

general life science exam

Multiple Choice

Identify the choice that best completes the statement or answers the question.

- _____ 1. Which statement about all living organisms is true?
 - a. They produce energy as they carry out life functions.
 - b. They use similar methods of reproduction.
 - c. They contain the same genes.
 - d. They have multicellular structures.
 - e. They have a common ancestor.

- _____ 2. If the living things we observe today had originated from multiple origins instead of a single origin, they would be more likely to
 - a. use a variety of genetic codes.
 - b. show genetic similarities.
 - c. use a common set of amino acids.
 - d. display similar patterns of cell structure.
 - e. share the same cellular processes.

- _____ 3. A biologist claims to have discovered a single-celled organism that is evolutionarily unrelated to any organisms known to inhabit Earth. Which observation made during an extensive study of the organism most solidly supports the biologist's claim?
 - a. The organism takes in the small molecule, methane, as a source of chemical energy to fuel its cellular reactions.
 - b. The organism reproduces at a rate faster than any known organism living on Earth.
 - c. The chemical identities of the amino acids making up the organism's proteins differ from those found in bacteria.
 - d. Cold temperatures induce the organism to become dormant, which causes it to cease all observable activity.
 - e. Analysis of the organism's external membrane reveals that it is made of more layers than are present in bacteria.

- _____ 4. Scientists hypothesize that the first organisms on Earth were
 - a. plants.
 - b. eukaryotes.
 - c. protists.
 - d. prokaryotes.
 - e. viruses.

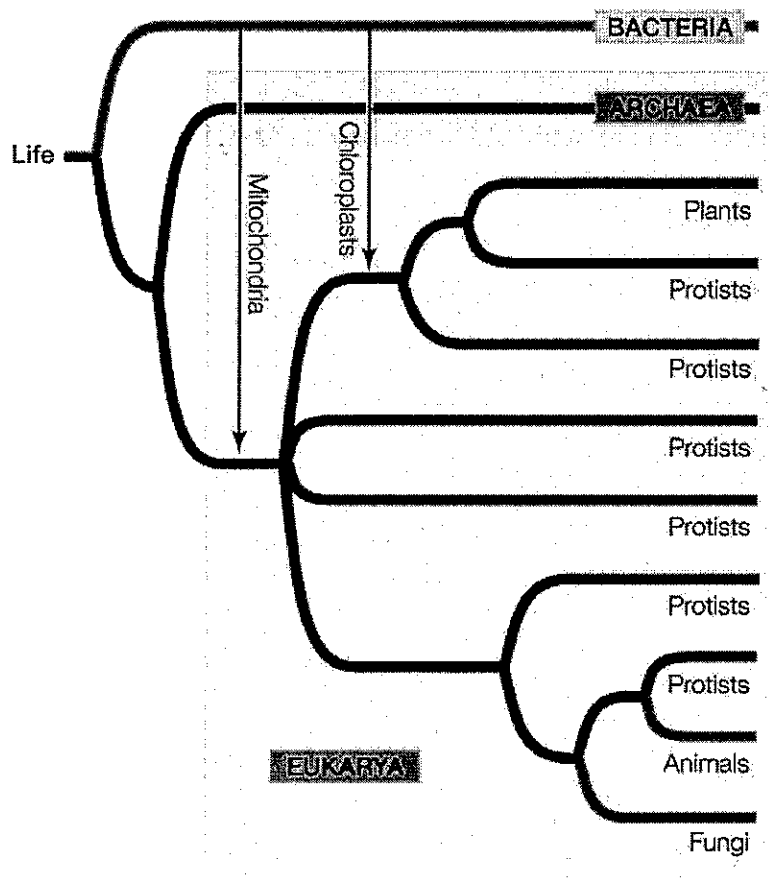
- _____ 5. Eukaryotic cells differ from prokaryotic cells in that eukaryotic cells have
- genes.
 - proteins.
 - a nucleus.
 - a cell membrane.
 - cytoplasm.
- _____ 6. Which statement correctly explains why the development of photosynthesis changed the course of evolutionary history?
- Photosynthetic organisms contributed oxygen to the environment, which led to the evolution of anaerobic organisms.
 - Photosynthesis led to conditions that prevented living organisms from colonizing land habitats.
 - Photosynthesis suppressed organism survival by making sunlight a new source of energy in biological systems.
 - Photosynthesis provided a mechanism for the production of food that supported non-photosynthetic organisms.
 - All of the above are true.
- _____ 7. Refer to the figure below.

