- A. spiders are the top predators on all islands.
- B. herbivorous insects survive best on islands where spiders and centipedes live.
- C. herbivorous insects and spider populations are decreased by centipedes.
- D. herbivorous insects feed on spiders and centipedes.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

32. If you were to design a long-term research study to determine why there are no human births in Lapland during the months of August, September, and October, you would need to also examine a comparison population of humans in which births took place every month. The primary reason for including a comparison population within the design of this experiment would be to:

- A. accumulate more facts that could be reported to other scientists.
- B. test the effects of more than one variable at the same time.
- C. prove that there are no births in Lapland during August, September, and October.
- D. act as a control that would ensure that the results obtained are due to a difference in only one variable.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

33. *Essay on the Principle of Population*, written by Thomas Malthus in 1798, influenced Darwin's thoughts as he struggled to understand what mechanisms could be at work to produce evolution. Malthus proposed that populations of animals and plants, including humans,

- A. evolved from mainland to islands, thus explaining why the island flora and fauna resembled the mainland species so closely.
- B. decreased arithmetically in numbers while the nutrients available increased geometrically.
- C. increased arithmetically in numbers while the nutrients available only increased geometrically.
- D.** increased geometrically in numbers while the nutrients available only increased arithmetically.
- E. increased geometrically in numbers while the nutrients available increased arithmetically.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.03.01 Examine Darwin's theory of evolution by natural selection as a scientific theory.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*



34. A student set up an experiment to test if plants give off water vapor. Fifty pea plants, growing in pots, were covered with individual glass containers and left overnight. The next morning, the inside of each lid was covered in droplets of water. The lab student concluded that plants generally give off water vapor. What critique would you make of the experimental design?

- A. There was no control so the water could have come from other sources such as air in the jar or the soil.
- B. There was not a large enough sample of pea plants used to get adequate data.
- C. The student did not have a clearly stated hypothesis before beginning the experiment.
- D. The experiment was not precise, meaning it was not reproducible.

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about designing an experiment.
- ***What type of thinking is required?*** This question is asking to analyze the design of an experiment.
- ***What key words does the question contain and what do they mean?***
  - o The hypothesis is that plants give off water vapor.
  - o 50 pots each containing plants were covered with lids.
  - o The next day each pot contained water vapor.

### Gather Content

- ***What do you know about experimental design? How does it relate to the question?*** The weakness of this experiment is that it does not contain a control group, so you cannot conclude that the water came from the plants or from the soil or other components of the experiment.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
- What are other explanations are there for these results? 50 plants is a large sample size, there was a hypothesis and the experiment was carried out correctly. So you can eliminate these as answers.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?*** The best answer is that there was not an appropriate control group. Half of the pots should have been prepared with no plants in them to be sure the water vapor was not coming from the soil or pots.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - o This question asked you to apply the definitions of deductive and inductive reasoning to specific examples. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you not realize that all of the pots contained a plant? While the hypothesis was not clearly stated, you could infer it from the first sentence of the problem. Did you think that 50 plants was too small a sample?

## Chapter 01 - The Science of Biology

*Blooms Level: 4. Analyze*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

35. It is known that many trees lose their leaves in response to decreasing day length. As a result, you think that *Ginkgo* trees may also lose their leaves in response to decreasing day length. This statement is an example of:

- A. a theory
- B. deductive reasoning
- C. an experiment
- D.** a hypothesis

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.02.01 Compare the different types of reasoning used by biologists.*

*Section: 01.02*

*Topic: The Nature of Science*

36. Multiple independent experiments have demonstrated that phytochrome helps trigger seasonal change responses in the plant such as changing color and loosening of leaves. Plants have the ability adapt to seasonal changes in their surroundings. This statement is an example of:

- A. a hypothesis
- B. deductive reasoning
- C.** a theory
- D. an experiment
- E. inductive reasoning

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.02.01 Compare the different types of reasoning used by biologists.*

*Section: 01.02*

*Topic: The Nature of Science*

37. Plants are raised under artificial lights turned off and on by an electric clock. Some are given long periods of light, others short periods. This is an example of:

- A. deductive reasoning
- B. a hypothesis
- C. inductive reasoning
- D. an experiment**
- E. a theory

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

38. Both walnut and Gingko trees lose their leaves in the fall when day length starts decreasing. Based on these observations one may conclude that many tree species will lose their leaves in the fall in response to decreasing day length. This statement is an example of:

- A. inductive reasoning**
- B. a theory
- C. deductive reasoning
- D. an experiment

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

39. *Gingko* trees are known to lose their leaves at a certain time each year throughout the United States. Based on this information, *Gingko* trees in China must behave the same way. These statements are an example of:

- A. inductive reasoning
- B. deductive reasoning**
- C. a theory
- D. an experiment

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.02.01 Compare the different types of reasoning used by biologists.*

*Section: 01.02*

*Topic: The Nature of Science*

40. Most individuals in academia are basic researchers, funded through research grants from agencies or foundations. Based on your knowledge of applied research, an industrial company would most likely employ individuals

