Name: _____ Class: _____ Date: _____

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1. Which of the following is classified as a living organism by biologists?
   a. DNA molecule
   b. Bacterium
   c. Metabolic energy
   d. Feather
   e. Meteorite

ANSWER: b

2. The basic structural and physiological unit of most living organisms is the
   a. aggregate.
   b. organelle.
   c. genome.
   d. membrane.
   e. cell.

ANSWER: e

3. One reason we consider the dormant seed of a desert plant to be alive is that it
   a. is extracting energy from the environment.
   b. formed within a nonliving structure.
   c. is evolving.
   d. contains genetic material.
   e. is always converting molecules into new biological molecules.

ANSWER: d

4. One reason biologists consider viruses to be a part of life is that viruses
   a. are composed of cells.
   b. evolve.
   c. live independently.
   d. carry out physiological functions, independently of cells.
   e. extract energy from the environment.

ANSWER: b

5. Which statement about viruses is true?
   a. They do not mutate or evolve.
   b. They do not contain genetic information.
   c. They carry out physiological functions on their own.
   d. They depend on cellular organisms to reproduce.
   e. They are composed of cells.

ANSWER: d

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6. Suppose you are leading a team looking for extraterrestrial life on distant planets. You find something that you suspect might be a living organism. Which characteristic would be required for it to be classified as a living organism?

a. Ability to self-replicate
b. Genetic material in the form of DNA
c. Cellular structure that includes a nucleus
d. Ability to transform energy from the sun through photosynthesis
e. Aerobic metabolism

ANSWER: a

7. Organisms similar to today's _____ most likely existed prior to the abundance of O_2 on Earth.

a. cyanobacteria
b. photosynthetic plants
c. aerobic eukaryotes
d. amphibians
e. fungi

ANSWER: a

8. The *Curiosity* rover is currently searching for signs of life on Mars. What kind of evidence would most likely indicate the presence of living organisms on Mars?

a. Carbon dioxide in the atmosphere
b. Different nucleic acids and amino acids than those found on Earth
c. Fatty acid molecules
d. Complex molecules containing genetic information
e. Simple organic molecules

ANSWER: d

9. Evidence indicates that all life on Earth today

a. has a single common ancestor.
b. requires oxygen for life.
c. is able to extract energy from the sun.
d. evolved from ancestors containing genetic material in the form of proteins.
e. is multicellular.

ANSWER: a

10. If we picture the history of Earth as a 30-day month, modern humans arose

a. at the beginning of week 4.
b. on day 27.
c. in the last 5 minutes of day 30.
d. on day 15.

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e. in the early morning of day 30.

ANSWER: c

11. There has been life on Earth for approximately _____ years.
    a. 10,000
    b. 4 million
    c. 100 million
    d. 1 billion
    e. 4 billion

ANSWER: e

12. The oldest rocks on Earth are approximately _____ years old.
    a. 4,000– 5,000
    b. 400,000– 500,000
    c. 2–3 million
    d. 4–4.5 billion
    e. 8 billion

ANSWER: d

13. Earth is approximately _____ years old.
    a. 2–3 thousand
    b. 4–5 million
    c. 40–50 million
    d. 4–5 billion
    e. 5 trillion

ANSWER: d

14. The critical step for the evolution of life was the
    a. formation of fatty acids.
    b. appearance of nucleic acids that could replicate themselves.
    c. appearance of proteins that could replicate themselves.
    d. formation of simple molecules.
    e. synthesis of proteins.

ANSWER: b

15. Which of the following is the most probable order of appearance of molecules and structures that led to the evolution of life on Earth?
    a. Nucleic acids, proteins, membranes, cells
    b. Proteins, membranes, nucleic acids, cells
    c. Membranes, nucleic acids, proteins, cells

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d. Cells, membranes, nucleic acids, proteins
e. Proteins, cells, nucleic acids, membranes

ANSWER: a

16. Cells are characterized by
a. an aggregation of proteins.
b. the synthesis of proteins with stable shapes.
c. the enclosure of biological molecules by a membrane.
d. complex proteins being dissolved in water.
e. the formation of reactants and products.

ANSWER: c

17. Refer to the figure showing life's "timeline."

Based on the timeline, which statement is true?
a. The oldest fossils include photosynthesizers.
b. The first photosynthesizers were prokaryotic.

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c. Multicellularity arose before the evolution of eukaryotic cells.
d. The oldest fossils include multicellular organisms.
e. The first photosynthesizers were multicellular.

ANSWER: b

18. What is one major reason that the earliest organisms on Earth were confined to the oceans?
a. The oxygen in the atmosphere was toxic.
b. There was not enough oxygen in the atmosphere to support life.
c. Not enough ultraviolet light could penetrate the atmosphere to support life.
d. The oceans created a shield against the damaging effects of ultraviolet radiation.
e. The salt within the oceans provided the raw materials for making proteins.

ANSWER: d

19. If you were able to travel back in time 4 billion years to when life first appeared on Earth, what feature of Earth would make it immediately impossible for you to survive?
a. The high ozone content of the air would interfere with metabolic processes.
b. There would be no water on Earth.
c. There would not be enough ultraviolet radiation to support photosynthesis.
d. There would not be any protein-containing organisms for food.
e. The oxygen content of the air would be too low to support aerobic metabolism.

ANSWER: e

20. What is the correct order in which the following appeared during the early evolution of life on Earth?
a. Oxygen, ozone, photosynthesis, life on land
b. Photosynthesis, oxygen, ozone, life on land
c. Life on land, photosynthesis, oxygen, ozone
d. Ozone, oxygen, photosynthesis, life on land
e. Oxygen, photosynthesis, life on land, ozone

ANSWER: b

21. A prerequisite for the survival of life on land was the accumulation of a protective layer of
a. O_2 in the atmosphere.
b. CO_2 in the atmosphere.
c. water vapor in the atmosphere.
d. ozone in the atmosphere.
e. bacteria in the soil.

ANSWER: d

22. O_2 is critical for terrestrial life on Earth because it
a. allows for anaerobic metabolism.

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b. blocks UV radiation.
c. provides energy to some basic forms of life.
d. provided food for early prokaryotes.
e. once led to production of ozone in the upper atmosphere.

ANSWER: e

23. Which event was most directly responsible for increasing oxygen in Earth's atmosphere?
a. The cooling of the planet
b. The emergence of eukaryotes
c. The development of multicellularity
d. The evolution of photosynthesis
e. The rise of prokaryotes

ANSWER: d

24. The chemical formula for molecular oxygen is
a. O.
b. O_2.
c. H_2O_2.
d. O_3.
e. CO_2.

ANSWER: b

25. The accumulation of _____ allowed organisms to grow larger.
a. O_2 in the atmosphere
b. CO_2 in the atmosphere
c. CO_2 in the water
d. O_3 in the atmosphere
e. O_3 in the water

ANSWER: a

26. Ozone is important to life on Earth because it
a. is used for aerobic metabolism.
b. can be used in place of oxygen.
c. helps block ultraviolet radiation.
d. provides energy to some basic forms of life.
e. sits in the lower atmosphere as a protective layer.

ANSWER: c

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27. Photosynthesis was a major evolutionary milestone for several reasons. One reason is that
    a. photosynthetic organisms contributed ozone to the environment, which led to the evolution of aerobic organisms.
    b. photosynthesis led to conditions that allowed life to arise on land.
    c. photosynthesis is the only metabolic process that consumes oxygen.
    d. photosynthesis provides oxygen for anaerobic organisms.
    e. photosynthesis changed the levels of carbon dioxide in Earth's atmosphere.

ANSWER: b

28. For a multicellular organism to have evolved from a unicellular ancestor, what new feature must have been present that was *not* necessary for unicellular life-forms?
    a. A mechanism for cell division
    b. Adhesion molecules on the surfaces of the cells
    c. Specialization of cellular functions
    d. Chloroplasts
    e. A mechanism for cell movement

ANSWER: b

29. Every living organism on Earth can be assigned to one of three separate
    a. species.
    b. genus groups.
    c. domains.
    d. ancestors.
    e. genomes.

ANSWER: c

30. Which structure(s) is/are necessary in the forming of a cell?
    a. Nucleus
    b. Organelles
    c. Membrane
    d. Chloroplast
    e. Mitochondria

ANSWER: c

31. Scientists estimate that for more than _____ years after cells originated, all organisms consisted of one cell.
    a. 250,000
    b. 2 million
    c. 200 million
    d. 2 billion

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e. 20 billion

ANSWER: d

32. Which process would be most effective at preventing evolutionary change in a population of bacteria?
a. Imperfect replication of genetic material
b. Formation of spontaneous mutations
c. Cell division
d. Perfectly accurate copying of DNA
e. Production of functional proteins

ANSWER: d

33. If you were trying to create rapid evolutionary change in a population of bacteria, what treatment would be most effective?
a. Exposing the bacteria to UV light, which damages DNA
b. Growing the bacteria under optimal conditions for growth
c. Maintaining the bacteria at 4°C, which slows growth
d. Freezing the bacteria in liquid nitrogen
e. There is no treatment that could induce evolutionary change.

ANSWER: a

34. It is hypothesized that mitochondria in eukaryotic cells evolved by endosymbiosis, when a larger cell ingested a smaller cell. If you were examining eukaryotic cells using a high-powered microscope, what evidence would you look for that would best support this hypothesis?
a. Nuclei within the mitochondria
b. Chloroplasts within the mitochondria
c. Two membranes around each mitochondrion
d. A rupture in the membrane of the cell
e. A second cell within each mitochondrion

ANSWER: c

35. The initial accumulation of oxygen in the atmosphere was the result of photosynthesis from an organism most like modern
a. algae.
b. mosses.
c. kelp.
d. eukaryotes.
e. cyanobacteria.