| Organism | Prokaryotic | Eukaryotic | Photosynthetic | Anaerobic | Aerobic |
|----------|-------------|------------|----------------|-----------|---------|
| A | ✓ | | ✓ | ✓ | |
| B | | ✓ | | | ✓ |
| C | ✓ | | | | ✓ |

Three single-celled organisms were isolated from an ancient lake and characterized. Their properties are indicated by check marks in the table above. Based on this information, what is the probable order of evolution of these organisms, from oldest to most recent?

- A, B, C
 - A, C, B
 - B, A, C
 - C, A, B
 - C, B, A
- _____ 8. Which development allowed organisms to achieve multicellular structures?
- Invasion of land habitats
 - Development of aerobic metabolism
 - Incorporation of organelles
 - Specialization of cells
 - Development of photosynthesis

9. Refer to the figure below.



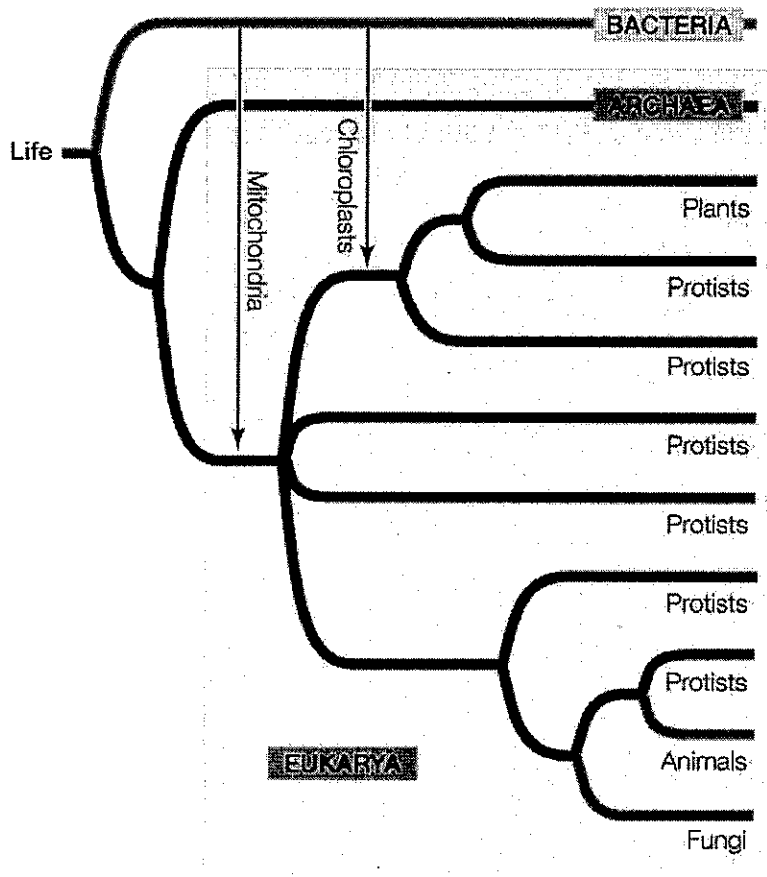
How is time depicted in this representation of a phylogenetic tree?

- It is shown along the y axis, with the past at the bottom and the present at the top.
- It is shown along the y axis, with the present at the bottom and the past at the top.
- It is shown along the x axis, with the past at the left and the present at the right.
- It is shown along the x axis, with the present at the left and the past at the right.
- It is shown along the vertical arrows labeled "Chloroplasts" and "Mitochondria."