- A. who develop alternative fuel sources.
- B. who identify a new species of beetle in the Amazon rainforest.
- C. looking at novel proteins involved in the development of a neurological disease.
- D. who document fossils found in a specific archeological expedition.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

41. Wings of birds and butterflies have similar functions, but different evolutionary origins.

They are:

- A. physiological structures.
- B. homologous structures.
- C. analogous structures.
- D. phylogenetic structures.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.03.02 Describe the evidence that supports the theory of evolution.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

42. An alien from another planet landed on earth. He is fascinated by cars and is determined to figure out how they work. He decides to disassemble one of them and examine each part independently. He removes one of the tires and proceeds to learn all he can about the tire. He then removes one of the headlights and proceeds to learn all he can about the headlight. What type of approach is this alien taking to learn about the car?

- A. reductionism
- B. Emergent properties
- C. inductive reasoning
- D. deductive reasoning

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about different types of reasoning.
- ***What type of thinking is required?*** Apply the definitions of different types of reasoning to a specific example.
- ***What key words does the question contain and what do they mean?***
  - o Inductive reasoning uses data to create a hypothesis
  - o Deductive reasoning draws conclusions from existing observations or definitions
  - o Reductionism is breaking down something into its component parts to study them individually

### Gather Content

- ***What do you know about different types of reasoning? How does it relate to the question?*** The key concept here is that the alien is breaking down the car to figure out how each part works independently.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
- What are other types of reasoning? Is a hypothesis being tested or data analyzed? If not then this is not an example of inductive or deductive reasoning.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?*** Without data or a hypothesis and by breaking down the object being studied a reductionist method is being used.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - o This question asked you to apply the definitions of reductionist reasoning to a specific example. If you got the correct answer, great job! If you got an incorrect answer, where did the process break down? Did you forget the definitions of deductive and inductive reasoning? Did you not realize that taking something apart to figure out how it works is reductionism?

## Chapter 01 - The Science of Biology

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.02.01 Compare the different types of reasoning used by biologists.*

*Section: 01.02*

*Topic: The Nature of Science*

43. While you are riding the ski lift up to the top of the mountain on a very cold day you start to shiver involuntarily. You know that the shivering is your body's attempt to help regulate your body temperature and is an example of what type of mechanism?

- A. sensitivity
- B. evolutionary adaptation
- C. homeostasis
- D. energy utilization

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.01.02 Describe the characteristics of living systems.*

*Section: 01.01*

*Topic: The Science of Life*



44. You have been assigned to address a problem of overpopulation of species X in a nearby county. One of the members of your team suggests introducing species Y, which is a natural predator of species X, but not normally found in the area. After some discussion, you go ahead and introduce species Y. What aspects of the hierarchical organization may be affected within a period of a several years?

- A. organism, population, species
- B. population, species, community, biosphere
- C. population, species, community
- D. population, community

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about the impact of a new species on the hierarchical organization of living systems.
- ***What type of thinking is required?*** To apply the definition of levels of organization to determine how they are affected by addition of a new species.
- ***What key words does the question contain and what do they mean?***
  - o Y is a predator of X. This means that Y eats X.
  - o Population – members of a species in a local area
  - o Species – all members of a species
  - o Community – multiple species interacting with each other
  - o Biosphere – both living and non-living components

### Gather Content

- ***What do you know about hierarchical organization? How does it relate to the question?*** Hierarchical refers to one level building on the level below it, like a pyramid. So if one level is affected it can impact the levels above it.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
- If a predator is added which levels of structure would be affected? A predator would impact the prey species at the population level. Levels above this would also be affected up to the level of community.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?*** The best answer is that the population of X will be affected, which in turn affects the species and the community that it belongs to.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
- This question asked you to predict the impact of a predator on different levels of a hierarchical system. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? A decrease in the number of species X would affect the hierarchical levels above it up to the community level. Increased predation will not have an impact at the level of an individual organism or the biosphere.

## Chapter 01 - The Science of Biology

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.01.03 Characterize the hierarchical organization of living systems.*

*Section: 01.01*

*Topic: The Science of Life*

45. You have been assigned to analyze some extraterrestrial material recently collected from Mars. After examining a sample using a microscope you jump up excitedly and shout to your colleagues that you have confirmed the existence of life on Mars. One of your colleagues takes a look at your sample and remarks that all he sees is a single-celled "blob" with little internal structure. Assuming that life on Mars can be classified into similar domains and kingdoms as Earth, to which domain does your "blob" belong?

- A. Archaea
- B. Fungi
- C. Protista
- D. Animalia

## Clarify Question

- ***What is the key concept addressed by the question?*** The question asks you to determine the domain of a new organism.
- ***What type of thinking is required?*** Apply the criteria of different domains to specific examples.
- ***What key words does the question contain and what do they mean?***
  - o Single celled means that the entire organism contains only one cell.
  - o Internal structure refers to organelles like the nucleus.

