

Important Terms:

- Biodiversity
- Evolutionary relationships
- Molecular Evidence
- Structural Evidence
- Chromatography
- DNA
- Extinct
- Enzymes
- Gel Electrophoresis
- *Genus species*
- Habitat Destruction
- Habitat Degradation
- Human Impact
- Amino Acids
- Transcription
- Translation

Key Points:

1. The diversity of life on the planet has been created through the process of evolution by means of natural selection.
2. Through natural selection, organisms have evolved to lessen competition, and therefore fill a wide array of niches. This biodiversity increases the stability of ecosystems.
3. Biodiversity has important benefits to mankind, including development of new food sources and medicines; as well as beneficial, free, ecosystems services. Ecosystem degradation and destruction lead to the loss of genetic biodiversity and increases the chance that an ecosystem will become less stable and collapse.

Procedures:

1. Structural Characteristics of Plants
2. Structural Characteristics of Seeds
3. Structural Characteristics of Stems (Cross Sections)
4. Paper Chromatography to Separate Plant Pigments
5. Indicator Test for Enzyme M
6. Gel Electrophoresis (simulated) to Compare DNA
7. Translating the DNA Code to Make a Protein

Analysis:

1. Scientists use a variety of evidence to determine evolutionary relationships.
 - a. Structure, cell types, DNA, behavior, fossils
 - b. The more criteria that are shared between organisms, the more likely they are closely related.
2. Relatedness can be shown using a “branching tree diagram”. Organisms that are closely related are next to each other on the same branch.
3. The most reliable way of determining relatedness is genetic sequencing. Organisms can look similar structurally and may not be closely related. (Birds and Bats)
4. The extinction of species can have major implications for mankind and natural ecosystems.
5. Scientists use gel electrophoresis to separate DNA fragments. Negatively charged DNA molecules migrate through the gel towards the positive side. The smaller molecules migrate more rapidly through the gel than the larger ones do.

Lab: Making ConnectionsImportant Terms:

- pulse
- circulatory system
- muscle fatigue
- feedback mechanisms
- homeostasis
- scientific method
- hypothesis
- control group
- conclusion

Key Points:

1. The components of living systems, from a single cell to an ecosystem, interact to maintain balance. Different organisms have different regulatory mechanisms that function to maintain the level of organization necessary for life.
2. The components of the human body, from organ systems to cell organelles, interact to maintain a balanced internal environment. To successfully accomplish this, organisms possess a diversity of control mechanisms that detect deviation and make corrective actions.
3. If there is a disruption in any human system, there may be a corresponding imbalance in homeostasis.
4. Feedback mechanisms have evolved that maintain homeostasis.

Procedures:

1. Record individual average pulse rates.
2. Use the average pulse rate for each student to fill in chart and prepare a class data histogram (bar graph).
3. Students exercise, record pulse rates again and note any changes.
4. Students record number of times they can squeeze a clothes pin in one minute.
5. Repeat immediately and record any changes in results.
6. Students use background knowledge from part A to develop a controlled experiment for the following problem: Does exercising first increase or decrease squeezing rates?

Analysis:

1. Pulse rate increases after exercise because oxygen and nutrients are needed by the muscle cells.
2. Muscle cells may get fatigued due to waste products building up in them.
3. The respiratory and circulatory systems work together. The respiratory system takes in oxygen and releases carbon dioxide. The circulatory system brings needed oxygen to the cells and carries away wastes like carbon dioxide.

Lab: The Beaks of FinchesImportant Terms:

- variation
- struggle for survival
- environment
- migration
- competition
- adaptation
- selecting agent

Key Points:

1. Species evolve over time. Evolution is a result of the interactions between:
 - a. The potential for a species to increase its population
 - b. Genetic variation of offspring due to mutation and genetic recombination
 - c. A limited amount of resources in the environment (food, space, mates...)
 - d. Selection by the environment of those individuals that are better able to survive and produce viable offspring (survival of the fittest)
2. Some characteristics/variations give individuals an advantage over others in surviving and reproducing. The offspring of these "better adapted" individuals will be more likely to survive and reproduce than those of other individuals. The proportion/frequency of individuals with favorable characteristics will increase.
3. Variation in a population increases the likelihood that at least some individuals will survive the changing environmental conditions.