10. A phylogenetic tree

- shows evolutionary relationships between organisms.
- relies on evidence from fossils, metabolic processes, and molecular analyses of genomes.
- helps us understand the history and relationships of living organisms.
- shows the order in which populations split and evolved into new species.
- All of the above are true.

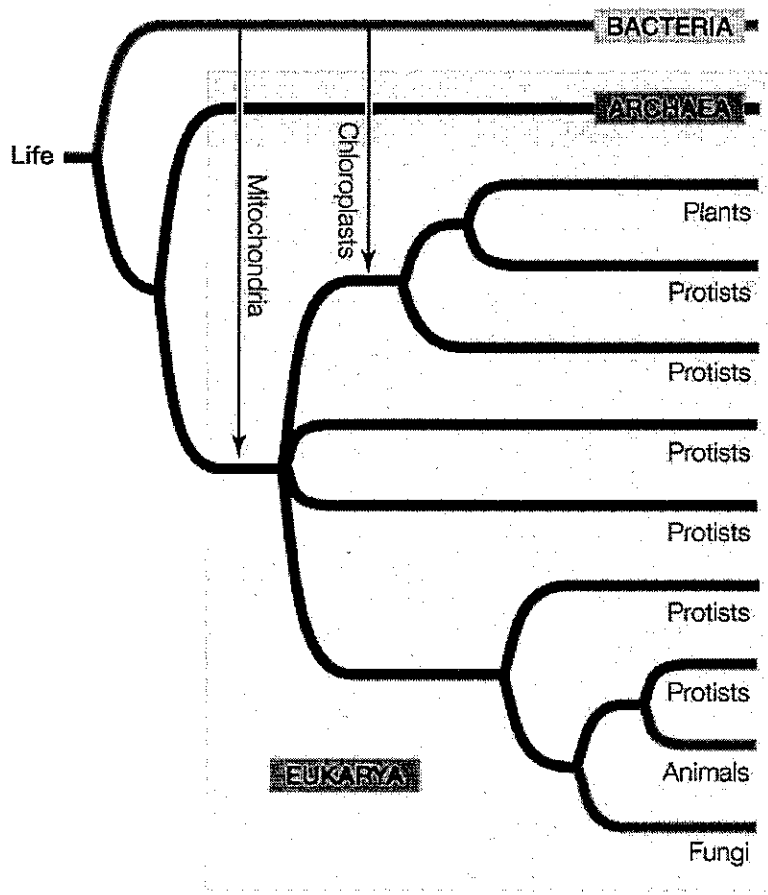
11. Refer to the figure below.



Which concept is demonstrated in this diagram of the tree of life?

- There are three groups of Eukarya.
- Animals, plants, and bacteria have no common ancestor.
- Animals and fungi have a more recent common ancestor than plants and animals do.
- Chloroplasts evolved before mitochondria.
- Archaea is the most ancient group.

___ 12. Refer to the figure below.



Scientists have found organisms from each of the three domains that express a protein called cytochrome *c*. According to this phylogenetic tree, which organism would be expected to have a cytochrome *c* gene most similar in DNA sequence to the cytochrome *c* gene from a human?

- An organism classified as a bacterium
- An organism classified as an archaean
- An organism classified as a plant
- An organism classified as a fungus
- All of the above organisms are similarly related to humans.