## Gather Content

- ***What do you know about different domains? How does it relate to the question?***
  - o Protista and fungi both have single celled members, but have internal structures.
  - o Animals are all multicellular and have internal structures.
  - o Archaea are like bacteria and are single celled and do not have internal structure.

## Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
- If the only clue was single celled which could be correct? Protista and fungi both have single celled members, animals are all multicellular.

## Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?*** All members of the domain Archaea are single celled and do not have internal structure, so this is the best answer.

## Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - This question asked you to apply the characteristics of different domains to specific examples to classify an unknown organism. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? While three of the domains listed have single celled organisms, only one lacks internal structures.

Blooms Level: 3. Apply

Gradable: automatic

LO: 01.04.01 Discuss the unifying themes in biology.

Section: 01.04

Topic: Unifying Themes in Biology

46. Why was the determination of the actual sequence of the human genome considered to be descriptive science?

- A. It did not involve deductive reasoning.
- B. It did not involve hypothesis-driven research.**
- C. It involved hypothesis-driven research.
- D. It involved deductive reasoning.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.04.01 Discuss the unifying themes in biology.*

*Section: 01.04*

*Topic: Unifying Themes in Biology*

47. You look outside and realize that your grass needs to be mowed. You pick up the container of gasoline and see that you have approximately a third of a gallon left. You hypothesize that this amount will be enough to mow your entire lawn. Unfortunately, half way through mowing your lawn you run out of gasoline. You grumble and think to yourself that the next time you mow the lawn, you hypothesize that you will need to have at least two-thirds of a gallon of gasoline available. How did the results of your lawn-mowing experience influence the validity of your new hypothesis for future gasoline needs?

- A. Your prediction proved that your hypothesis is correct.
- B. Your hypothesis was supported by trial and error. One more trial added to your data set.
- C. The hypothesis was invalidated by your experimental evidence.
- D. Your prediction of future gas needs is based on experimental data and therefore increases the validity of your hypothesis.**

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

48. Why is it necessary to take an interdisciplinary approach to studying biology?

- A. Research methods used to solve many biological questions often require a number of different types of approaches and the expertise of a variety of scientists.
- B. An interdisciplinary approach is the only way we can further our biological knowledge.
- C. Interdisciplinary approaches are required to answer all scientific questions since all disciplines borrow knowledge from each.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.01.01 Compare biology to other natural sciences.*

*Section: 01.01*

*Topic: The Science of Life*

49. How does peer review influence the development of scientific theories?

- A. Peer review allows other scientists to know what is current in their field.
- B. Careful evaluation of research results by other scientists ensures that only solid and legitimate research results are published, and helps prevent faulty research or false claims from being viewed as scientific fact.
- C. Peer review increases competition among scientists and thus increases the quality of the published work.
- D. Peer review makes it extremely difficult for work to be published other than earth-shattering scientific theories.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

## Check All That Apply Questions

50. Cell theory is one of the foundations of biology. What are the tenants of the cell theory?

Check all that apply.

- ☐ All organisms are made up of more than one cell.
- ☐ All cells have the ability to move.
- ☒ Cells carry genetic material passed to daughter cells during cellular division.
- ☒ Cells arise from other cells through the process of cell division.
- ☐ Organisms are formed through spontaneous generation
- ☒ All living organisms consist of cells

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.04.01 Discuss the unifying themes in biology.*

*Section: 01.04*

*Topic: Unifying Themes in Biology*

51. Darwin's theory of evolution is supported by many modern pieces of evidence. Check all that apply.

- ☒ New measurements of the age of the earth.
- ☒ An understanding of the mechanism of heredity.
- ☐ Human population growth.
- ☐ Comparative studies of animal structures.
- ☒ Similarities in DNA of related species.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.03.02 Describe the evidence that supports the theory of evolution.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

## Multiple Choice Questions



52. Amanda was studying turtles based on DNA analysis. Under the current classification scheme, which of the following turtle species are thought to be most closely related? (1) *Graptemys ouachitensis*, (2) *Trachemys scripta*, (3) *Apalone spinifera*, (4) *Graptemys kohni*.
- A. 1 and 3 due to inductive reasoning
  - B. 1 and 3 due to deductive reasoning
  - C. 2 and 3 due to inductive reasoning
  - D. 1 and 4 due to inductive reasoning**
  - E. 2 and 3 due to deductive reasoning
  - F. 1 and 4 due to deductive reasoning

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about the differences between inductive and deductive reasoning.
- ***What type of thinking is required?*** This question is asking for you to apply the definition of inductive and deductive reasoning to specific examples.
- ***What key words does the question contain and what do they mean?***
  - o Studying turtles by DNA analysis – this means sequencing the DNA from individuals and comparing the similarity of the sequences. The more closely related the species, the more similar their DNA sequences will be.
  - o Genus and species names are given. Closely related species will have the same genus.

