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WHAT IS LIFE?

Multiple Choice

- 1) An independent individual that possesses the characteristics of life is called a(n)
- cell.
 - organism.
 - organ.
 - tissue.
 - atom.

Text Section: LO2

Key Concept: biological hierarchy

Level: Basic fact retention

Answer: B; Some students may be tempted to select choice a (cell) because there are many unicellular organisms. However, this would not be the best answer because in a multicellular organism, each individual cell is not independent.

- 2) An organ is made up of several
- biological molecules.
 - organ systems.
 - tissues.
 - cells.
 - organisms.

Text Section: LO2

Key Concept: biological hierarchy

Level: Basic fact retention

Answer: C; Although a and d could also be considered to be correct, c is the best answer because it is the level of organization immediately below organ in terms of complexity.

- 3) The simplest entity that exhibits all of the properties of life is called a(n)
- cell.
 - molecule.
 - organ.
 - tissue.
 - organism.

Text Section: LO2

Key Concept: biological hierarchy

Level: Basic fact retention

Answer: A

- 4) The scientific name for the black-footed ferret is *Mustela nigripes*. The name *Mustela* indicates the _____ to which this organism belongs.
- class
 - family
 - genus
 - phylum
 - species

Text Section: LO4

Key Concept: binomial nomenclature

Level: Basic fact retention

Answer: C

- 5) If an ecologist is studying the cycling of carbon through a particular environment (which involves the movement of carbon through living things as well as through rock, air, and water), the scientist is studying at what level of ecology?
- community
 - biosphere
 - ecosystem
 - organismal
 - population

Text Section: LO5

Key Concept: biological hierarchy

Level: Application of concepts

Answer: C; This is an ecosystem-level study because it involves both the living and the nonliving components of a particular environment.

- 6) Characteristics usually associated with life include all of the following except
- motility.
 - responsiveness to stimuli.
 - reproduction.
 - lack of change from generation to generation.
 - a high degree of organization.

Text Section: LO1

Key Concept: characteristics of life

Level: Basic fact retention

Answer: D

- 7) Which list is organized from smallest to largest level of organization of life?
- organelles, cells, tissues, organs, organ systems, organisms
 - organelles, tissues, cells, organ systems, organs, organisms
 - cells, tissues, organ systems, organelles, organs, organisms
 - organisms, organ systems, organs, tissues, cells, organelles
 - tissues, cells, organelles, organs, organ systems, organisms

Text Section: LO2

Key Concept: organization of life

Level: Basic fact retention

Answer: A

- 8) To maintain order within their cells and organs, all living things must
- extract energy from sunlight.
 - constantly change.
 - carry on metabolism.
 - reproduce.
 - be able to move.

Text Section: LO2

Key Concept: metabolism

Level: Basic fact retention

Answer: C

- 9) Organisms that undergo asexual reproduction
- produce offspring that are identical to each other and to the parent.
 - are usually very complex.
 - do not require energy to reproduce.
 - produce offspring that are different from each other.
 - require another organism to reproduce.

Text Section: LO3

Key Concept: reproduction

Level: Basic fact retention

Answer: A

- 10) Young multicelled organisms usually start out small, then grow in size and increase in complexity. This process is called
- reproduction.
 - heredity.
 - development.
 - evolution.
 - metabolism.

Text Section: LO3

Key Concept: development

Level: Basic fact retention

Answer: C

- 11) The units of inheritance are
- heredities.
 - evolutions.
 - twins.
 - metabolic activities.
 - genes.

Text Section: LO3

Key Concept: heredity, genes

Level: Basic fact retention

Answer: E

- 12) Scientists have found that ancient fossils
- are very similar to present-day organisms.
 - are more similar to present-day organisms than more recent fossils.
 - are just as similar to present-day organisms as more recent fossils.
 - are less similar to present-day organisms than more recent fossils.
 - bear no resemblance to present-day organisms.

Text Section: LO4

Key Concept: evolution, fossils

Level: Basic fact retention

Answer: D

- 13) Organisms that have descended from the same initial group and have the ability to interbreed belong to the same
- genus.
 - species.
 - class.
 - family.
 - order.