Procedures:

1. Students simulate competition for food by finches in an island environment.
2. The beak variations of finches are represented by a variety of tools (tweezers, spoons, pliers...)
3. In Round One, students simulate feeding on small seeds. Each student removes seeds alone, without competition from other students.
4. Winners of Round One stay on original island while losers migrate to a new island with large seeds.
5. In Round Two, competition is simulated by two students feeding on the same food at the same time.
6. In Round Three, increased competition is simulated by multiple students feed on the same food source at the same time. (Two islands: small seeds and large seeds)
7. The winning teams from Round Three represent the beak variations that are best fit for feeding on that particular type of seed.

Analysis:

1. Those individuals with beaks best adapted for feeding on small seeds remained on island at the end of Round One while those with "less adapted" beaks migrated to a new island.
2. Competition for food in Round Two should have had an adverse effect on feeding success.
3. There were fewer survivors at the end of Round Three due to increased competition.
4. The following components of Natural Selection were simulated:
 - a. Variation: different beaks, different size seeds
 - b. Competition: more than one bird feeding at one bowl
 - c. Struggle for survival: each bird trying to get enough food to survive
 - d. Adaptation: particular characteristics of "beaks"
 - e. Environment: students, seeds, dishes
 - f. Selecting agent: type of "beak" and type of seeds available

Lab: Diffusion Through a MembraneImportant Terms:

- Diffusion
- Selectively permeable
- Indicators
- Dialysis tubing
- Starch
- Glucose
- Starch indicator
- Glucose indicator
- Controls
- Cytoplasm
- Cell membrane
- Cell wall
- Osmosis
- Wet mount
- Cover slip

Key Points 1:

1. Molecules tend to move from high to low concentration without the use of energy (diffusion).
2. Membranes may allow some molecules to pass through while not allowing others (selectively permeable).
3. Indicators are used to show the presence of certain kinds of molecules.

Procedure 1:

1. A model cell is made using a plastic membrane (dialysis tubing) containing starch and glucose.
2. Starch indicator (iodine) is placed in solution outside the "cell".
3. Starch indicator diffuses in and glucose diffuses out of the cell (High to Low concentration).
- 4) Starch (milky white) + starch indicator (brown) → blue black color
- 5) The inside of the bag turns blue-black while the outside stays brown.
- 6) Glucose indicator (blue) + glucose (clear) + HEAT → green, brown, red or ORANGE
- 7) Testing the fluid outside the "cell" shows glucose has left. This is tested by placing fluid from outside into a test tube, adding indicator solution, and heating the mixture.

Analysis 1:

1. Glucose and starch indicator may pass through the membrane. Starch may not. This is because starch is a much larger molecule than glucose or starch indicator.
2. This shows the importance of breaking down large molecules inside the digestive system in order for nutrients to enter the bloodstream.

Key Points 2:

1. Diffusion of water molecules is particularly important and is called OSMOSIS.
2. The balance of water molecules inside and outside the cell is extremely important for the survival of all organisms, including humans.

Procedure 2:

1. Make a wet mount slide of a thin section of red onion using distilled water.
2. Replace with salt water and observe.
3. Replace again with distilled water and observe.

Analysis 2:

1. Cells placed in very salty solutions will lose water because they contain a higher concentration of water. They will shrink.
2. Cells placed in distilled water will gain water because they contain a lower concentration of water. They will swell and may burst if a cell wall is not present.
3. Freshwater creatures, particularly single-celled organisms, must cope with too much water entering the cells. Saltwater organisms tend to have the opposite problem and must try to reclaim lost water.