### Gather Content

- ***What do you know about relatedness based on species names? How does it relate to the question?*** There are two parts of a species name and those with the same genus are the most closely related.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
- In which examples are general principles being used and in which are specific results being considered? In inductive reasoning there are data to analyze to create a hypothesis. In deductive reasoning you make conclusions or predictions from existing data or observations

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?*** Data (DNA sequences) are being analyzed to draw conclusions, so this is inductive reasoning. The two turtle species with the same genus should have the most similarity in their DNA sequences.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
- This question asked you to apply the definition of inductive reasoning to a specific example and also to recognize that two species of the same genus will be more closely related. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? Did you not realize that the two species of turtles from the same genus would be closely related? Did you not recognize that analyzing DNA sequences to draw a conclusion was inductive reasoning?

## Chapter 01 - The Science of Biology

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.02.01 Compare the different types of reasoning used by biologists.*

*Section: 01.02*

*Topic: The Nature of Science*

53. Marceau is studying small single-celled organisms that contain phospholipid membranes. These organisms can be broadly classified into the domain:

- A. Bacteria
- B. Animalia
- C. Fungi
- D. Protista

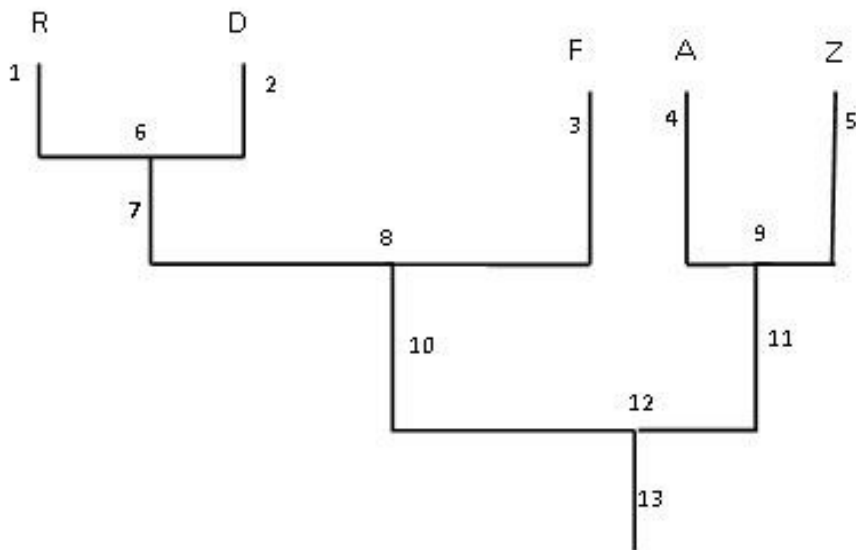
*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.04.01 Discuss the unifying themes in biology.*

*Section: 01.04*

*Topic: Unifying Themes in Biology*



*LO: 01.03.02 Describe the evidence that supports the theory of evolution.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

54. The common ancestor that produced the most evolutionary recent derived characters is
- A. 12
  - B. 9
  - C. 8
  - D. 6**

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about interpreting phylogenetic trees.
- ***What type of thinking is required?*** This question is asking for you to apply the principles of a phylogenetic tree to infer relatedness.
- ***What key words does the question contain and what do they mean?***
  - evolutionary recent derived characters— this refers to traits that related species have. Evolutionary recent means that they happened more recently than other shared traits.

### Gather Content

- ***What do you know about relatedness based on a phylogenetic tree? How does it relate to the question?*** The Y axis measures time, the longer the line, the more time since the living species at the end of either branch shared a common ancestor. The nodes or branchpoints refer to recent common ancestors.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
- Which lines are the shortest? The lines between species R and D and their most recent common ancestor are the shortest and occurred most recently. The other pairs of species all have more distant common ancestors based on the lengths of the lines.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?*** R and D have the most recent common ancestor and this ancestor is indicated by branchpoint 6.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
- This question asked you to apply your understanding of a phylogenetic tree to determine recent ancestors. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? Did you realize that the Y axis (vertical) represents time and the numbers at the branch points represent common ancestors?

## Chapter 01 - The Science of Biology

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.03.02 Describe the evidence that supports the theory of evolution.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

55. The species that have had proportionally the most time to diverge are:

- A. R and D
- B.** F and Z
- C. A and Z
- D. F and R
- E. F

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about interpreting phylogenetic trees.
- ***What type of thinking is required?*** This question is asking for you to apply the principles of a phylogenetic tree to infer the most distant common ancestor.
- ***What key words does the question contain and what do they mean?***
  - Time to diverge refers to the most time elapsed since the species had a common ancestor.

### Gather Content

- ***What do you know about relatedness based on a phylogenetic tree? How does it relate to the question?*** The Y-axis reflects the amount of time since two species had a common ancestor. The common ancestors are indicated by the branch points.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
- Which lines connecting two species are the longest? R and D have a common ancestor at branch point 6, this is the shortest of the links between two species. So these species had the shortest time to diverge.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?*** Using the logic above the two species with the longest time to diverge are F and Z with a common ancestor at branch point 12.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - This question asked you to apply your understanding of a phylogenetic tree to determine which species had the most time to diverge. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? Did you realize that the Y axis (vertical) represents time and the numbers at the branch points represent common ancestors?