Text Section: LO4

Key Concept: classification of organisms

Level: Basic fact retention

Answer: B

- 14) Which of the following includes other levels of hierarchy?
- kingdom
 - domain
 - order
 - phylum
 - family

Text Section: LO4

Key Concept: classification of organisms

Level: Basic fact retention

Answer: B

- 15) In populations, adaptation usually arises through
- natural selection.
 - heredity.
 - development.
 - metabolism.
 - responsiveness.

Text Section: LO4

Key Concept: adaptation

Level: Basic fact retention

Answer: A

- 16) All the living organisms in a particular area at a particular time make up a
- population.
 - community.
 - ecosystem.
 - biosphere.
 - biosystem.

Text Section: LO5

Key Concept: community

Level: Basic fact retention

Answer: B

- 17) The first step in the scientific method is to
- identify a problem.
 - propose a solution.
 - predict the results of an experiment.
 - perform an experiment.
 - draw a conclusion.

Text Section: LO5

Key Concept: scientific method

Level: Basic fact retention

Answer: A

- 18) All living things have the following characteristics except
- responsiveness to external and/or internal stimuli.
 - utilization of energy.
 - self-replication.
 - growth.
 - sexual reproduction.

Text Section: LO1, LO2, LO3

Key Concept: characteristics of life

Level: Application of concepts

Answer: E

- 19) Which of the following is considered to be the most basic living unit?
- molecule
 - organelle
 - organ system
 - tissue
 - cell

Text Section: LO2

Key Concept: cell as living unit

Level: Basic retention of facts

Answer: E

- 20) The binomial nomenclature for humans is *Homo sapiens*. The term “*Homo*” refers to the
- genus name.
 - species name.
 - scientific name.
 - trivial name.
 - ordinal name.

Text Section: LO4

Key Concept: taxonomic hierarchy

Level: Basic retention of facts

Answer: A

- 21) What is the term that describes the study of the relationship between living things and components of their environment?
- zoology
 - ecology
 - herpetology
 - analogy
 - ichnology

Text Section: LO5

Key Concept: ecology

Level: Basic retention of facts

Answer: B

- 22) When examining the hierarchy of life, which of the following terms is most inclusive?
- population
 - species
 - biosphere
 - ecosystem
 - population

Text Section: LO5

Key Concept: biosphere

Level: Basic retention of facts

Answer: C

- 23) Which of the following concepts best describes the wide variety of dog species we observe, ranging from the domesticated golden retriever or the basset hound, to the wild dogs of Africa, to foxes?
- evolution
 - taxonomy
 - special creation
 - preadaptation
 - inheritance of acquired characteristics

Text Section: LO4

Key Concept: evolution

Level: Application of concepts

Answer: A

Matching

1) Match the following domains with the appropriate characteristic.

1. ___ Domain Bacteria
 2. ___ Domain Archaea
 3. ___ Domain Eukarya
- A. often live in extreme environments
 - B. includes only plants and animals
 - C. complex cells with a nucleus
 - D. includes the species that causes strep throat

Text Section: LO4

Key Concept: classification

Level: Basic fact retention

Answer: 1. d; 2. a; 3. c

2) Match the following examples with the correct descriptive term.

4. ___ The portion of the earth where life exists
 5. ___ Group of organisms of the same species
 6. ___ All living organisms in an area
 7. ___ All living organisms and the nonliving physical environment
 8. ___ Living biological entity
- A. organisms
 - B. community
 - C. ecosystem
 - D. biosystem
 - E. population
 - F. biosphere

Text Section: LO5

Key Concept: hierarchy of life

Level: Basic fact retention

Answer: 4. f; 5. e; 6. b; 7. c; 8. a

3) Match the following characteristics with the proper description.