Part D

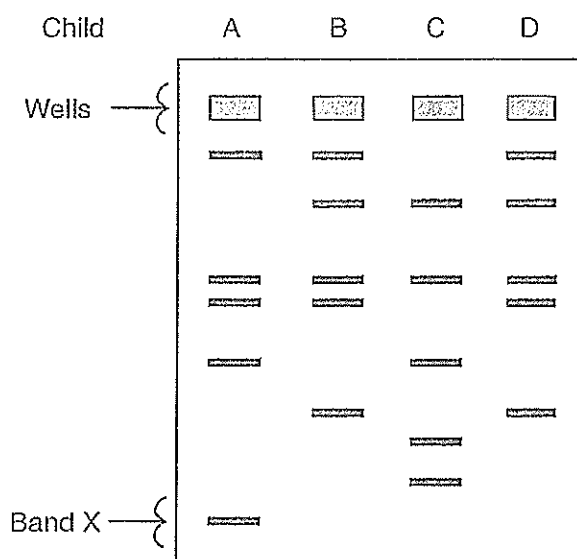
Answer all questions in this part. [13]

Directions (63-75): For those questions that are followed by four choices, circle the number of the choice that, of those given, best completes the statement or answers the question. For all other questions in this part, follow the directions given in the question and record your answers in the spaces provided.

Base your answers to questions 63 through 66 on the information and diagram below and on your knowledge of biology.

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DNA samples were collected from four children. The diagram below represents the results of a procedure that separated the DNA in each sample.



63 Identify the procedure used to obtain these results. [1]

Gel Electrophoresis

63

64 Band X represents the

- (1) largest fragment of DNA that traveled the fastest
- (2) smallest fragment of DNA that traveled the fastest
- (3) largest fragment of DNA that traveled the slowest
- (4) smallest fragment of DNA that traveled the slowest

64

65 The DNA is most similar in which two children? Support your answer. [1]

B & D have the most bands in
common, therefore their DNA is most similar

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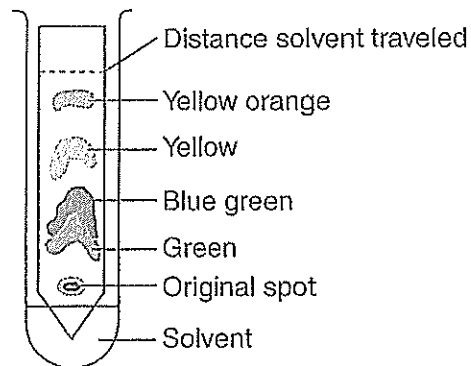
65

66 State *one* way information obtained from this procedure can be used. [1]

This information can be used to
establish relationships.
(confirm identity)

66

67 A technique used to analyze pigments in spinach leaves is shown in the diagram below.



This technique is known as

- (1) paper chromatography
- (2) gene manipulation
- (3) dissection
- (4) staining

67

68 A student conducted an experiment to determine if listening to different types of music would affect pulse rate. She thought that pulse rate would change with different types of music. Each person participating in her experiment listened to seven different selections of music for 30 seconds each. The pulse rates were taken after each 30-second interval of music. Based on her experiment, the student concluded that a person's pulse rate changed when listening to different types of music.

The component missing from this experiment is a

- (1) prediction
- (2) hypothesis
- (3) control group
- (4) research plan

(Group with no music)

68

69 An experiment was carried out to determine whether drinking caffeinated soda increases pulse rate. The pulse rates of two groups of people at rest were measured. Group A was then given caffeinated soda and group B was given caffeine-free soda. One hour after drinking the soda, the pulse rates were measured. The participants in the experiment were all the same age, and they were all given the same amount of soda.

The dependent variable in this experiment is the

- (1) type of soda given to each group
- (2) amount of soda given to each group
- (3) pulse rate of each group
- (4) age of participants in each group

(item being measured)

69

Base your answer to question 70 on the information below and on your knowledge of biology.