ANSWER: e

36. Cells
a. are composed of many types of tissues.

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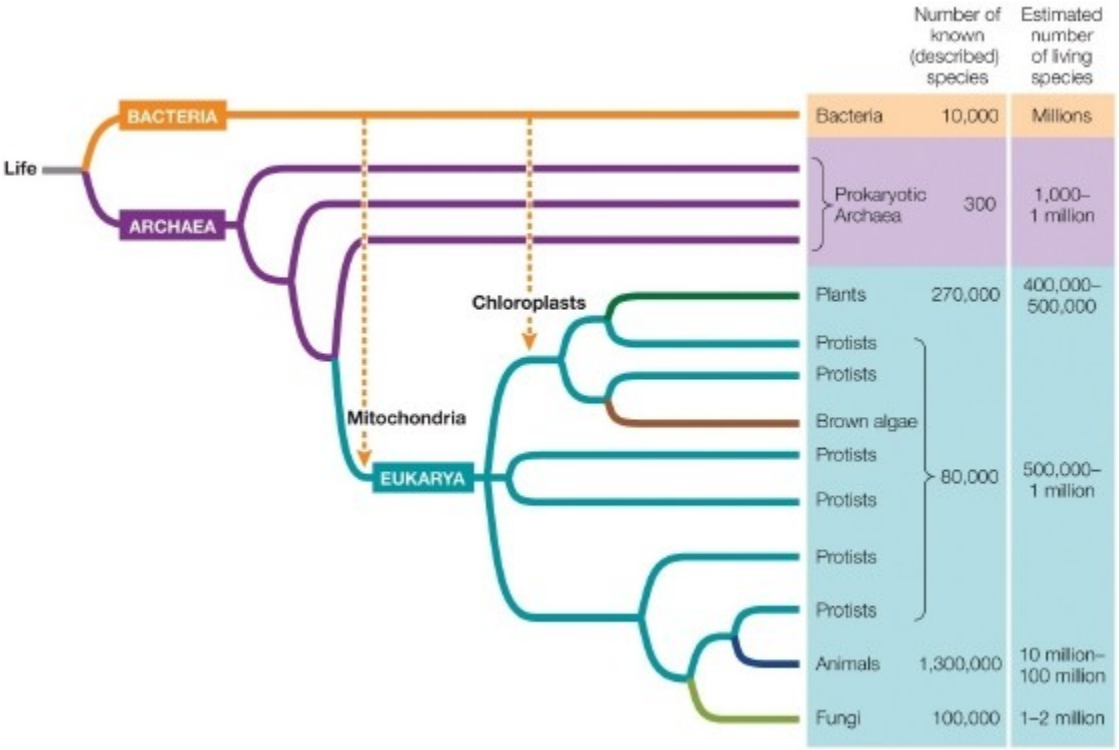
b. are found in plants and animals, but not bacteria.
c. are the smallest entity studied by biologists.
d. can be building blocks for complex organisms.
e. must contain DNA within a nucleus.

ANSWER: d

37. Refer to the figure showing a tree of life.



What is one conclusion that you can draw from the figure?

a. Plants are more closely related to Archaea than they are to animals.
b. Animals are more closely related to fungi than they are to plants.
c. Animals and plants belong to different domains.
d. Chloroplasts are found only in plants.
e. Chloroplasts evolved before mitochondria.

ANSWER: b

38. Refer to the figure showing a tree of life.

Name: _____ Class: _____ Date: _____

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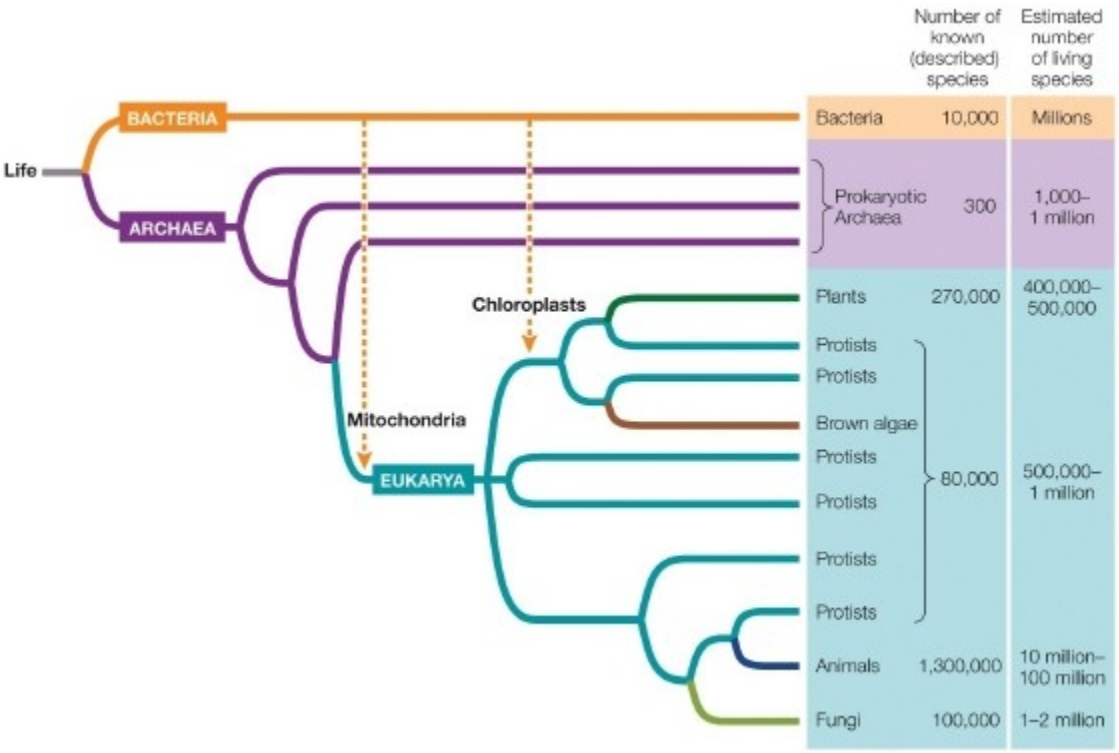

From the figure you can conclude that plants evolved from

a. protists.
b. endosymbiotic bacteria.
c. mitochondria.
d. Bacteria.
e. Archaea.

ANSWER: a

39. Refer to the figure showing a tree of life.

Name: _____ Class: _____ Date: _____

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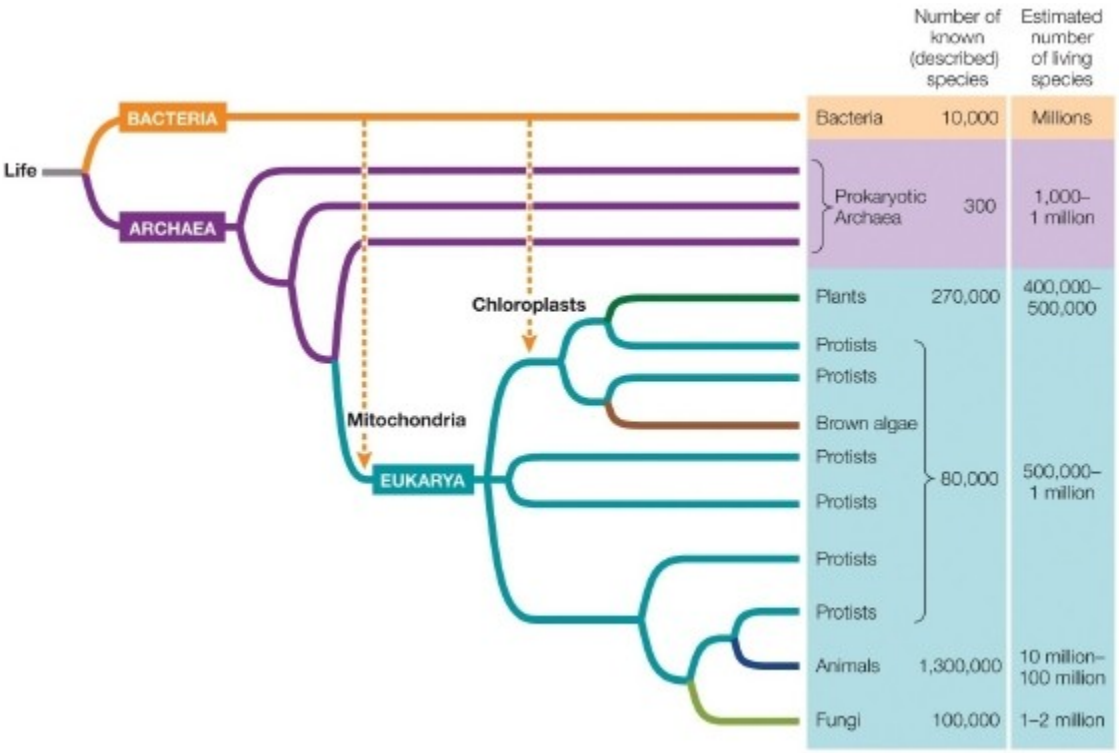

If the estimated numbers in the figure are accurate, you can conclude that

a. more animal species exist than species of plants or fungi.
b. most Archaea species have been described.
c. more species of fungi exist than species of animals.
d. fewer species remain to be described than have already been described.
e. there are more species of protists than any other group.

ANSWER: a

40. Refer to the figure showing a tree of life.

Name: _____ Class: _____ Date: _____

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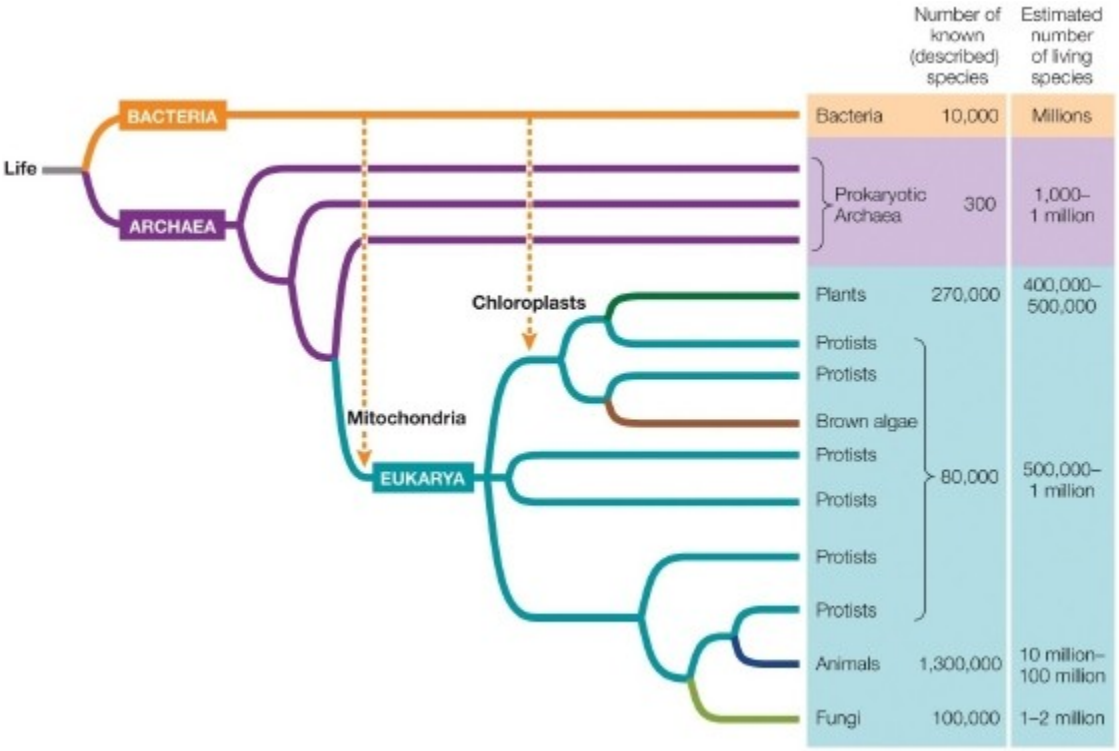

Which statement concerning the figure is true?

a. All protists are more closely related to other protists than they are to other organisms.
b. Only one domain includes single-celled prokaryotes.
c. Two of the domains had endosymbiotic events leading to the formation of mitochondria and chloroplasts.
d. All three domains split from a common ancestor.
e. Two of the domains include multicellular organisms.