9. ___ motility
 10. ___ hierarchy of order
 11. ___ development
 12. ___ metabolism
 13. ___ responsiveness
- A. organisms are composed of cells; cells form tissues; tissues are arranged into organs; and organ systems compose the organism
 - B. a characteristic by which organisms make accommodations based on the external or internal environment
 - C. ability to move
 - D. the process by which an organism grows and changes over time
 - E. the characteristic by which cells use energy

Text Section: LO1, LO2

Key Concept: characteristics of life

Level: Application of concepts

Answer: 9. c; 10. a; 11. d; 12. e; 13. B

4) Match the following organisms with the domain in which they are classified.

- 14. ___ fungi
 - 15. ___ plants
 - 16. ___ animals
 - 17. ___ protists
 - 18. ___ single-celled organisms that typically live in extreme, hostile environments
- A. Eukarya
 - B. Fungi
 - C. Archaea
 - D. Bacteria
 - E. cells that are produced in the bone marrow, are never changed by the thymus, and manufacture antibodies

Text Section: LO4

Key Concept: classification of life

Level: Basic fact retention

Answer: 14. a; 15. a; 16. a; 17. a; 18. c

Integrate and Apply What You've Learned (Short Answer)

- 1) If you were studying a soil sample from another planet and you discovered some interesting specimens that seemed to be alive, what procedure could you use to verify that they were indeed alive?

Text Section: LO1

Key Concept: characteristics of life

Level: Application of concepts

Answer: Using the scientific method, you would perform experiments to verify that the items in question demonstrated all of the properties of life.

- 2) List the 9 characteristics that living things share.

Text Section: LO1

Key Concept: characteristics of life

Level: Basic fact retention

Answer:

- a. *an internal order, a high degree of organization, or structural/behavioral complexity and regularity*
- b. *metabolism (use of energy to transform and organize matter)*
- c. *motility*
- d. *response to external stimuli*
- e. *reproduction*
- f. *growth and development*
- g. *heredity (like gives rise to like)*
- h. *evolution*
- i. *adaptations*

3) List the units of the hierarchy of life in order from smallest to largest.

Text Section: LO2

Key Concept: biological hierarchy

Level: Basic fact retention

Answer: biological molecules → organelles → cells → tissues → organs → organ systems → organism

4) To support the existence of life on Mars (or any other planet), why is it important to demonstrate the availability of liquid water?

Text Section: LO2

Key Concept: importance of water

Level: Basic fact retention

Answer: The chemical reactions of metabolism require liquid water.

5) Consider the following statement: Plants violate one of the major characteristics of life because they are immobile. Do you agree or disagree with this statement? Defend your answer.

Text Section: LO2

Key Concept: characteristics of life

Level: Advanced critical thinking

Answer: Students should disagree with the statement. Plants exhibit subtle movements based on growth (like leaves turning to face the sun, or hydrostatic movement like leaves opening and closing, Venus's-Flytrap, etc.)

6) The presence of DNA is not one of the major characteristics of life. Why, then, might scientists look for the presence of DNA to help confirm the existence of life?

Text Section: LO3

Key Concept: heredity

Level: Application of concepts

Answer: In all of the life-forms on Earth, genes that are made up of DNA control heredity (which is one of the major characteristics of life). Although heredity in life-forms from another planet might be controlled differently, this is the only mechanism with which we are currently familiar.

7) Define the term evolution.

Text Section: LO4

Key Concept: evolution

Level: Basic fact retention

Answer: Evolution refers to descent with modification based on changes in the frequencies of genes within populations over time. (Please note that descent with modification alone does not indicate adequate understanding of the process.)

- 8) List in order the eight categories into which organisms are classified, beginning with the most general (or most inclusive) category.

Text Section: LO4

Key Concept: classification

Level: Basic fact retention

Answer: domain, kingdom, phylum, class, order, family, genus, species

- 9) Compare and contrast sexual and asexual reproduction.

Text Section: LO3

Key Concept: modes of reproduction

Level: Application of concepts

Answer: Sexual reproduction involves two parental cells or organisms that result in an offspring that is not genetically identical to either parent; asexual reproduction involves one parental cell or organism that produces offspring that are genetically identical to the parent.

- 10) Describe natural selection. Who first coined this phrase?

Text Section: LO4

Key Concept: natural selection

Level: Application of concepts

Answer: Darwin first used this term to describe the mechanism of evolution. This describes the changes in genetics of a population over time allowing them to adapt to their environment.