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.03.02 Describe the evidence that supports the theory of evolution.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

56. Bacterial cells are placed into a 250mL liquid growth medium in a closed laboratory flask. According to Malthusian theory, they will reproduce exponentially and then:
- A. continue reproducing arithmetically as long as there are no limitations on food supply.
  - B. continue reproducing geometrically as long as there are no limitations on food supply.
  - C. continue reproducing arithmetically until the food supply is used up, then they will cease to grow.
  - D.** continue reproducing geometrically until the food supply is used up, then they will cease to grow.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.03.01 Examine Darwin's theory of evolution by natural selection as a scientific theory.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*



57. If two different species of fish fossils were found in two different layers of sedimentary rock, what might one infer about the specimens?

- A. The species in lower layer died first
- B. They died at the same time
- C. The species in the higher layer evolved from the species in the lower layer
- D. The species in the higher layer died first
- E. The two species are unrelated

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about the formation of fossils.
- ***What type of thinking is required?*** This question is asking you to apply the principles of fossil formation to interpret data.
- ***What key words does the question contain and what do they mean?*** Fossils found at different layers of sedimentary rock.

### Gather Content

- ***What do you know about relatedness based on location in a rock layer? How does it relate to the question?*** Sedimentary rock forms when sediment (silt and sand) drops to the bottom of a lake or ocean, covering whatever is on the bottom of the lake or ocean. In general when fossils are found in different layers, the older fossils are found at the bottom.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
- In sedimentary rock the upper layers are newer. Whether or not the two different species are related does not impact what layer they are found in, and you also cannot assume that one evolved from the other.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?*** Sediments form at the bottom of a lake and accumulate over time. Thus the older fossils are in the older layer and these organisms died before those in the upper layer.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
- This question asked you to apply your understanding of fossil formation to predict the relative age of different fossils. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? Did you recall that as sedimentary rock forms it traps dead animals that can then become fossils?

## Chapter 01 - The Science of Biology

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.03.01 Examine Darwin's theory of evolution by natural selection as a scientific theory.*

*Section: 01.03*

*Topic: An Example of Scientific Inquiry: Darwin and Evolution*

58. A dental student wants to test if fluoride is an effective additive against tooth decay. The student studies tooth decay in a population of people who live in neighborhoods supplied with fluoridated water. This student would like to ask whether access to fluoridated water prevents tooth decay. What would be an effective control group to ask this question?

- A. Individuals who have fluoride added to their toothpaste but not their water.
- B. Individuals with access to fluoridated water.
- C. Individuals with access to water with no fluoride added.
- D. Individuals with access to differing amounts of fluoride in the water.

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about designing an experiment.
- ***What type of thinking is required?*** This question is asking you to apply your knowledge to identify an appropriate control for an experiment.
- ***What key words does the question contain and what do they mean?***
  - o The hypothesis is to test the effectiveness of fluoride in the water on preventing tooth decay.

### Gather Content

- ***What do you know about experimental design? How does it relate to the question?*** The neighborhood being tested already has fluoride in the water. If you want to see if fluoride is effective in preventing tooth decay you need a control group with no fluoride to compare it with.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
- What are other explanations are there for these results? Adding any fluoride to the water would not be a good control group.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?*** The best control would be a group of individuals with no fluoride in their water.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - This question asked you to apply your understanding of a hypothesis to identify the proper control group for an experiment. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? Did you realize that fluoride is your independent variable, this is the variable the researcher can control? Did you realize that adding any fluoride to the water of the control group would make it more difficult to test your hypothesis?

## Chapter 01 - The Science of Biology

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

59. Which statement represents the biological characteristics that kittens, oak trees, swans, earth worms, elephants and crickets have in common?

A. DNA nucleotides form the basis of inherited life, with cells that are formed spontaneously from the environment.

**B.** DNA nucleotides form the basis of all inherited life, with cells that are formed from other cells.

C. RNA nucleotides form the basis of all inherited life, with cells that are formed from other cells.

D. RNA nucleotides form the basis of inherited life, with cells that are formed spontaneously from the environment.

*Blooms Level: 1. Remember*

*Gradable: automatic*

*LO: 01.04.01 Discuss the unifying themes in biology.*

*Section: 01.04*

*Topic: Unifying Themes in Biology*

60. Viruses defy characterization as living organisms even though they possess nucleic acids and proteins. The reason why viruses are not considered to be alive is because they

A. form spontaneously.

B. cannot form spontaneously.

**C.** cannot reproduce without a host cell.

D. lack genetic material.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.04.02 Contrast living and nonliving systems.*

*Section: 01.04*

*Topic: Unifying Themes in Biology*

Phil is conducting a seed germination experiment. He places 3 groups of lettuce seeds in a 34° Celsius incubator with adequate moisture. One set of seeds is placed in a dark area with no light source. A second set is placed under artificial light and third set of seeds is placed in direct sunlight. This experiment is intended to test Phil's hypothesis that light is necessary for lettuce seed germination.