ANSWER: d

41. A phylogenetic tree

a. classifies all plant species based on their habitats.
b. diagrams the evolutionary history of a particular group of organisms.
c. is based on binomial nomenclature.
d. only catalogs fossil plants.
e. only uses genome sequencing data.

ANSWER: b

42. Plants are _____ organisms that are _____ of oxygen production.

a. eukaryotic unicellular; capable
b. eukaryotic multicellular; incapable
c. prokaryotic multicellular; capable

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d. prokaryotic unicellular; incapable
e. eukaryotic multicellular; capable

ANSWER: e

43. Biologists have organized the diversity of life into three domains based largely on
a. physical similarities.
b. ecological niches.
c. chronological order.
d. molecular data.
e. numbers of species.

ANSWER: d

44. While going through a museum, you see the fossilized skeletons of the organisms listed below. Which one is a member of the genus that is our closest relative?
a. Chimpanzee (*Pan troglodytes*)
b. Neanderthal *(Homo neanderthalensis)*
c. Lucy, a member of *Australopithecus afarensis*
d. Gorilla (*Gorilla gorilla*)
e. Gibbon (*Hylobates lar*)

ANSWER: b

45. Which of the scientific names below is written correctly?
a. *homo sapiens*
b. *Branta Canadensis*
c. *Roundworm*
d. *Neanderthalensis homo*
e. *Canis lupis*

ANSWER: e

46. In looking at prepared slides of organisms from pond water using a microscope, you see a unicellular organism that has genetic material but no nucleus. Which group could this organism possibly belong to?
a. Bacteria
b. Plants
c. Fungi
d. Animals
e. Protists

ANSWER: a

47. A phylogenetic tree
a. is based on where organisms live.

b. relies for its construction on evidence from fossils, metabolic processes, and molecular analyses of genomes.
c. helps us understand the history of the universe.
d. shows that new species are unrelated to older species.
e. indicates that organisms within a genus are related but organisms within a domain are not.

ANSWER: b

48. Suppose a space probe is successful in discovering a living organism on a distant planet. Which would be the best approach to collect data that would show whether this organism shares a common origin with Earth organisms?

a. Observe the organism's reproduction rate.
b. Test the organism's ability to adapt to an Earth environment.
c. Analyze the chemical makeup of the organism's genome.
d. Determine whether the organism can use oxygen in its metabolism.
e. Investigate whether a population of that type of organism can undergo evolutionary change.

ANSWER: c

49. By studying yeasts, we can discover facts about human cells because yeasts and humans

a. are both prokaryotes.
b. share a common viral ancestor.
c. contain the same genome.
d. use chloroplasts to make sugars.
e. use the same genetic code.

ANSWER: e

50. Which list represents a correct ordering of the levels of complexity at which life is studied, from most simple to most complex?

a. Community, population, organism, organ, tissue, cell
b. Cell, organ, tissue, organism, population, community
c. Cell, tissue, organ, organism, population, community
d. Cell, tissue, organ, population, organism, community
e. Tissue, organ, cell, population, organism, community

ANSWER: c

51. A group of cells that work together to carry out a similar function is known as a(n)

a. tissue.
b. organ system.
c. unicellular organism.
d. protein.
e. gene.

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ANSWER: a

52. Refer to the figure.

In this image, what is the largest (highest) level of biological organization that is visible?

a. Community
b. Organism
c. Landscape
d. Biosphere
e. Population

ANSWER: c

53. Refer to the figure.

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In this image, what is the *smallest* (*lowest*) level of biological organization that is visible?

a. Community
b. Organism
c. Molecule
d. Cell
e. Population

ANSWER: b

54. The cells in your body
a. are static once your body reaches maturity.
b. replace molecules throughout your life.
c. use energy when you are awake but not when you are asleep.
d. break down and rebuild proteins slowly over a matter of years.
e. release hydrogen from food and combine it with water to create carbon dioxide.

ANSWER: b

55. Refer to the figure showing a community containing voles, grass, owls, and foxes. In this community, interactions determine the number of voles.

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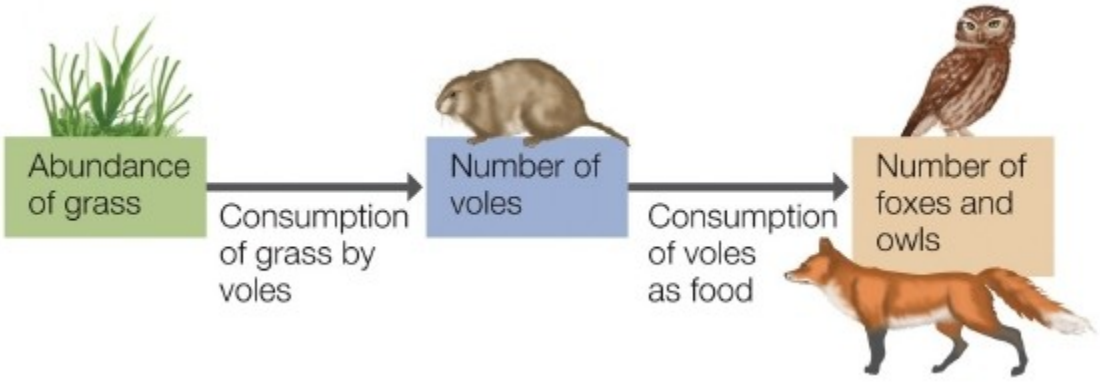

What would initially happen to this community if foxes were removed?

a. The number of owls would diminish.
b. The number of voles would diminish.
c. The abundance of grass would increase.
d. The community would collapse.
e. The number of voles would increase.

ANSWER: e

56. A systems analysis approach to understanding how biological systems function is used to

a. predict how a complicated metabolic network will change over time.
b. analyze the fossil record.
c. indicate phylogenetic relationships.
d. determine the age of Earth.
e. examine organelles within a cell.

ANSWER: a

57. Your body constitutes a system of organized units controlling your internal environment, such as the concentration of Na^+ in your blood. If this concentration falls below normal, you would have hyponatremia, a condition that can cause headaches, mental confusion, and even seizures. Which event would most likely cause hyponatremia?

a. Gut cells absorbing too much Na^+ from food
b. Kidney cells absorbing too much Na^+ from urine
c. Sweating profusely, followed by drinking large quantities of water
d. Producing increased amounts of urine after drinking several cups of coffee
e. Kidney cells excreting Na^+ into the urine

ANSWER: c

58. Your fat cells secrete a hormone called leptin, and the amount produced is proportional to the amount of body fat you have. This hormone is called a "satiety hormone" because it signals your brain that you are full, and thereby helps to regulate energy balance by inhibiting hunger. This is an example of

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a. gene regulation.
b. positive feedback.
c. a cellular-level system.
d. a computational model.
e. negative feedback.

ANSWER: e

59. During childbirth, the hormone oxytocin causes uterine contractions. These contractions move the baby toward the birth canal (vagina), where it pushes on pressure-sensing receptors. These receptors signal the mother's hypothalamus to produce more oxytocin, which in turn increases the uterine contractions. This is an example of

a. gene regulation.
b. positive feedback.
c. a cellular-level system.
d. a computational model.
e. negative feedback.

ANSWER: b

60. Genes are

a. nucleotides that code for DNA.
b. segments of proteins.
c. sequences of DNA that code for proteins.
d. static and do not change over time.
e. each made up of billions of nucleotides.

ANSWER: c

61. The information needed to produce proteins is contained in

a. nutrients.
b. tissues.
c. evolution.
d. organs.
e. genes.