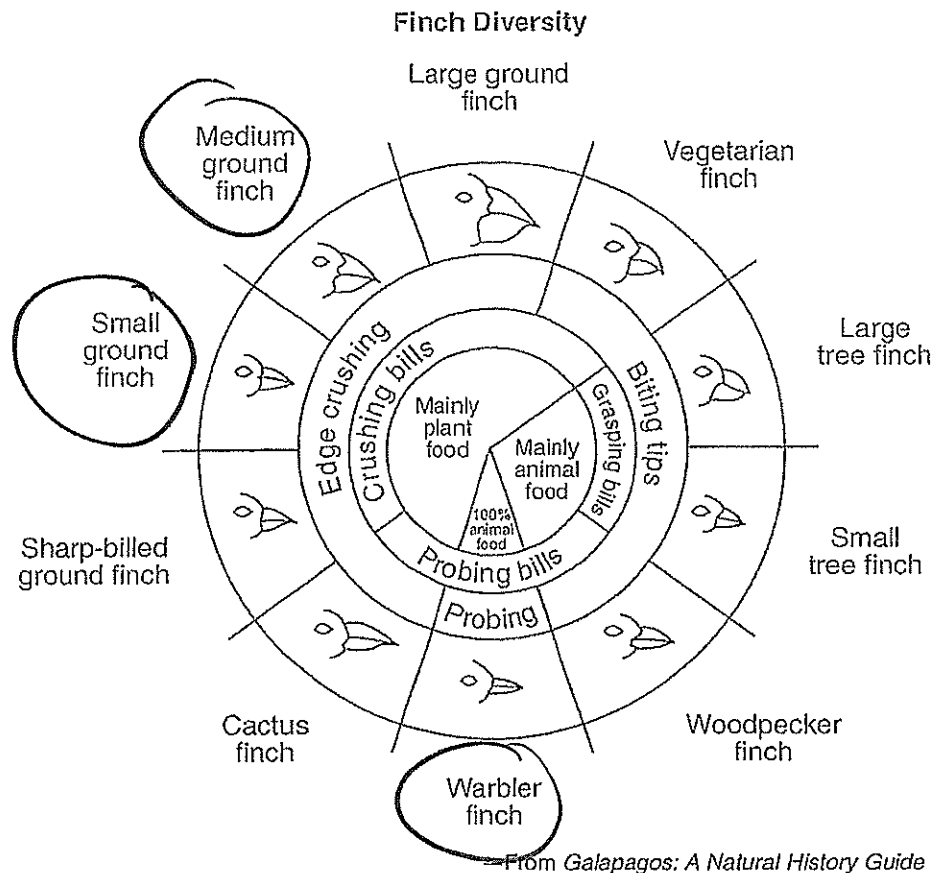
A student states that exercise will affect the number of times a person can squeeze a clothespin in a certain amount of time. An experiment is carried out to test this hypothesis. One group of ten students sits quietly before squeezing a clothespin as many times as possible during a one-minute interval. A second group of ten students does 25 jumping jacks before squeezing a clothespin as many times as possible during a one-minute interval.

70 State *one* way the experiment could be improved in order to increase the validity of the results. [1]

Repeat the experiment
Use a larger sample size

70

Base your answer to questions 71 and 72 on the information in the diagram below and on your knowledge of biology.



71. Small ground finches and medium ground finches live on an island with abundant plant and animal food. Predict how the small ground finch and the medium ground finch would be affected if warbler finches migrated to the island where these finches live. Support your answer. [1]

Warbler finches eat animal food. They would not compete with the small and medium ground finches.

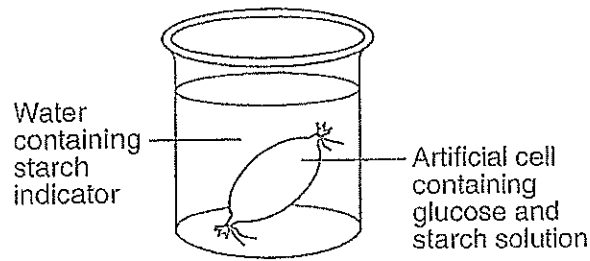
71

- 72 The differences observed in the bird beaks are most likely due to

- (1) asexual reproduction of these finch species
- (2) the selection for different shaped beaks that best suit different niches
- (3) the genetic recombination associated with mitotic cell division
- (4) the genetic engineering of the DNA of each of these species

72

Base your answers to questions 73 through 75 on the laboratory setup illustrated below and on your knowledge of biology.



73 Identify the color of the contents of the artificial cell after two hours. [1]

The contents will turn blue/black

73

74 After two hours, the color of the liquid in the beaker did *not* change. This shows that

- (1) glucose moved from the artificial cell into the beaker
- (2) starch did not pass out of the artificial cell
- (3) starch was digested to glucose in the artificial cell
- (4) glucose molecules combined to produce starch in the artificial cell

74

75 This laboratory setup would most likely be used to demonstrate

- (1) carbohydrate synthesis
 - (2) active transport
 - (3) diffusion
 - (4) dehydration
-

75