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

61. Based on the experimental design, which variable was the control?

- A. Moisture
- B.** Seeds in the dark
- C. Type of light
- D. Temperature
- E. Germination rate



### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about designing an experiment.
- ***What type of thinking is required?*** This question is asking you to apply your knowledge of experimental design to identify an appropriate control for an experiment.
- ***What key words does the question contain and what do they mean?***
  - o The hypothesis is that light is necessary for seed germination.

### Gather Content

- ***What do you know about experimental design? How does it relate to the question?*** Seeds were placed in three conditions, in the dark, artificial light and direct sunlight.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
  - o Which of the three groups is the control? If you are testing to see if light is necessary for germination then the two conditions exposing seeds to light are not good control groups.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
  - o The seeds in the dark are the control group. The other two groups are receiving some kind of light, and this is the hypothesis that is being tested, so these seeds are in the test or experimental group.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
- This question asked you to apply your understanding of experimental design to identify the correct control group for an experiment. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? A control group is what you are comparing your test groups to. Were you confused that the hypothesis being tested was that light was required for germination?

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

62. Based on the experimental design, which variable was the dependent variable?

- A. Germination rate
- B. Type of light
- C. Seeds in the dark
- D. Moisture
- E. Temperature

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about designing an experiment.
- ***What type of thinking is required?*** This question asks you to apply the definition of dependent variable to identify it in an experiment.
- ***What key words does the question contain and what do they mean?***
  - o Dependent variable is the variable that the researchers are measuring.

### Gather Content

- ***What do you know about dependent variables? How does it relate to the question?*** This is what the researcher is measuring after making changes in the independent variable.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
  - o Moisture and temperature were kept constant and were controlled variables.
  - o The amount of light was the independent variable the researcher changed.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
  - o The variable being measured was the rate of seed germination, so this is the dependent variable. The amount of light was being changed by the experimenter, so light is the independent variable.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - This question asked you to apply your understanding of experimental design to identify the correct control group for an experiment. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? Did you recall that the dependent variable is dependent on changes in the independent variable? In this example the amount of germination (dependent variable) was affected by the amount of light (independent variable).

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

63. Osmometer cells in the brain sense an increase in the salt concentration of plasma. This information is sent to the hypothalamus, which notifies the pituitary gland to release the hormone, ADH. ADH causes the kidney to save water, which lowers the salt concentration of the plasma. What characteristic of life does this overall pathway represent?

- A. Sensitivity
- B. Energy utilization
- C. Cellular organization
- D. Homeostasis**
- E. Evolutionary adaptation

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.01.02 Describe the characteristics of living systems.*

*Section: 01.01*

*Topic: The Science of Life*

64. A chemical imbalance in the blood can cause the heart to stop pumping blood, which will have a detrimental effect on other organs. This observation can be attributed to:

- A. Equilibrium state
- B. Emergent properties**
- C. Reductionism
- D. Evolutionary conservation

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.04.02 Contrast living and nonliving systems.*

*Section: 01.04*

*Topic: Unifying Themes in Biology*

Luke went to a pediatrician when he was 6 months old. The pediatrician consulted a graph and concluded that Luke was in the 97<sup>th</sup> percentile for height, weight and length. The pediatrician predicted that Luke would be tall when he reached adulthood.

*LO: 01.02.01 Compare the different types of reasoning used by biologists.*

*Section: 01.02*

*Topic: The Nature of Science*

65. What type of reasoning did the pediatrician use to generate her prediction about Luke's future growth in height?

- A. Inductive reasoning
- B. Applied theory
- C. Deductive reasoning
- D. Reductionism

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about different types of reasoning.
- ***What type of thinking is required?*** Applying the definitions of different types of reasoning to a specific example.
- ***What key words does the question contain and what do they mean?***
  - o Applied theory – using a theory to solve a problem
  - o Reductionism – breaking something into its parts and studying each part individually
  - o Inductive reasoning – using data to draw a conclusion
  - o Deductive reasoning – using an existing theory or definition to draw a conclusion

### Gather Content

- ***What do you know about different types of reasoning? How does it relate to the question?***
  - o Data was being analyzed and used to make a prediction.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
  - o What are other types of reasoning?
  - o Deductive reasoning uses a definition or theory to draw conclusions.
  - o Reductionism breaks an object into pieces to study how each piece works independently.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
  - o Inductive reasoning uses data to make a prediction, so this is the correct answer. The doctor was measuring Luke's current height and using it to predict his future growth.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - This question asked you to apply the definition of inductive reasoning to a specific example. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? Did you forget that treating a prediction or hypothesis from data is inductive reasoning? Or did you forget that deductive reasoning is creating a hypothesis from existing data or definitions?