ANSWER: e

62. Refer to the figure showing DNA as life's "blueprint."

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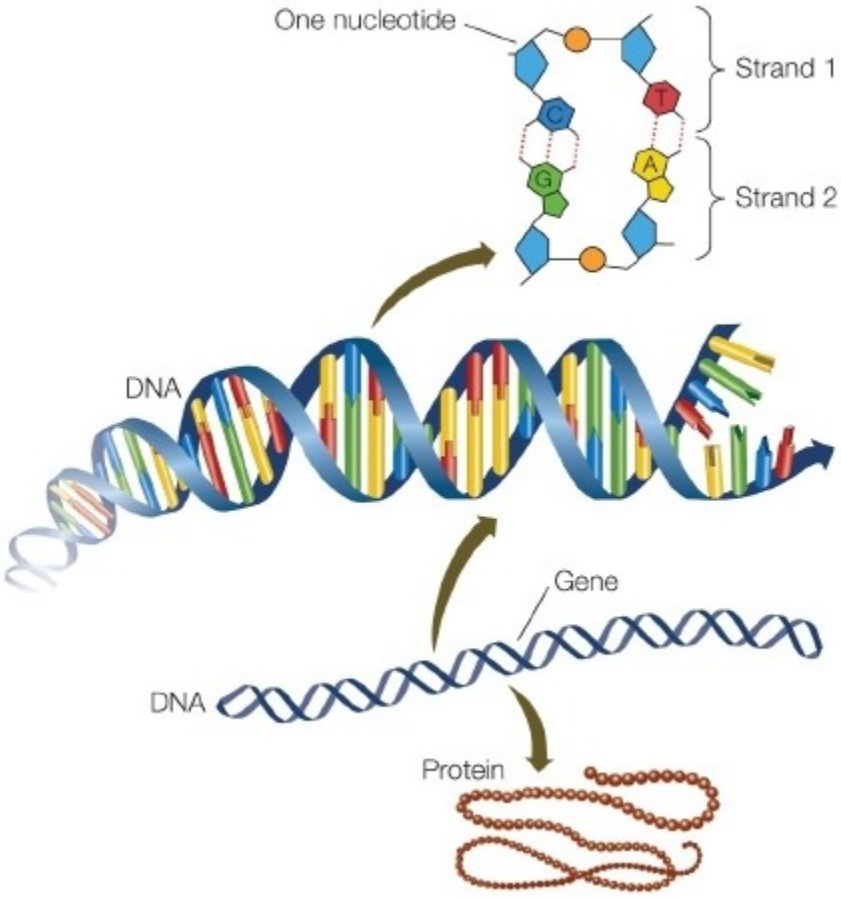

Which statement is supported by evidence presented in the figure?

a. DNA is made out of proteins.
b. Genes are made out of single nucleotides.
c. DNA is made out of two strands of nucleotides.
d. Proteins are made out of DNA.
e. Proteins are made out of a single string of nucleotides.

ANSWER: c

63. Mutations

a. occur in proteins.
b. are alterations in an organism's DNA.
c. are not caused by chemicals.
d. usually improve the function of the organism.
e. are not passed on from one generation to the next.

ANSWER: b

64. If a mutation arises spontaneously in one of your blood cells,

a. you can pass that mutation on to your offspring.

b. it would most likely improve the function of that blood cell.
c. the blood cell is evolving.
d. it could have been caused by exposure to radiation.
e. it will be passed on to all the other cells in your body.

ANSWER: d

65. The exposure of DNA to excessive levels of ultraviolet radiation produces dimers of thymine (a nucleotide); if unrepaired, these can lead to production of skin cancer. This mutation would

a. have no effect on genes.
b. have no effect on proteins.
c. affect both genes and proteins.
d. affect only proteins.
e. affect only genes.

ANSWER: c

66. Which trait or function is the same in muscle cells and brain cells?

a. Cell function
b. Extracellular environment
c. Expressed genes
d. Genome
e. Proteins formed

ANSWER: d

67. The sequencing of the human genome

a. started at the beginning of 2001 but has not yet been completed.
b. is not possible, because the human genome is too large.
c. involved figuring out the order of approximately 1000 nucleotides.
d. revealed that humans have fewer genes than expected.
e. will allow us to compare the human genome with that of other primates but not other organisms such as roundworms.

ANSWER: d

68. Evolution is the change in the genetic makeup of

a. cells within an organism.
b. organs within an organism.
c. populations of organisms over time.
d. fossils from the distant past.
e. future organisms within the biosphere.

ANSWER: c

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69. The ultimate source of new genetic variation is
    a. perfect replication of the genome.
    b. mating.
    c. artificial selection.
    d. mutations in the genome.
    e. structural adaptations.

ANSWER: d

70. Populations of organisms have been able to inhabit a wide variety of environments on Earth because they
    a. have a genome.
    b. contain organelles.
    c. carry out photosynthesis.
    d. adapt through evolution.
    e. are similar to model organisms.

ANSWER: d

71. In formulating his theory of evolution, Darwin used information available to him through observation and common knowledge, including the knowledge that
    a. offspring differ from their parents and that populations of species display variation.
    b. genes are the basis for inheritance and that mutations in DNA lead to evolutionary change.
    c. populations do not change over time, though individuals within a population do.
    d. the fossil record includes all forms of present-day life.
    e. cells pass on their genetic material through cell division and all cells within an organism have the same genome.

ANSWER: a

72. Darwin noted that all populations have _____ potential to grow, but in nature most populations _____ over time.
    a. limited; are stable
    b. unlimited; grow slowly
    c. limited; fluctuate unpredictably
    d. unlimited; do not have unchecked growth
    e. limited; decrease in growth

ANSWER: d

73. Natural selection acts
    a. by causing mutations in the genome.
    b. by producing structural and functional changes within organisms.
    c. through differential probabilities of survival and reproductive success.
    d. through the selection of breeding pairs that produce offspring with specialized characteristics.

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e. by allowing unlimited growth of populations.

ANSWER: c

74. Darwin referred to the differential reproductive success of individuals with particular variations as
    a. evolution.
    b. artificial selection.
    c. the cell theory.
    d. natural selection.
    e. the inheritance of acquired characteristics.

ANSWER: d

75. Which of the following is one of the key points in Darwin's explanation of evolution?
    a. The biological structures most likely to be inherited are those that have become best suited to the environment through constant use.
    b. All mutations that occur are those that will help future generations fit more successfully into their environments.
    c. Any trait that confers even a small increase in the probability that its possessor will survive and reproduce will be strongly favored and will spread through the population.
    d. Genes change in order to help organisms cope with problems encountered within their environments.
    e. Extinction is nature's way of weeding out undeserving organisms.

ANSWER: c

76. The toe pads of tree frogs and the webbed feet of aquatic frogs are examples of
    a. behavioral traits.
    b. structural adaptations.
    c. sexually selected traits.
    d. artificially selected traits.
    e. proximate explanations.

ANSWER: b

77. Evolution is
    a. relevant only to the study of biology.
    b. the change in the genetic makeup of a population through time.
    c. the change in protein expression of a population through time.
    d. not influenced by natural selection.
    e. seen only in fossil evidence.

ANSWER: b

78. Which statement about evolution is true?
    a. The diversity of life depends on the existence of similar environments and ecological communities

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throughout the globe.

b. Sexual selection contributes to the diversity of life.

c. Earth has existed and changed over a few thousand years, at most.

d. All ancestral forms of life were very similar to organisms that currently exist.

e. Some organisms that exist do not share common ancestors with other organisms.

ANSWER: b

79. Evolutionary theory is a

a. hypothesis based on theories.

b. historical model showing how organisms changed in the ancient past.

c. body of facts that allows us to make predictions.

d. useful tool for long-term predictions, but it is not useful for short-term predictions.

e. set of mechanisms that explains exactly how biological populations change over time.

ANSWER: c

80. A scientist walking by a pristine stream, and then a polluted pond below a mill, observes that fish are present in the stream but not in the pond. The scientist then says, "polluted water kills fish." This statement is an example of

a. an evaluation of experiment results.

b. scientific inquiry.

c. quantifiable data.

d. a hypothesis.

e. a fact.

ANSWER: d

81. The main purpose of any single experiment is to

a. obtain accurate quantitative measurements.

b. prove unambiguously that a particular hypothesis is correct.

c. avoid a merely comparative analysis.

d. answer as many key questions as possible.

e. test a prediction that is based on a hypothesis.

ANSWER: e

82. In scientific methodology, a hypothesis is

a. formed before any observations are made.

b. a guess that cannot be tested.

c. a tentative answer to a question that can be tested.

d. formed after an experiment has been designed.

e. a set of data obtained from an experiment.

ANSWER: c

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83. Which statement about the scientific method is true?

a. After forming a hypothesis, scientists apply logic to make predictions from the hypothesis.

b. The most informative experiments are those that have results that support the hypothesis.

c. In a comparative experiment, a scientist compares groups that differ in terms of a variable that has been manipulated in one of the groups and left unaltered in the other group.

d. Controlled experiments are valuable when we do not know or cannot control the critical variables.

e. A statistical test of a hypothesis starts with the premise that a significant difference exists between the groups in the study.

ANSWER: a

84. Which of the following is usually the first step in a scientific investigation?

a. Refinement of the experimental design

b. Designing an experiment to test a prediction

c. Using statistical tests to evaluate the significance of the results

d. Making predictions

e. Making observations

ANSWER: e

85. A researcher collected frog and water samples from eight widely separated sites across the United States and studied the incidence of abnormalities in frogs exposed to different levels of the herbicide atrazine. This was a(n) _____ experiment.

a. comparative

b. controlled

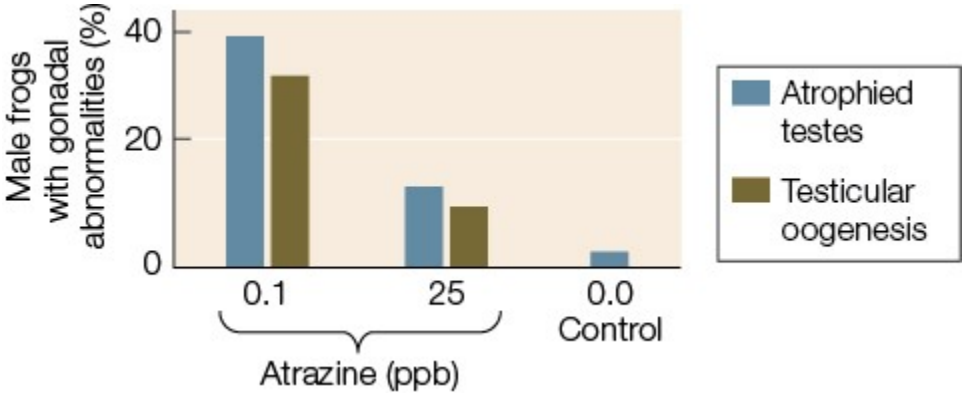
c. inductive

d. logic

e. deductive

ANSWER: a

86. Refer to the graph showing the results of a study that exposed male frogs to atrazine, a chemical used in killing weeds in agricultural areas.



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According to the data in the graph, higher atrazine concentrations do not result in a higher rate of gonadal abnormality. Which conclusion can be drawn from these results?

a. Low levels of atrazine are not as dangerous to amphibians as high levels of atrazine.
b. A dosage of 15 ppb would cause a rate of abnormality between the one caused by the 0.1 ppb dosage and the one caused by the 25 ppb dosage.
c. The effect of the atrazine exposure is not proportional to the level of exposure.
d. Atrazine is only hazardous in a natural ecosystem, where it is naturally diluted in the waterways.
e. Atrazine usage should be banned.