- _____ 13. Which statement about model systems is true?
- Insights gained from studying bacteria as a model system cannot be extended to understanding human cells.
 - Researchers choose to study model systems because of their high degree of complexity.
 - Basic understanding of chemical reactions in cells came from research on a model system.
 - The biochemistry of photosynthesis is so complex that model organisms could not be used to study it.
 - The study of model organisms makes it unnecessary to study biochemical processes in human cells.
- _____ 14. _____ is required to maintain organization in living systems.
- Thermodynamics
 - Heat
 - Water
 - Oxygen
 - Energy
- _____ 15. In terms of increasing complexity, the order of parts of a multicellular animal is
- cell, macromolecule, tissue, organ, organ system.
 - molecule, cell, tissue, organ, organ system.
 - tissue, cell, molecule, organ system, organ.
 - molecule, tissue, cell, organ, organ system.
 - tissue, molecule, cell, organ, organ system.
- _____ 16. A group of spiders of the same species lives in a wetland region, feeding on numerous species of winged insects that become ensnared in their webs. Several species of birds, as well as a number of small mammal species, feed on the spiders. Which statement correctly characterizes this scenario?
- The wetland is a landscape composed of several populations, one of which includes the community of spider species, the communities of bird species that prey on the spiders, and the communities of insect species preyed on by spiders.
 - The wetland is a community composed of several landscapes, one of which includes the population of spider species, the populations of bird species that prey on the spiders, and the populations of insect species preyed on by spiders.
 - The wetland is a landscape composed of several communities, one of which includes the population of spider species, the populations of bird species that prey on the spiders, and the populations of insect species preyed on by spiders.
 - The wetland is a population composed of several organisms, one of which includes the community of spider species, the communities of bird species that prey on the spiders, and the communities of insect species preyed on by spiders.
 - The wetland is a community composed of several organisms, one of which includes the landscape of spider species, the landscapes of bird species that prey on the spiders, and the landscapes of insect species preyed on by spiders.

- _____ 17. A group of differentiated cells that work together to carry out a similar function is known as a(n)
- tissue.
 - organ system.
 - unicellular organism.
 - protein.
 - gene.
- _____ 18. A _____ is a set of interacting parts in which neither the parts nor the whole can be understood without taking into account the interactions.
- system
 - gene
 - community
 - structure
 - hierarchy
- _____ 19. When do atoms making up cells in a tree become fixed in those cells for the duration of the tree's existence?
- When the tree germinates from its seed
 - When the tree begins producing bark
 - When the tree reaches its maximum height
 - When the number of cells in the tree remains constant
 - When the tree dies
- _____ 20. Which statement explains the concept of feedback as it applies to biological systems?
- Feedback is a piercing, high-pitched audio signal produced by an electronic sound system.
 - Feedback is the critical review given by one person about another person's performance within a system.
 - Feedback is a process in which the amount of one component of a system affects the rate at which the system operates.
 - Feedback is data collected from users of a system to determine the effectiveness of the system.
 - Feedback is information used to improve function and performance of an organized system.
- _____ 21. The rate of fruit ripening is under positive feedback regulation from ethylene, a gaseous compound produced by cells in ripening fruit. Suppose a farmer picks unripened apples, stores them in an enclosed shed, and counts the number of ripened apples each day over the next week. What will be the shape of the graphed data if the number of ripened apples is plotted on the y axis versus time on the x axis? (Assume that most of the apples are still unripened at the end of the week.)
- A straight line with a positive slope
 - An upwardly curved line with a constantly increasing slope
 - An upwardly curved line with a constantly decreasing slope
 - A downwardly curved line with a constantly increasing slope
 - A downwardly curved line with a constantly decreasing slope

- _____ 22. A biologist who is developing a mathematical model to describe a set of changes in a cell is conducting a(n)
- systems analysis.
 - set prediction.
 - organizational computation.
 - systems discovery.
 - quantification process.
- _____ 23. In which case is systems analysis used to solve a biological problem?
- A medical researcher compares the array of microbes in the human gut across a spectrum of patients to see if a specific microbe set is correlated with obesity.
 - A pharmaceutical firm runs control and experimental trials to see if a new drug is effective in lowering blood cholesterol levels in patients with high levels.
 - An ecologist uses field data to develop a computer simulation of changing animal populations to estimate how an increased wolf population could affect an elk population.
 - A molecular biologist isolates a gene from a bacterium and uses a computer program to compare the new gene's DNA sequence to sequences of other genes in a database.
 - A biochemist compares the amino acid sequence of a protein from one species of lizard to that of another lizard species to learn how closely related the lizards are.
- _____ 24. The information needed to produce proteins is contained in
- nutrients.
 - tissues.
 - evolution.
 - organs.
 - genes.
- _____ 25. The various types of cells in a multicellular organism
- contain different subsets of the genome.
 - randomly express different genes.
 - have functions determined by protein expression.
 - produce the same proteins at the same times.
 - delete genes to avoid expressing unneeded proteins.