## Chapter 01 - The Science of Biology

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.02.01 Compare the different types of reasoning used by biologists.*

*Section: 01.02*

*Topic: The Nature of Science*

66. What type of logic is being used when the pediatrician uses the graph to make conclusions about Luke's progress?

- A. Applied theory
- B. Reductionism
- C. Deductive reasoning
- D. Inductive reasoning



### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about different types of reasoning.
- ***What type of thinking is required?*** Applying the definitions of different types of reasoning to a specific example.
- ***What key words does the question contain and what do they mean?***
  - o Applied theory – using a theory to solve a problem
  - o Reductionism – breaking something into its parts and studying each part individually
  - o Inductive reasoning – using data to draw a conclusion
  - o Deductive reasoning – using an existing theory or definition to draw a conclusion

### Gather Content

- ***What do you know about different types of reasoning? How does it relate to the question?***
  - o A definition or theory is used to draw conclusions in deductive reasoning.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
  - o What are other types of reasoning? Inductive reasoning analyzes data to make a prediction.
  - o Reductionism breaks an object into pieces to study how each piece works independently.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
  - o As an existing graph of percentile weight and length was used this is deductive reasoning. Based on Luke's current height the doctor could make a prediction about Luke's height in the future.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - This question asked you to apply the definition of inductive reasoning to a specific example. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? Did you forget that using a chart or table to make a prediction is deductive reasoning?

## Chapter 01 - The Science of Biology

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.02.01 Compare the different types of reasoning used by biologists.*

*Section: 01.02*

*Topic: The Nature of Science*

Turtle hatchling survivorship rate is low in many turtle species due to predation. Amanda researched the predatory rate on a species of turtle eggs in the Red River. The eggs were harvested from trapped turtles and the egg's cloaca film (reproductive discharge) was either washed off or left on once gathered. Research suggests that predators use the female's cloaca scent to locate the eggs.

The eggs were only handled when wearing gloves and then reburied along islands where the turtles were trapped. The nests were monitored by cameras and manually on foot and data on nest predation were recorded.

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

67. Based on the experimental design, what is the dependent variable?

- A. Number of hatchlings
- B. Cloaca film on eggs
- C. Time eggs spent in ground
- D. Eggs without cloaca film

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about designing an experiment.
- ***What type of thinking is required?*** This question is asking you to apply the definition of the dependent variable to identify it in an experiment.
- ***What key words does the question contain and what do they mean?***
  - o Cloaca – a thin film on eggs. Predators may use its scent to locate the eggs.
  - o Dependent variable – this is what the researcher is measuring to see if it changes when the independent variable is changed.

### Gather Content

- ***What do you know about dependent variables? How does it relate to the question?***
  - o The dependent variable is the variable the researcher measures.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
  - o The independent variable is the variable that the researcher changes, in this case the presence or absence of cloaca.
  - o Control variables are held constant, in this case the time spent in the ground.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
  - o The dependent variable is the number of hatchlings, this is what the researchers are measuring to see if the presence of cloaca affects predation of the eggs.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - This question asked you to apply your understanding of experimental design to identify the dependent variable in an experiment. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? Did you recall that the dependent variable is dependent on changes in the independent variable? In this case the number of hatchlings is dependent on the presence or absence of cloaca.

## Chapter 01 - The Science of Biology

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

68. Based on the experimental design, what is the independent variable?

- A. Number of hatchlings
- B. No cloaca film on eggs**
- C. Time eggs spent in ground
- D. Inducing egg laying

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about designing an experiment.
- ***What type of thinking is required?*** This question is asking you to apply the definition of the independent variable to identify it in an experiment.
- ***What key words does the question contain and what do they mean?*** The eggs were harvested from trapped turtles and the egg's cloaca film (reproductive discharge) was either washed off or left on once gathered.

### Gather Content

- ***What do you know about controls? How does it relate to the question?*** This is what the researcher compares their test samples to.

### Consider Possibilities

- **What other information is related to the question? Which information is most useful?**
  - o The dependent variable is the variable that the researcher measures, in this case the number of hatchlings.
  - o Control variables are held constant, in this case the time spent in the ground.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?*** The independent variable is the presence of cloaca affects predation of the eggs.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - This question asked you to apply your understanding of experimental design to identify the independent variable in an experiment. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? Did you recall that the dependent variable is dependent on changes in the independent variable? In this case the number of hatchlings is dependent on the presence or absence of cloaca.

## Chapter 01 - The Science of Biology

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*



69. Based on the experimental design, what is the control?

- A. Time eggs spent in ground
- B. No cloaca scent on eggs
- C. Hatchling survival rate
- D. Cloaca scent on eggs**

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about designing an experiment.
- ***What type of thinking is required?*** This question is asking you to apply the definition of a control group identify it in an experiment.
- ***What key words does the question contain and what do they mean?***
  - o Control group – this is the group in which the researcher keeps the independent variable constant. In other groups the independent variable is changed and compared to the control.