ANSWER: c

87. A scientific hypothesis

a. can be falsified through predictions.
b. is used to make untestable predictions.
c. is based on observations.
d. cannot be tested by experimentation.
e. cannot be tested by observational analysis.

ANSWER: c

88. Comparative experiments are designed to answer questions that require

a. experimental groups and control groups.
b. little or no data collection.
c. a final, definitive answer.
d. the collection of only qualitative data.
e. observation and comparison rather than controlled variables.

ANSWER: e

89. A biologist listens to frogs singing at a local pond and hypothesizes that the sounds are mating calls. What would be the next step in the hypothesis–prediction method?

a. Controlling an environment
b. Making an observation
c. Forming a hypothesis
d. Making a prediction
e. Testing a prediction

ANSWER: d

90. A biologist hypothesizes that the sounds made by lions at night in the Serengeti are territoriality calls and predicts that two lions inhabiting the same territory will roar even louder. She selects an area inhabited by one lion, records its calls, and plays them back in the same area. She records her observations, and notes that the lion does indeed roar more often as a result of this experiment. What would be the next step in the hypothesis–prediction method?

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a. Asking new questions
b. Making an observation
c. Forming a hypothesis
d. Making a prediction
e. Testing a prediction

ANSWER: a

91. The advantage of controlled scientific experiments is that
a. all variables except one are held constant.
b. the hypothesis can be proven correct.
c. patterns can be predicted.
d. investigations can be carried out in the field.
e. a massive amount of data can be synthesized.

ANSWER: a

92. A comparative experiment
a. has only independent variables.
b. has only one dependent variable.
c. compares one independent variable with one dependent variable.
d. starts with groups or samples that are as similar as possible.
e. starts with the prediction that there will be a difference between groups or samples.

ANSWER: e

93. A rapid decline in populations of amphibians (frogs and salamanders) has been observed worldwide. Which of the following would be a reasonable hypothesis to test as an explanation for this decline?
a. Amphibians do not evolve and therefore cannot survive change.
b. The amphibian habitats have not changed, but amphibians have evolved so that they are no longer adapted to these habitats.
c. The habitats amphibians live in are disappearing due to our changes in land use.
d. An "intelligent designer" has decided to reduce the number of amphibians.
e. Amphibians are experiencing deaths from natural causes, only.

ANSWER: c

94. Which statement about statistical analysis in science is true?
a. Statistical methods are applied to data in order to prove that the null hypothesis is incorrect.
b. Statistical tests analyze variation to determine whether the variation is due to chance.
c. Statistical tests can be used to evaluate results from controlled experiments but not comparative experiments.
d. Scientists use statistics to prove their conclusions are true.
e. Statistics are used to measure the probability that an observed difference is due to chance.

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ANSWER: e

95. A statistical test starts with
   a. a null hypothesis.
   b. deductive logic.
   c. inductive logic.
   d. a hypothesis.
   e. a model system.

ANSWER: a

96. Refer to the table. A biologist studied plant growth using two plant species grown over a 2-week period. For each species, 20 plants were used, randomly split into control and experimental groups. Except for CO_2 exposure, conditions were identical for all plants. The table summarizes results as average height increase, along with a plus/minus value indicating the range of individual plant heights measured.

	Average increase in plant height at normal CO_2 levels	Average increase in plant height at elevated CO_2 levels
Plant species A	8.4 ± 5.1 cm	9.8 ± 4.7 cm
Plant species B	2.9 ± 0.5 cm	3.2 ± 0.7 cm

Which is the null hypothesis that would be developed when using statistics to analyze these results?
   a. The growth rates of certain species of plants are more influenced by CO_2 levels than others.
   b. Differences in growth rate at the different CO_2 levels could be due to random variations in the samples of both species.
   c. All plants show variation in growth rate when environmental variables are changed.
   d. Carbon dioxide is one of many variables that can influence plant growth rate.
   e. The effect of CO_2 on plant growth rate depends on the species of plant being investigated.

ANSWER: b

97. Which question can be directly answered through controlled experiments?
   a. Are bees more attracted to red roses than to yellow roses?
   b. Are red roses more beautiful than yellow roses?
   c. Did an asteroid hitting Earth cause the mass extinction of dinosaurs?
   d. When did the first life forms appear on Earth?
   e. Is the increase in the severity of storms being caused by climate change?

ANSWER: a

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98. Which question is a scientific question that can be answered by the hypothesis– prediction approach?
    a. Have the migration paths of Western meadowlarks been affected by climate change?
    b. Is the song of the Western meadowlark prettier than that of the Eastern meadowlark?
    c. Did a "creator" bring Eastern meadowlarks into the world before Western meadowlarks because they are more important?
    d. Do the Audubon paintings of meadowlarks belong in a museum?
    e. Do poems about meadowlarks become more beautiful over time?

ANSWER: a

99. Scientific explanations for a natural phenomenon
    a. can be tested only in the laboratory.
    b. are always based on an ethical point of view.
    c. are based on reproducible and quantifiable observations.
    d. are based on hypotheses.
    e. cannot be rejected.

ANSWER: c

100. Which statement represents a scientific point of view?
    a. Earth was created by a supernatural force.
    b. The positions of the sun, moon, and stars provide guidance for making decisions.
    c. Inner strength comes from the beauty in nature.
    d. Testing the effect of antibiotics on pathogens can lead to tools for fighting disease.
    e. Meditation helps to solve ethical problems.

ANSWER: d

101. Scientific knowledge has enabled us to do things that can raise major ethical issues. Which of the following can be decided by science rather than society?
    a. The circumstances that warrant electing the sex of one's children
    b. Whether we should use asexual reproduction to clone a human baby
    c. If we should modify the human genome by modifying germ cells, such that the change will be inherited by future generations
    d. Whether to use the theory of evolution as the basis for further scientific studies
    e. Whether certain countries have a right to add more CO_2 to the atmosphere by burning more fossil fuels than other countries, thereby accelerating global warming

ANSWER: d

102. There is some controversy about whether viruses are living organisms. Based on what scientists consider to be typical of living organisms, what arguments could you use to support the claim that a virus is *not* a living organism?

ANSWER: Suggested Answer:

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Viruses are not composed of cells and are incapable of living independently. They depend on host cells to carry out physiological functions.

103. A computer virus is capable of replicating itself. What other features of a computer virus are similar to those of a living organism? What features distinguish it from a living organism?

ANSWER: Suggested Answer:
A computer virus is made up of a common set of building blocks, and it can evolve via mutation and selection. However, unlike living organisms, it does not depend on structurally complex parts and it does not convert molecules from its environment into new molecules.

104. Refer to the figure showing life's "timeline."

Based on the figure, what can you conclude about the organisms that first evolved the ability to photosynthesize?

ANSWER: Suggested Answer:
These organisms were prokaryotes, and they arose before the evolution of cells containing organelles.

105. Refer to the figure showing life's "timeline."

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Imagine that you were to set an alarm clock to go off at the time represented on the 30-day timeline when modern humans arose. What day and time would you set the alarm clock for?

ANSWER: Suggested Answer:
5 minutes before midnight on day 30.

106. During the origin of life, why were fatty acids the critical ingredient in forming the enclosure of a cell?

ANSWER: Suggested Answer:
Fatty acids were a critical ingredient in forming the enclosure of a cell because these molecules form membrane-like films instead of dissolving in water, allowing them to surround and enclose complex proteins and other biological molecules.

107. Refer to the diagram showing the evolutionary tree of life.

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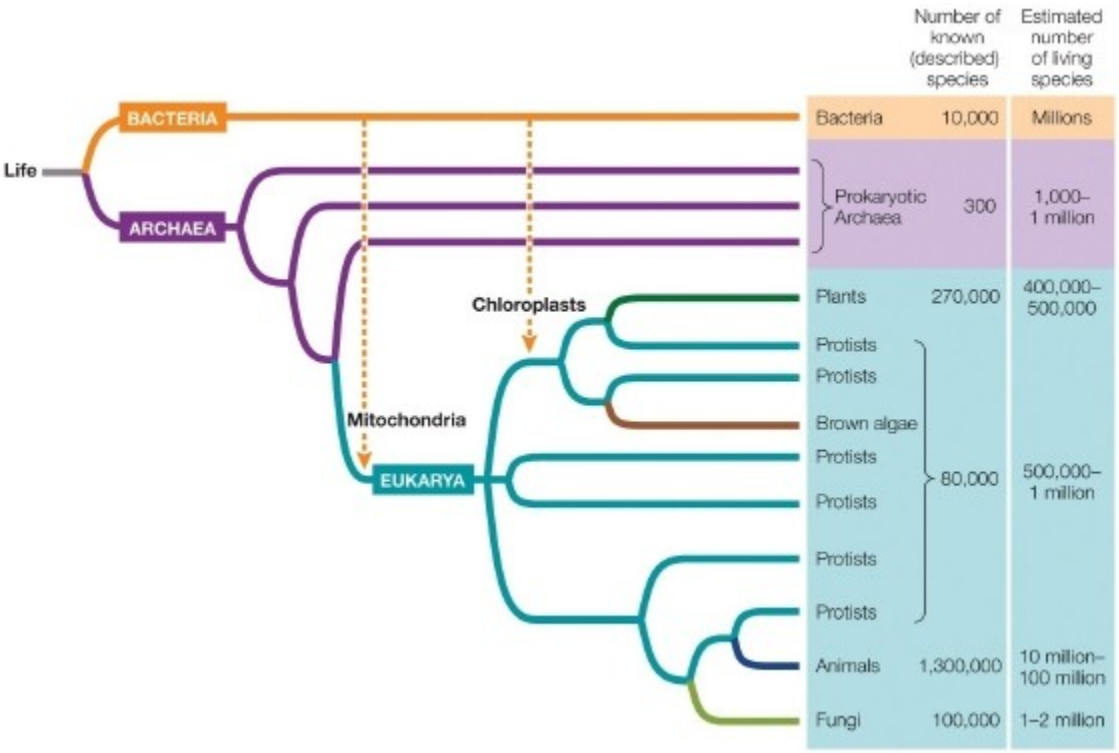

According to the relationships indicated by this phylogeny, which groups of organisms have mitochondria and which groups have chloroplasts?