- 11) List the five steps of the scientific method in order.

Text Section: LO6

Key Concept: scientific method

Level: Basic fact retention

Answer:

- a. Ask a question or identify a problem based on observations of the natural world.*
- b. Propose a hypothesis or a potential solution.*
- c. Make a prediction.*
- d. Test the prediction through experimentation and/or observation.*
- e. Draw a conclusion.*

- 12) Many studies of potentially useful new drugs involve the use of two groups of people: One group takes the drug and another group takes a placebo (like a sugar pill). Members of both groups do not know whether they are taking the drug or the placebo. What is the reason for designing these experiments this way?

Text Section: LO6

Key Concept: scientific method

Level: Advanced critical thinking

Answer: The placebo group serves as a control group to account for any factor that might affect the condition of the patient other than the drug.

- 13) Some scientists believe that any Martian organisms would most closely resemble members of the Archaea on Earth. What is the basis for their thinking?

Text Section: LO4

Key Concept: Archaea

Level: Application of concepts

Answer: Members of the Archaea inhabit some of the most extreme environments on the planet. These are similar to the environments present on Earth soon after its formation. This suggests that the Archaea organisms are very ancient in origin. It is thought that any Martian environments are also very harsh and extreme, much like those inhabited by Archaea organisms today.

- 14) Some bacteria are able to thrive in very warm environments such as the hot springs in Yellowstone National Park. Explain how natural selection may have allowed these organisms to inhabit this harsh environment.

Text Section: LO 4

Key Concept: adaptation

Level: Application of concepts

Answer: The hot springs in Yellowstone provided a new ecological habitat that was not being exploited by any living organisms. Bacteria near the hot springs could not survive the increased temperature. Some individuals within the bacterial populations had variations that allowed them to withstand a slightly higher temperature than their neighbors. This allowed these organisms to move into the cooler parts of the hot springs pools without competition from others. Eventually these pioneer organisms multiplied and some individuals within this new population could tolerate slightly higher temperatures. These moved into the warmer parts of the pools. Through this step-wise process, eventually there emerged bacteria that could not only tolerate the higher temperatures but actually thrived under these conditions. Natural selection describes the process by which those individuals that were better able to tolerate the increased temperatures thrived within these habitats while others did not.

- 15) Biologists think that all organisms alive today descended from organisms that lived before. In fact, they feel that we can trace any living organism back to the origin of life on Earth. Explain how metabolism fits into this thinking.

Text Section: LO4

Key Concept: continuity of life

Level: Application of concepts

Answer: Despite the vast diversity of living organisms, they all have very similar metabolic machinery and the metabolic pathways are very similar. This suggests that these evolved in common ancestors. Since all organisms share these similarities, it suggests that all life can be traced back to the original living organisms on Earth.

Analyze and Evaluate the Concepts (Essay)

- 1) How do the characteristics of life apply to situations such as individuals on life support, organs on life support, frozen organisms (including embryos), genetically engineered organisms, test tube babies, and hybrids between computers and living things?

Text Section: LO1

Key Concept: characteristics of life

Level: Advanced critical thinking

Answer: This is an open-ended question with no definite answer, but the student should be able to identify which (if any) characteristics of life are called into question with each of these examples. For example, should a frozen organism be considered alive if it is incapable of reproduction, movement, growth, etc., while frozen? The student should also recognize that although these characteristics seem simple on the surface, many of them are not black-and-white. For example, an individual on life support may not engage in reproductive activity, but might still produce eggs or sperm and thus be capable of reproduction.

- 2) One of the major characteristics of life is reproduction. There are two types of reproduction: asexual and sexual reproduction. Compare the advantages and disadvantages of both types of reproduction. What do you think is the benefit of sexual reproduction that makes it so much more prevalent among living things?