____ 26. Refer to the figure below.

| Nucleotide sequence | |
|---------------------|---------------------|
| Before mutation | -G-C-C-T-A-A-A-T-G- |
| After mutation | -G-C-C-T-A-A-C-T-G- |

The nucleotide sequence of a portion of a gene encoding eye color in fruit flies is shown in the top row of the table. Below it is the sequence after a mutation occurred. What conclusion can be drawn from this information?

- The fruit fly will be harmed by the mutation.
 - The mutation will improve the fruit fly's chances of survival.
 - The fruit fly's eye color will change.
 - The mutation may change the protein encoded by the gene.
 - The mutation is too insignificant to have an effect.
- ____ 27. Which research problem would be best approached using bioinformatics?
- Characterizing the effects on a protein's function when specific amino acid changes are made
 - Evaluating whether music can reduce stress in rats placed under high-density living conditions
 - Identifying the specific nucleotide change in a gene known to have undergone mutation in a bacterial species
 - Determining environmental conditions that affect life span of a roundworm species
 - Comparing healthy and affected members in a population to see whether a disorder has a genetic basis

_____ 28. Refer to the table below.

| Organism | Estimated size (base pairs) | Estimated gene number |
|-----------|-----------------------------|-----------------------|
| Human | 3.0 billion | 25,000 |
| Fruit fly | 165.0 million | 13,000 |
| Plant | 157.0 million | 25,000 |
| Bacteria | 4.6 million | 3,200 |

What could be accomplished by a comparative analysis of the data shown in the table?

- a. Determining whether all of the organisms listed share the same core set of genes
 - b. Evaluating whether gene number is dictated by genome size
 - c. Identifying the smallest possible number of genes needed to support life
 - d. Drawing a conclusion about how fast organisms evolve
 - e. Comparing the organisms listed to place them in a phylogenetic tree
- _____ 29. A key biological principle is that evolution explains the diversity as well as the unity of life. Which example illustrates this principle with respect to the unity of life?
- a. Several different butterfly species migrate in spring and summer, which allows them to experience mild temperatures all year long.
 - b. Horseshoe crabs have retained the same physical features and body shape for millions of years.
 - c. Comparison of the same gene isolated from individuals of the same plant species show variations in nucleotide sequence.
 - d. Bacteria and human cells have a core set of proteins in common, and genes for these proteins bear similarities in nucleotide sequence.
 - e. All of the above
- _____ 30. Darwin referred to the differing survival and reproduction among individuals of a population as
- a. evolution.
 - b. artificial selection.
 - c. the cell theory.
 - d. natural selection.
 - e. inheritance of acquired characteristics.
- _____ 31. Organisms have been able to survive in a wide variety of environments because they
- a. have a genome.
 - b. contain organelles.
 - c. carry out photosynthesis.
 - d. adapt through evolution.
 - e. are similar to model organisms.