ANSWER: Suggested Answer:
Only the organisms classified within the Eukarya have mitochondria—Bacteria and prokaryotic Archaea do not. Only plants, brown algae, and some protists have chloroplasts.

108. Refer to the diagram showing the evolutionary tree of life.

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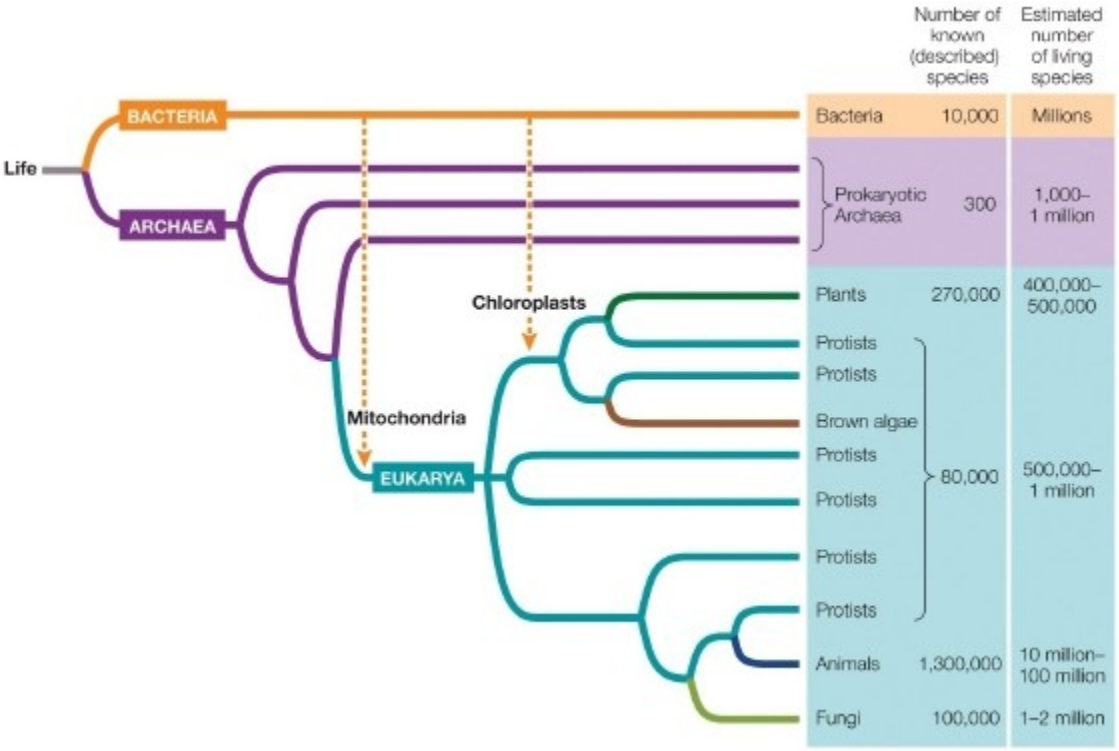

Based on the diagram, how would you describe the relationship of fungi to plants and animals?

ANSWER: Suggested Answer:
Fungi are more closely related to animals than they are to plants.

109. There are six different evolutionary groups of the unicellular eukaryotes known as protists. Based upon the way in which distinctions are made among the three domains, how were these six groups of protists most likely differentiated?

ANSWER: Suggested Answer:
They were most likely differentiated on the basis of genomic data.

110. What hypothesis has been proposed to explain the emergence of eukaryotic cells?

ANSWER: Suggested Answer:
Eukaryotic cells contain a number of membrane-bound organelles. It is hypothesized that organelles such as mitochondria and chloroplasts evolved from engulfed prokaryotic organisms that were not digested but instead began a mutual relationship with the host cell that engulfed them.

111. Cellular life is divided into three major lineages. What are these three lineages, and what are their key similarities and differences?

ANSWER: Suggested Answer:
The three major lineages of life are Bacteria, Archaea, and Eukarya. Both Bacteria and Archaea are composed of prokaryotes—unicellular organisms that have an outer membrane but lack membrane-bound organelles. Members of Eukarya (including protists, plants, animals, and fungi) are defined by having their DNA contained within a nuclear membrane and by containing other

membrane-bound organelles, including mitochondria and, within some members, chloroplasts.

112. What is the significance of the fact that mitochondria and chloroplasts contain the DNA that instructs their form and function?

ANSWER: Suggested Answer:
The independent DNA found in mitochondria and chloroplasts is evidence of their ancient origins as bacteria that became incorporated into eukaryotic cells. Since the ancestors of these organelles once existed as independent organisms, they have their own genomes.

113. Biologists can now isolate genes from organisms and decode their DNA. When the nucleotide sequences from the same gene in different species are compared, differences are discovered. How could you use those data to deduce the evolutionary relationships among the organisms in your comparison?

ANSWER: Suggested Answer:
If two species share particular changes in the gene being compared and those changes are not shared by other species being examined, we would expect the two species with the common changes to be more closely related to one another.

114. Scientists interested in human biology typically perform experiments with other model systems. Why do scientists use model systems in this way?

ANSWER: Suggested Answer:
Model systems are useful in the study of biology because all organisms have evolved from a common ancestor. Therefore, cellular pathways in, for example, bacteria and fruit flies are very similar to those found in humans. Model systems are valuable because in many cases they can be manipulated experimentally.

115. In ecology, the study of organisms can be organized in levels from populations up to the biosphere. Describe how each level is connected with the level below it.

ANSWER: Suggested Answer:
Many organisms of the same species living together make up a population. A community encompasses all the populations within a given area. A landscape includes many communities in the same geographical area. All the ecosystems on Earth make up the biosphere.

116. Within the hierarchy of ecological systems, what level is represented in this image, and which details in the image lead to this answer?

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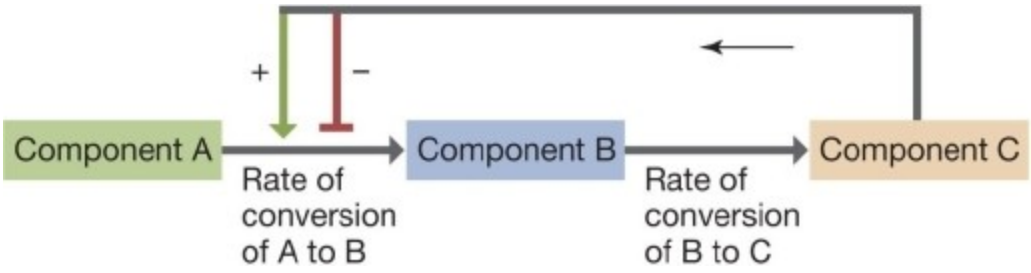
ANSWER: Suggested Answer:
The image shows a community, because several populations of organisms that interact with one another are shown.

117. Refer to the diagram showing various feedback loops.



If component C reacts to increase the rate of the conversion of component A to component B, what type of feedback loop is this, and how will it affect the amount of component C?

ANSWER: Suggested Answer:
It is a positive feedback loop, and it will cause an increase in the amount of component C.

118. The amount of thyroid hormone released by the thyroid gland is controlled by the pituitary gland. When thyroid hormone levels in the blood are low, the pituitary gland secretes thyroid-stimulating hormone (TSH), which in turn stimulates the thyroid gland to produce more thyroid hormone. When levels of thyroid hormone in the blood are normal, TSH production is decreased. What type of feedback loop does this represent? If a person has an autoimmune disease that is destroying the thyroid gland, what would likely happen to the TSH levels?

ANSWER: Suggested Answer:
It is a negative feedback loop. In the person with an autoimmune disease that destroys the thyroid, TSH levels would rise.

119. Refer to the figure showing DNA as life's "blueprint."

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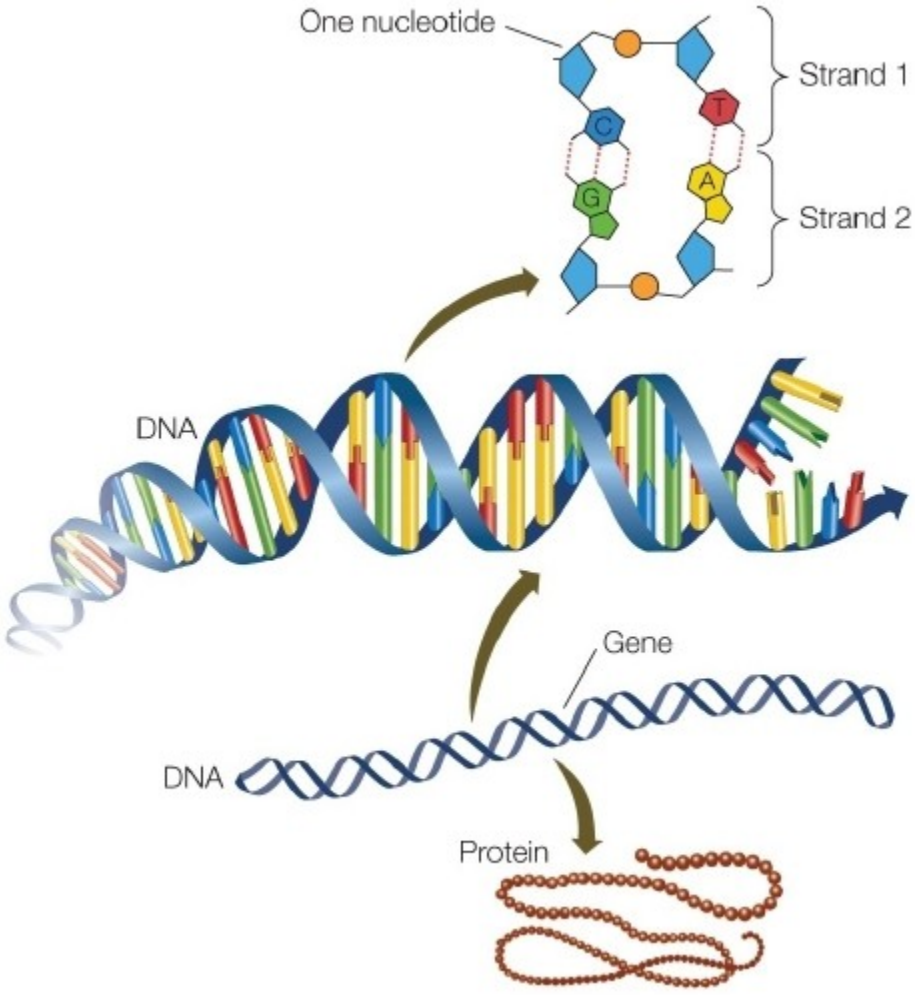

From the figure, what can you conclude about the composition of genes, their location, and their function?