### Gather Content

- ***What do you know about control groups? How does it relate to the question?***
  - o The control group is what you compare the test group to by changing the independent variable.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
  - o The independent variable is the variable that the researcher changes, in this case the presence or absence of cloaca.
  - o The dependent variable is the variable that the researcher measures, in this case the number of hatchlings.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
  - o The control group are the turtle eggs that did not have their cloaca wiped off. The rate of hatching can then be compared to the rate of hatching in eggs with their cloaca wiped off.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - o This question asked you to apply your understanding of experimental design to identify the correct control group for an experiment. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? Did you confuse the control with the dependent and independent variables? Which eggs were not altered by the researcher in the experiment?

## Chapter 01 - The Science of Biology

*Blooms Level: 4. Analyze*

*Gradable: automatic*

*LO: 01.02.02 Demonstrate how to formulate a hypothesis.*

*Section: 01.02*

*Topic: The Nature of Science*

70. Viruses contain DNA or RNA, but lack genes necessary for metabolism and reproduction.

Why are viruses not considered to be alive?

- A. Viruses are unable to reproduce independently of a host.
- B. Viruses do not have the ability to evolve in their environment.
- C. Viruses do not contain internal organelles.
- D. Viruses do not contain nucleic acids.

*Blooms Level: 2. Understand*

*Gradable: automatic*

*LO: 01.04.02 Contrast living and nonliving systems.*

*Section: 01.04*

*Topic: Unifying Themes in Biology*

71. Dr. Edward Jenner realized that cows have a disease called cowpox, which is like a disease that infects humans called smallpox; Jenner noticed that milkmaids whose hands were infected with cowpox were not contracting smallpox. Jenner infected a child with the pus from a cowpox blister, and found that the child did not contract smallpox. Which statement represents a supporting hypothesis?

- A. The cowpox virus prevented the small pox virus from entering the child's immune system.
- B. the smallpox virus was so similar to the cowpox virus that the child's immune system ignored the smallpox virus
- C. The cowpox infection will prevent the child from being infected by the small pox virus.
- D. The cowpox infection will have no effect on the child's immunity to the small pox virus.

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about identifying a hypothesis.
- ***What type of thinking is required?*** This question is asking to analyze statements describing the hypothesis being tested in an experiment.
- ***What key words does the question contain and what do they mean?***
  - o Cowpox – a virus carried by cows that does not cause disease in humans.
  - o Smallpox – a virus related to cowpox, but does cause infection in humans.

### Gather Content

- ***What do you know about a hypothesis? How does it relate to the question?***
  - o A hypothesis is being tested in an experiment. In this case you want to identify a hypothesis that supports the observed results.

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
  - o The cowpox infection seems to be protecting the child from smallpox. This would require the smallpox virus being recognized by the child's immune system.
  - o This is how vaccines often work, a person is given a small amount of a killed virus or in this case a related virus. The person then raises an immune response to the vaccine. If the person is then exposed to the disease causing virus they have some immunity to the virus and may not become infected.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
  - o The best hypothesis to support the data is that exposure to the cowpox virus protected the child from the smallpox virus.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
- This question asked you to analyze the results of an experiment to identify a hypothesis supported by the results. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? Did you realize that vaccinating a child with cowpox would protect the child from smallpox? Were you confused about the definition of a hypothesis?

72. A beautiful wood desk you may do your homework on was once a living tree, but after being cut down its tissues died. Now, it only exhibits what property of life?

- A. Organization
- B. Metabolism
- C. Homeostasis
- D. Sensitivity

### Clarify Question

- ***What is the key concept addressed by the question?*** The question is about identifying different properties of life.
- ***What type of thinking is required?*** Applying the definitions of the properties of life.
- ***What key words does the question contain and what do they mean?***
  - Wood was from a living tree.
  - Which properties of life remain after death of the tree.

### Gather Content

- ***What are the properties of life? How do they relate to the question?***
  - Homeostasis – keeping things in balance, requires energy
  - Sensitivity – nerve signals require energy
  - Organization – requires energy to establish, but can be maintained after death
  - Metabolism – extraction of energy from food

### Consider Possibilities

- ***What other information is related to the question? Which information is most useful?***
  - Which properties would be lost after an organism dies? Homeostasis, sensitivity and metabolism all require that an organism be alive.

### Choose Answer

- ***Given what you now know, what information and/or problem solving approach is most likely to produce the correct answer?***
  - While organization requires energy to become established, it can remain after the death of an organism.

### Reflect on Process

- ***Did your problem-solving process lead you to the correct answer? If not, where did the process break down or lead you astray? How can you revise your approach to produce a more desirable result?***
  - This question asked you to apply your understanding of the properties of life to specific examples. If you got the correct answer, great job! If you got an incorrect answer, where did you get stuck? A tree still has structure after it dies from its cell walls. The other answers all require the organism to still be alive.

## Chapter 01 - The Science of Biology

*Blooms Level: 3. Apply*

*Gradable: automatic*

*LO: 01.01.02 Describe the characteristics of living systems.*

*Section: 01.01*

*Topic: The Science of Life*