- _____ 32. Which occurs during artificial selection but not necessarily during natural selection?
- Only certain individuals in a population mate and pass their genes on to the next generation.
 - Traits that are beneficial to humans are selected for in each generation.
 - Preexisting variation in traits among individuals in a population provides the raw material for the selection process.
 - Genes carry the biological information that specifies traits in an organism and that the organism passes on to its offspring.
 - Traits that help the organism survive in its environment are selected for in each generation.
- _____ 33. Milk snakes are a species of non-poisonous snakes that inhabit a wide geographical range throughout North America. They can be gray, tan, red, orange, or black with or without bands of yellow, black, or white. Biologists have proposed that brightly colored milk snakes are adapted to regions where similarly colored poisonous snakes live because the color wards off potential predators. This is a(n) _____ explanation.
- ultimate
 - proximate
 - adaptive
 - selective
 - qualitative
- _____ 34. The process of evolution can be inferred from the fact that
- some organisms that lived in the past are preserved in the fossil record.
 - flu vaccines must be updated annually to keep up with changing viruses.
 - genes direct the production of proteins in a cell.
 - chemical agents can be used to treat some human diseases.
 - biologists have identified and classified approximately 1.8 million species.
- _____ 35. Which forms part of the basis for the scientific conclusion that evolution is a fact?
- The process of evolution has been observed and measured in the lab.
 - Scientists have documented how the process of evolution occurs, in detail.
 - Evolution can be used to produce new organisms designed to have specific traits.
 - Scientists have fossil proof of the majority of extinct organisms that lived on Earth.
 - All of the above
- _____ 36. Modern biologists emphasize the collection of quantitative observations over qualitative observations in their investigations because quantitative observations are
- less prone to error.
 - easier to collect.
 - more easily tested.
 - given greater importance by other scientists.
 - better applied to mathematical analysis.

- _____ 37. In its use in science, a hypothesis is
- the final answer to a question.
 - the best outcome of an investigation.
 - a tentative explanation.
 - a prediction of future events.
 - an observation of a natural event.
- _____ 38. After observing that birds live in residential areas with large trees but not in residential areas with no trees, researchers state that “birds require trees to survive.” This simple statement is an example of a
- conclusion.
 - result.
 - prediction.
 - hypothesis.
 - fact.
- _____ 39. Refer to the table below.

| | Average increase in plant height at normal CO ₂ levels | Average increase in plant height at elevated CO ₂ levels |
|-----------------------|---|---|
| Group 1 | 2.3 ± 0.7 cm | 2.6 ± 0.5 cm |
| Group 2 | 2.0 ± 0.4 cm | 2.9 ± 0.6 cm |
| Group 3 | 3.0 ± 0.5 cm | 3.0 ± 0.3 cm |
| Average of all groups | 2.4 ± 1.1 cm | 2.8 ± 0.7 cm |

A biologist hypothesizes that increasing carbon dioxide levels in the atmosphere causes an increase in plant growth. A controlled experiment using one species of plant was conducted using different groups of plants over a two-week growing period. Each group contained 20 plants randomly split into control and experimental groups. The plants received identical treatment, except CO₂ exposure. The table summarizes results as average height increases along with a plus/minus value indicating the range of individual plant height measured. Can the data be used to support the biologist’s hypothesis? Why or why not?

- Yes, because within each group, the average increase in height at normal CO₂ levels was lower or the same than the height increase at elevated CO₂ levels.
- Yes, because the average across all groups at normal CO₂ levels was lower than the height increase at elevated CO₂ levels.
- No, because one of three groups did not show a difference in height increase.
- No, because the variability in the data for each group is so large that statistical analysis would be needed to discern any differences.
- No, because the experimental design did not adequately control all variables.

- ___ 40. 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 qualitative data.
 - e. gathering raw data without changing variables.

- ___ 41. In a laboratory experiment, researchers measured plant growth at various light levels while keeping all other variables constant. This is an example of a _____ experiment.
 - a. controlled
 - b. repeated
 - c. statistical
 - d. comparative
 - e. verified

- ___ 42. An investigation was carried out to determine the effect of different fertilizers on apple production. Which provides the best control for such a study?
 - a. Treat one tree the same as the others, but omit all fertilizers for this tree.
 - b. Treat a large group of trees the same as the others, but omit all fertilizers for the selected group of trees.
 - c. Treat all trees with the same amount of fertilizer, except for a few to be exposed to a small amount of a mix of all fertilizers.
 - d. Treat one tree the same as the others, but apply a small amount of one type of fertilizer to this tree.
 - e. Treat a large group of trees the same as the others, but apply a small amount of a mix of all fertilizers to the selected group of trees.