ANSWER: Suggested Answer:
Genes are composed of DNA and they occupy a stretch of the DNA molecule. Genes are used in some way to make proteins.

120. Refer to the figure showing DNA as life's "blueprint."

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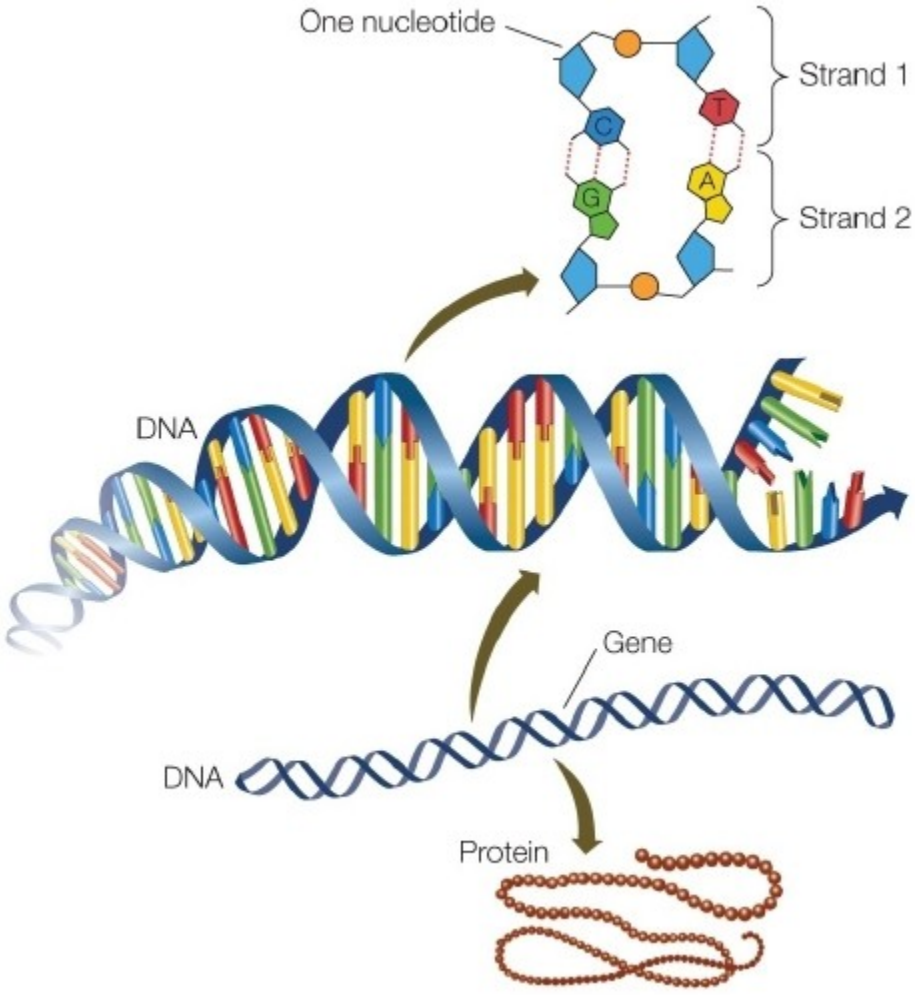

The exposure of DNA to excessive levels of ultraviolet radiation produces thymine (a nucleotide) dimers, which, if unrepaired, can lead to the production of skin cancer. Which structures in the figure could be affected by this mutation?

ANSWER: Suggested Answer:
The mutation affects the structure of nucleotides, and therefore the structure of DNA, and genes. The altered structure of the genes would, in turn, affect the structure of proteins.

121. If you wanted to do a year-long study on evolution using an organism in the laboratory, would you use bacteria or mice, and why?

ANSWER: Suggested Answer:
It would be better to use bacteria, because their generation time is far shorter than that of mice, and it is easier to grow populations of bacteria.

122. Refer to the diagram showing the steps in the scientific method.

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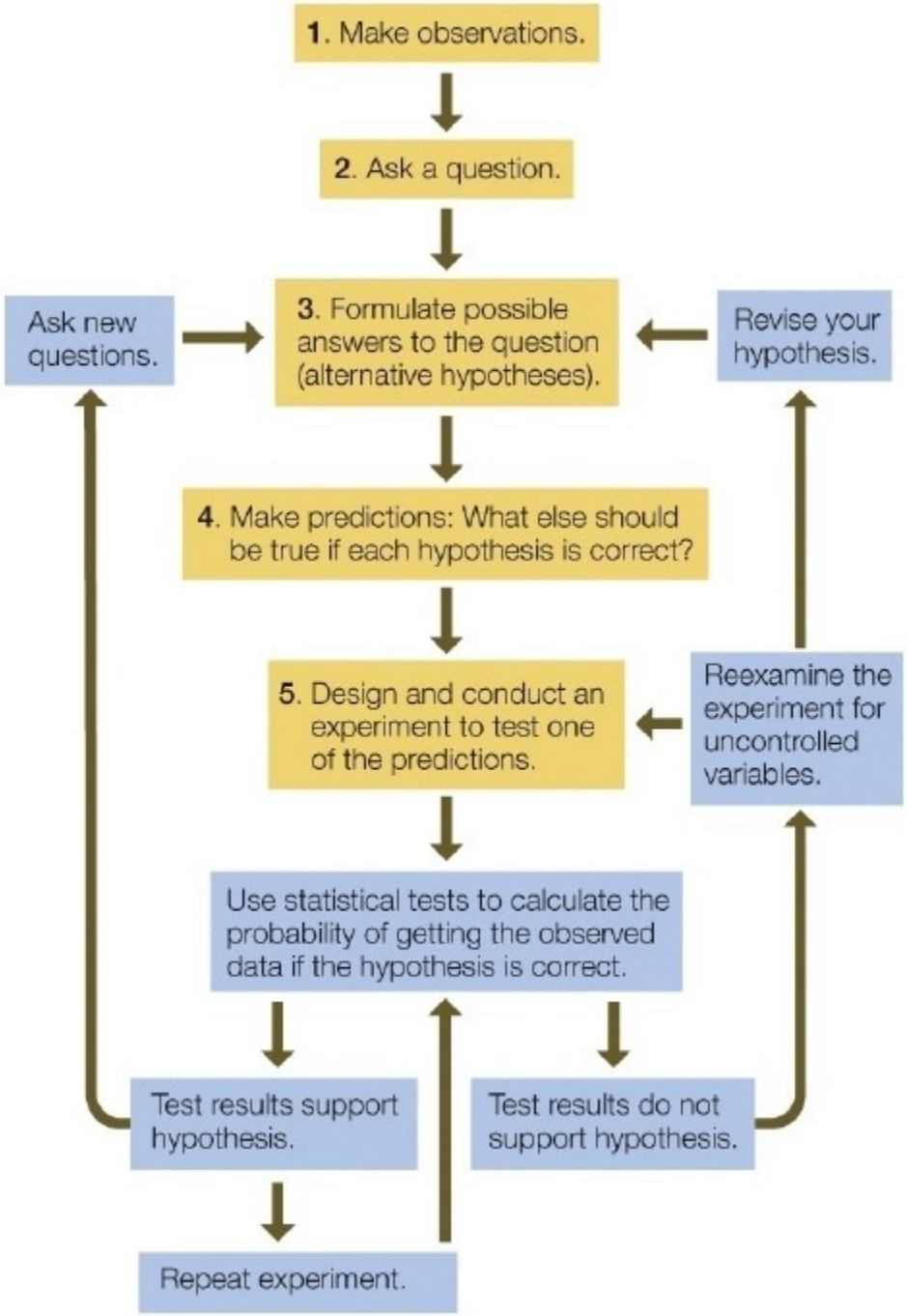

You are conducting a scientific experiment about the effects of coffee on test taking. Step 1 in your experiment is the observation that when you drink a cup of coffee with sugar and cream before taking test, you feel more focused. What question would you ask for step 2, what hypothesis would you form for step 3, and what prediction would you make for step 4 of your experiment?

ANSWER: Suggested Answer:
(Answers will vary. Sample answer provided.)
Step 2: Is it the caffeine or the sugar or the cream in the coffee that is making me feel more focused?

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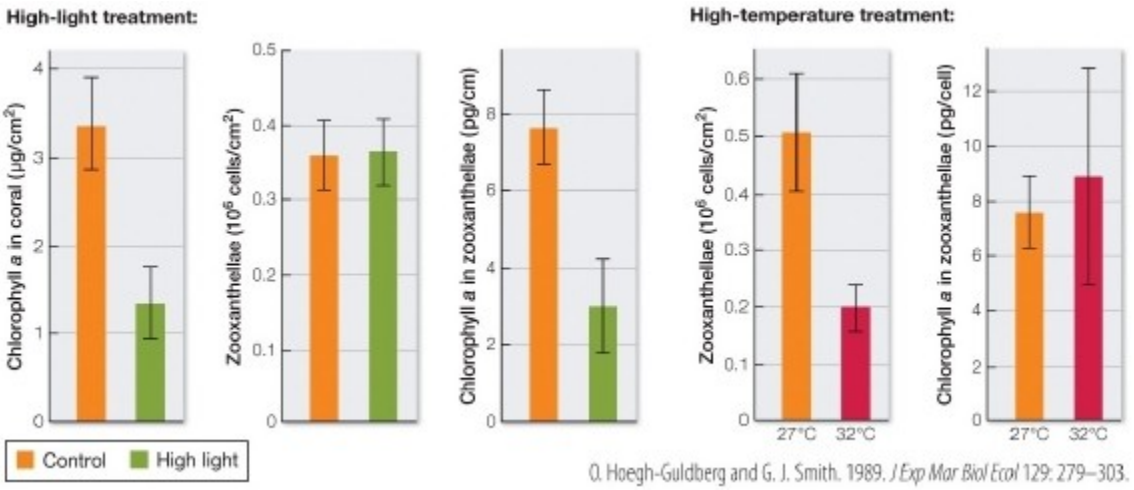
Step 3: I hypothesize that it is the caffeine in the coffee that has this effect and not either the sugar or the cream.
Step 4: I predict that drinking black coffee before an exam will have the same effect as drinking coffee with sugar and cream, but that drinking water with cream and sugar will not have this effect.