Text Section: LO3

Key Concept: reproduction

Level: advanced critical thinking

Answer: The best answers should include the following:

Advantages of asexual reproduction - no need to find a mate, easier, quicker, safer, less expenditure of energy, preserves genetic make up of the parent

Disadvantages of asexual reproduction - no mixing of the genes to produce new genetic combinations that might survive better in a given environment

Advantages of sexual reproduction - produces many different genetic combinations, each of which might survive better in a particular environment (It's like playing the lottery. The more tickets you buy, the more chances you have to win.)

Disadvantages to sexual reproduction - the need to find a mate and convince that potential partner to engage in the act of reproduction, can be energetically expensive, partners engaged in reproduction are more vulnerable to predation, genetic make up of the parent is not fully conserved.

Benefit - Sexual reproduction is more prevalent because the ability to produce genetically unique offspring that can successfully survive in different environments is a very powerful evolutionary force.

- 3) Life on Earth is often described as exhibiting both unity and diversity. Explain this statement.

Text Section: LO4

Key Concept: characteristics of life, evolution

Level: Advanced critical thinking

Answer: To explain what is meant by the unity exhibited by life on Earth, students should discuss the fact that all living things share the nine basic characteristics of life. In addition, most all cells share the same basic structure (cell membrane, nucleus, other organelles, etc.), metabolism (respiration), and mechanism for reproduction and heredity (DNA transmitted to daughter cells through mitosis and/or meiosis and fertilization). To explain what is meant by the diversity exhibited by life on Earth, students should discuss the process of evolution whereby even closely related species can become adapted to very different environments and, as a result, take on very different physical, behavioral, and physiological characteristics. It would be best if students could generate examples to illustrate this principle.

- 4) There is a standing debate among biologists involved in looking for life on other planets as to how any alien organisms should be handled. Some feel that alien organisms should not be introduced on Earth; others feel that investigating these alien organisms will provide important information. What are some of the arguments on both sides?

Text Section: LO7

Key Concept: alien life

Level: Advanced critical thinking

Answer: The best responses will include discussion of the following ideas: How to grow alien organisms; how to control their growth; problems that could arise from our lack of understanding of the alien organisms; studying alien organisms may allow us to better understand life on Earth; study may provide new answers to basic questions about Earth; study may provide new materials to aid mankind. Thoughtful answers will discuss the ramifications this information will have on society.

- 5) How might you abbreviate the genus and species name of *Apteralcydion lapierrii*? Why might you want to abbreviate it?

Text Section: LO4

Key Concept: scientific notation

Level: Application of concepts

Answer: It would be abbreviated *A. lapierrii*. Both the genus initial and the species name are italicized. Scientists use this shorthand just like we may use a nickname; it is shorter

- 6) If you were studying the ecology of a marsh community, what components would you need to consider?

Text Section: LO5

Key Concept: hierarchy of life

Level: Application of concepts

Answer: A correct answer would include the various components of all living things in that ecosystem, including members of both microscopic and macroscopic organisms, the interactions between these organisms, and the interplay between organisms and the abiotic environment.

- 7) Use the scientific method to analyze this question: Why has the population of kangaroo rats declined in Riverside County?

Text Section: LO6

Key Concept: scientific method

Level: Application of concepts

Answer: First, the question has already been stated. Next, hypotheses will be formulated: Is there a new predator killing the kangaroo rats? Or has urban sprawl ruined their habitat? Or might an interaction with another organism be preventing successful reproduction? After a bit of analysis of the population and the habitat in which they live, you may make a prediction. In this particular case, it appears to be urban sprawl. This would then be tested with an experiment and observations. Populations both near and far from development would be studied to see if there is differential death due to predation, disease, parasites, etc. Population size of kangaroo rats living close to development would be estimated using live traps and compared to populations of kangaroo rats living far from developed areas. If the population close to new development is significantly lower than those far from developing areas, our hypothesis is supported.

- 8) You will be learning much about evolution in this course. A friend says to you that evolution isn't true because it's "just a theory." How would you respond to this?

Text Section: LO6

Key Concept: evolution, scientific theories

Level: Application of concepts

Answer: A theory in science can be defined as a general principle about the natural world that is supported by many observations, experiments, and facts. Evolution can be shown to be a dynamic, unifying idea in biology supported by fossil evidence, the unity we see in living things, and many experimental studies.