___ 43. Refer to the table below.

| | | | |
|------------------------|-----|------|------|
| Incubation temperature | 5°C | 25°C | 45°C |
| Percent survival | 85% | 100% | 15% |

Groups of 50 house flies were kept in three chambers under the same conditions except for temperature. After 4 hours, the number of surviving flies was counted in each chamber and expressed as a percentage of the total. The results raised new questions that the data cannot be used to answer. Which is a new question prompted by the data shown?

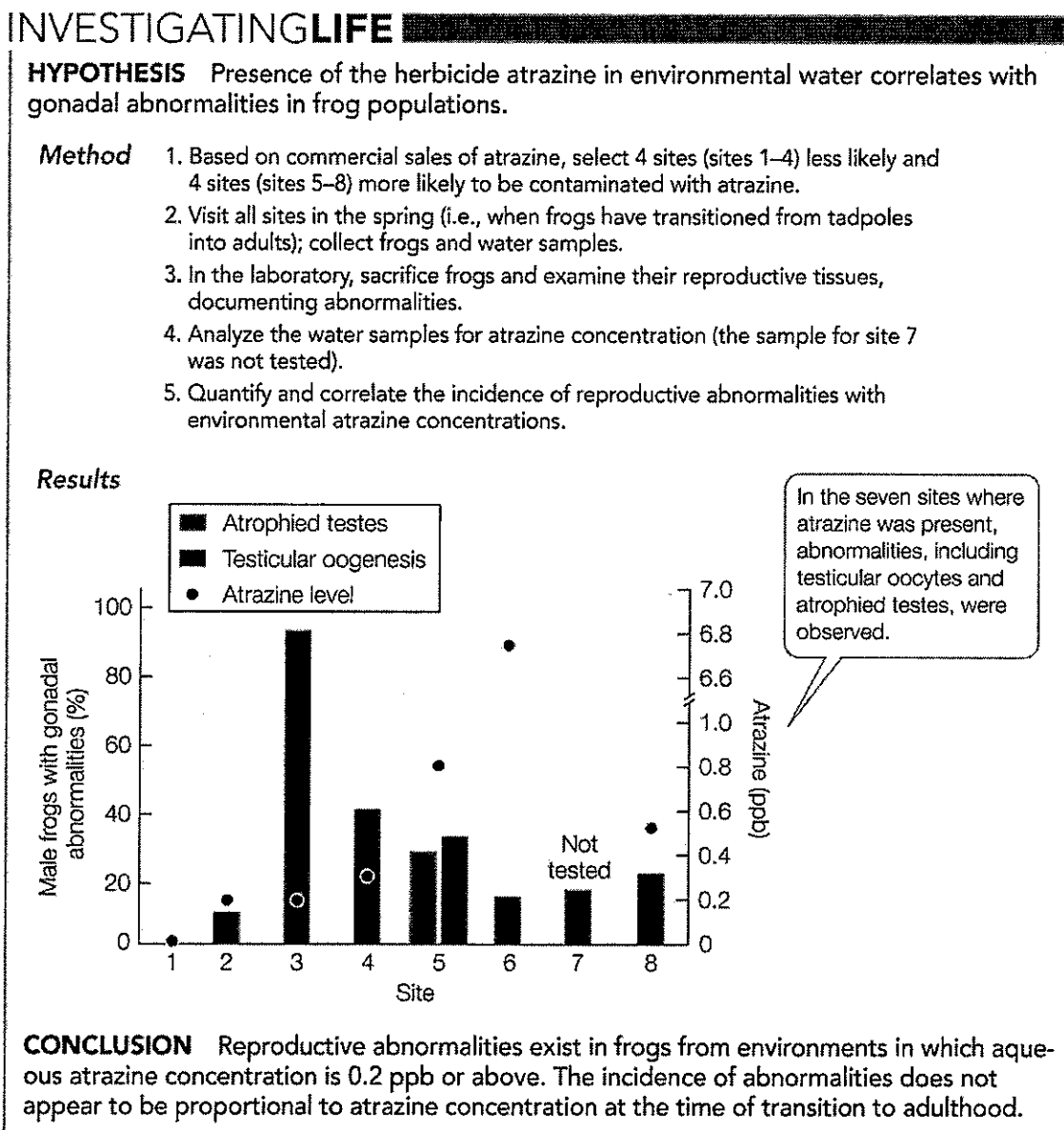
- Can house flies survive at temperatures 20 degrees colder or warmer than ambient room temperature?
 - Are house flies that are sensitive to heat also sensitive to cold, or are the two governed by separate mechanisms?
 - Are house flies more sensitive to cold temperatures or hot temperatures?
 - Do house flies show variations in traits within a population?
 - Is ambient room temperature an optimal temperature for the survival of house flies?
- ___ 44. Which design for an experiment would best test the hypothesis that blue flowers are more attractive to bees than pink or white flowers?
- Count the number of visits by all bee species to pink flowering species A in a field. Repeat for separate fields of white flowering species B and blue flowering species C.
 - Count the number of visits by all bee species to flowers in a single field of an equal mix of pink species A, white species B, and blue species C.
 - Plant pink species A, white species B, and blue species C in three separate greenhouses. Release bees of the same species in each greenhouse and count each visit to flowers.
 - Plant an equal mix of pink, white, and blue flowering plants of species D inside a greenhouse. Release bees of the same species and count each visit to each flower color.
 - Plant pink, white, and blue flowering plants of species D in three separate greenhouses. Release bees of the same species in each greenhouse and count each visit to flowers.