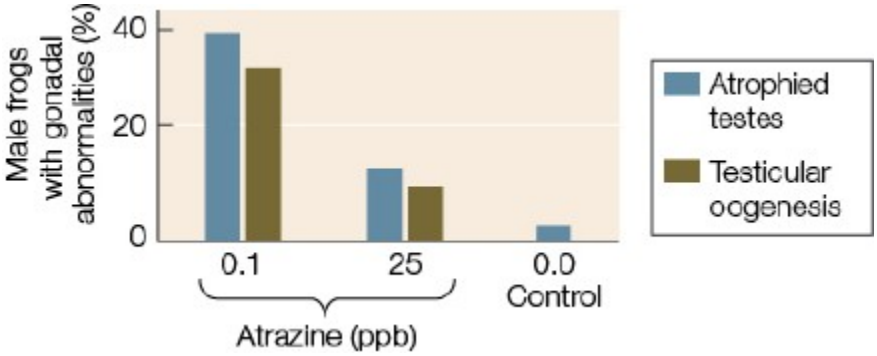
123. Refer to the graphs showing the results of a controlled laboratory experiment on a species of coral, testing whether high-light or high-temperature causes bleaching of the coral. The researchers looked at levels of the photosynthetic pigment chlorophyll *a* and the numbers of photosynthetic endo-symbiotic zooxanthellae in the coral tissues following each treatment.



What is an appropriate conclusion from these data?

ANSWER: Suggested Answer:
Both high-light and high-temperature conditions cause bleaching in the coral: high-light causes coral bleaching by reducing the amount of chlorophyll *a* in the zooxanthellae; high temperature does not reduce the amount of chlorophyll *a* in the zooxanthellae, but instead causes bleaching by causing the zooxanthellae to leave the coral.

124. Refer to the graph showing the results of a study of atrazine exposure in male frogs.



What conclusions can be deduced from these results regarding the effects of low versus high levels of atrazine and the relationship between the level of atrazine exposure and its effects?

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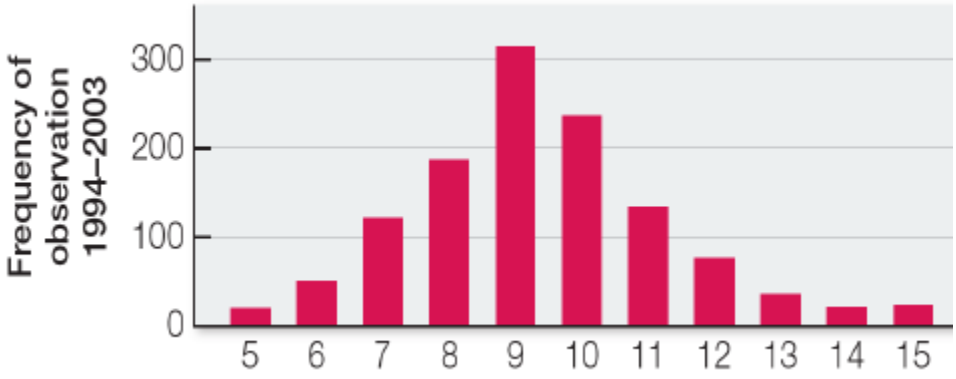
ANSWER: Suggested Answer:
Low levels of atrazine are more dangerous to amphibians than higher levels, showing that the effect of the atrazine exposure is not proportional to the level of exposure.

125. Refer to the graph showing data collected between 1993 and 2003 relating to a population of birds.



Suppose that in 2003 another biologist observed a sudden decrease in the population of an insect that was the major component of the diet of this bird species. Explain how both sets of observations would have provided a basis for developing a testable hypothesis.

ANSWER: Suggested Answer:
The observation that the insect population was decreasing dramatically would have prompted someone to realize that this could affect the amount of energy available to the bird population. A hypothesis could have been that the bird's clutch size would decrease as its main dietary component decreased in availability, because the birds would not have as much energy to put toward reproduction. The observations about the insects suggest that the birds would lose an important source of energy, and the observations about clutch size provide the basis for analyzing the effects of this loss of energy.

126. Refer to the figure showing comparative experiments performed to study the incidence of abnormalities in frogs from environments with very different levels of the herbicide atrazine.

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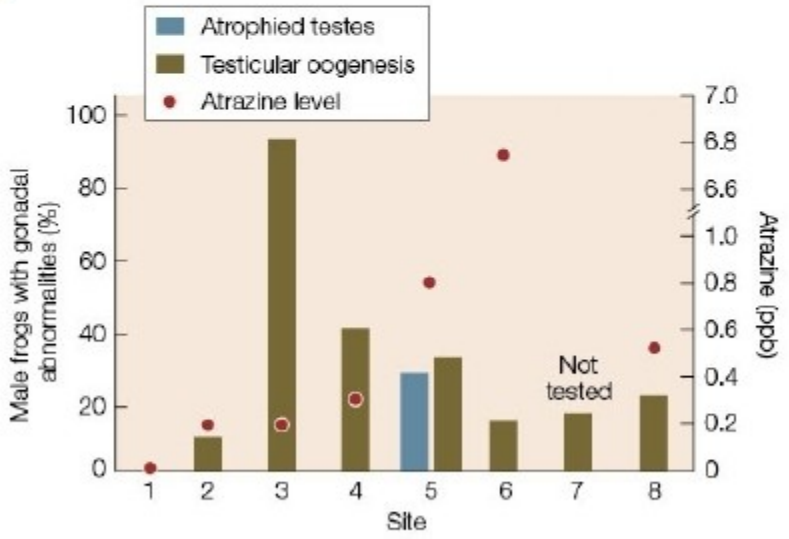
HYPOTHESIS Presence of the herbicide atrazine in environmental water correlates with gonadal abnormalities in frog populations.

Method

1. Based on commercial sales of atrazine, select 4 sites (sites 1–4) less likely and 4 sites (sites 5–8) more likely to be contaminated with atrazine.
2. Visit all sites in the spring (i.e., when frogs have transitioned from tadpoles into adults); collect frogs and water samples.
3. In the laboratory, sacrifice frogs and examine their reproductive tissues, documenting abnormalities.
4. Analyze the water samples for atrazine concentration (the sample for site 7 was not tested).
5. Quantify and correlate the incidence of reproductive abnormalities with environmental atrazine concentrations.

Results



CONCLUSION Reproductive abnormalities exist in frogs from environments in which aqueous atrazine concentration is 0.2 ppb or above. The incidence of abnormalities does not appear to be proportional to atrazine concentration at the time of transition to adulthood.

What would be the most likely null hypothesis for this study?

ANSWER: Suggested Answer:
The null hypothesis would be that differences in the percentage of gonadal abnormalities among sites with varied atrazine levels could be random sampling effects.

127. Why is it important in science to design and perform experiments that can falsify a hypothesis?

ANSWER: Suggested Answer:
In science, we formulate hypotheses about how the world works, then try to test those hypotheses with experiments. An experiment must be designed such that it can uncover problems with the hypothesis. If an experiment produces the type of information that could reject a hypothesis, then the experiment was a good test of that hypothesis.

128. Discuss how the process of scientific inquiry is different from other forms of inquiry. Include in your discussion a description of the hypothesis–prediction approach.

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ANSWER: Suggested Answer:
The process of scientific inquiry is unique in that a hypothesis must be testable, and it must be possible to reject it. The hypothesis–prediction approach begins with observations that lead to questions; from the questions, hypotheses are formed that are probable explanations for the observed phenomena; predictions are formed from the hypotheses and tested; conclusions are drawn from the test results. These conclusions may, in turn, lead to additional hypotheses.

129. Platelets are cell fragments that are critical for blood clotting, a process that involves the release of proteins from platelet storage granules. Platelet granules contain approximately 300 different proteins. One hypothesis about the packaging of proteins into these granules is that each protein is delivered in precisely measured amounts to each granule. What would the null hypothesis be in this case?

ANSWER: Suggested Answer:
The null hypothesis would be that each protein is targeted to the individual storage granules randomly.

130. A(n) _____ starts with the prediction that there will be a difference among naturally existing groups based on the _____.

a. controlled experiment; hypothesis
b. controlled experiment; theory
c. comparative experiment; theory
d. comparative experiment; hypothesis

ANSWER: d

131. All the cells of a given multicellular organism contain the same _____, yet the different cells have different functions and form different _____.

a. genome; proteins
b. proteins; nucleotides
c. genome; nucleotides
d. proteins; genomes

ANSWER: a

132. _____ refers to _____ changes in genetic frequencies in a population because of chance events.

a. Genetic drift; systematic
b. Artificial selection; random
c. Natural selection; random
d. Genetic drift; random

ANSWER: d

133. Cells synthesize, or manufacture, _____ and other complex molecules by assembling atoms into new, highly organized configurations.

a. tissues

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b. proteins
c. organs
d. organ systems

ANSWER: b

134. Darwin reasoned that the reproductive capacities of plants and animals, if unchecked, would result in _____ growth of _____.
a. unlimited; populations
b. limited; populations
c. unlimited; individuals
d. limited; individuals

ANSWER: a

135. In a _____, we start with groups that are as _____ as possible.
a. null hypothesis; similar
b. controlled experiment; similar
c. null hypothesis; varied
d. controlled experiment; varied

ANSWER: b

136. _____ are the building blocks of cells.
a. Proteins
b. Mitochondria
c. Nucleic acids
d. Tissues

ANSWER: a

137. _____ of a species form _____.
a. Individuals; communities
b. Individuals; populations
c. Populations; individuals
d. Communities; populations

ANSWER: b

138. Multicellularity allowed _____ of tissues and functions.
a. standardization
b. specialization
c. equilibrium
d. mutation

ANSWER: b

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139. If studying the toes of tree frogs, which of the following would involve examining the physical structure of the toe pads and explain how expansion of the toe leads to greater adhesion to a surface, such as that of a tree trunk?

a. Ultimate explanation
b. Systems analysis
c. Proximate explanation
d. Artificial selection

ANSWER: c