Name: _____

ID: A

- _____ 45. Which statement about scientific methods is true?
- a. After forming a hypothesis, scientists apply logical reasoning to make predictions from the hypothesis.
 - b. The most informative experiments are those that have the ability to show that a hypothesis is correct.
 - c. In a comparative experiment, a scientist compares groups that differ in a variable that has been manipulated in one of the groups and left unaltered in the other group.
 - d. Controlled experiments are valuable when the critical variables are not known or cannot be manipulated.
 - e. A statistical test of a hypothesis starts with the premise that a significant difference exists between the groups in the study.

46. Refer to the figure below.



Which statement represents the null hypothesis for this study?

- Atrazine might have a greater effect on gonad development at low concentrations than at high concentrations.
- Testes are normal in the absence of atrazine, but male gonadal abnormalities occur in the presence of atrazine.
- Atrophied testes and testicular oogenesis show no differences in their response to atrazine level.
- Atrazine levels show no differences with respect to the percentage of gonadal abnormalities.
- Differences in gonadal abnormalities among sites with varied atrazine levels are due to random variation.

- _____ 47. Which statement about statistical analysis in science is true?
- Statistical methods are applied when the amount of data collected for an investigation becomes too large to easily review and evaluate.
 - Statistical tests analyze variation and calculate the probability that observed differences in an experiment could be due to chance variation.
 - Statistical tests can be used to evaluate controlled experiments but not comparative experiments.
 - Scientists generally conclude that the differences they measure are significant if the statistical tests show that the probability of error is 50 percent or lower.
 - Statistics provides a means for determining data that is erroneous and should be discarded.
- _____ 48. Data from a scientific study are typically published in scientific journals, allowing other scientists to repeat the same experiments to _____ the results.
- appreciate
 - discover
 - improve
 - verify
 - witness
- _____ 49. Which is true about science?
- It identifies necessary human health changes.
 - It describes how the world works.
 - It directs which technologies should be developed.
 - It determines which research areas should be funded.
 - All of the above
- _____ 50. How does science differ from non-science?
- Science involves developing explanations that can be tested, whereas non-science deals with explanations that cannot be tested.
 - Science involves making observations and asking questions, whereas non-science does not involve either of these processes.
 - Science allows both opinion and fact to contribute to its knowledge base, whereas non-science only takes opinions into consideration.
 - Science allows tentative explanations to be posed to explain phenomena, whereas non-science relies on proven facts to explain phenomena.
 - All of the above