SAT II Biology Practice Test I
BIOLOGY E/M TEST

FOR BOTH BIOLOGY-E AND BIOLOGY-M,

ANSWER QUESTIONS 1–60

Directions: Each set of lettered choices below refers to the numbered questions or statements immediately following it. Select the one lettered choice that best answers each question or best fits each statement, and then fill in the corresponding oval on the answer sheet. A choice may be used once, more than once, or not at all in each set.

Questions 1–3 refer to the following molecules:

(A) proteins
(B) monosaccharides
(C) lipids
(D) DNA
(E) RNA

1. Contain carbon, hydrogen, and oxygen in a 1:2:1 ratio
2. Are often not soluble in water
3. This group includes enzymes

Questions 4–6 refer to the following groups:

(A) producer
(B) primary consumer
(C) secondary consumer
(D) tertiary consumer
(E) decomposer

4. The group in the food pyramid with the fewest number of members
5. Creates glucose from carbon dioxide in the atmosphere
6. Omnivores most often fall into this group

Questions 7–9 refer to the following processes:

(A) Krebs cycle
(B) oxidative phosphorylation
(C) aerobic respiration
(D) glycolysis
(E) anaerobic respiration

7. Stage at which one molecule of 6-carbon glucose is broken in half to produce two molecules of pyruvate. Two ATP are generated in this stage.
8. Process occurring in the mitochondria of eukaryotes and resulting in the total oxidation of acetyl-CoA to carbon dioxide. Two ATP are generated in this stage.
9. Occurs in the fermentation of alcohol

Questions 10–12 refer to the following behavior types:

(A) imprinting
(B) habituation
(C) conditioning
(D) insight learning
(E) fixed-action patterns

10. When confronted with a nonharmful stimulus many times, an animal will learn to ignore it.
11. When an animal associates two unrelated events that occur simultaneously, this is known as
12. This behavior involves an animal's recognition of its mother.
13. Of the following, which group’s members have the LEAST in common with each other?

(A) Species
(B) Order
(C) Family
(D) Phylum
(E) Kingdom

14. A culture of animal cells and a culture of plant cells are pulverized and tested for the presence of several different molecules. Which of the following molecules should be significantly more prevalent in the plant cell sample?

(A) Glucose
(B) Deoxyribonucleic acid
(C) Adenosine triphosphate
(D) Cholesterol
(E) Cellulose

15. Which of the following is the best example of exponential population growth?

(A) A population of pigeons in a small town grows until there are few nesting areas left.
(B) The salmon population in the Yukon River grows rapidly, greatly increasing the food supply for bears in the area.
(C) Dandelions grow in a field until they cover the entire expanse.
(D) Bacteria in a laboratory grow in many petri dishes and are transferred to new, empty dishes as the old dishes begin to fill.
(E) The population of buffalo in the Great Plains is severely diminished by hunting and development.

16. A person becomes anemic when they are not getting enough oxygen to their body. Which of the following could cause someone to be anemic?

(A) A deficiency in white blood cells
(B) A deficiency in red blood cells
(C) A low platelet count
(D) Too little plasma in the bloodstream
(E) An abnormally high T-cell count

17. Natural selection refers to all of the following EXCEPT

(A) Individual organisms differ from one another.
(B) Competition exists between individuals.
(C) The best-adapted organisms are most likely to survive.
(D) The best-adapted organisms are most likely to reproduce.
(E) The traits an organism acquires in its lifetime are passed down to its offspring.

18. Which of the following is the best example of an ecological community?

(A) All of the pigeons inhabiting a city
(B) A school of trout in the Mississippi River
(C) Tropical rain forests worldwide and all of the organisms that inhabit them
(D) All of the plants, insects, rodents, and predators inhabiting a small island
(E) An ant colony

19. Which of the following is the best description of a protein molecule?

(A) Small building blocks called amino acids linked together in one or more chains
(B) Small building blocks called amino acids linked together in a ring
(C) Small building blocks called nucleotides linked together in a helical structure
(D) Small building blocks called monosaccharides linked together in a chain
(E) A glycerol molecule linked to three hydrocarbon chains

20. The DNA sequence TTATTAGACCT is transcribed to the RNA sequence

(A) TCCAGATTATT
(B) GGGCGCUCAAG
(C) TTUTUGUCCT
(D) UUTUUTFUGGU
(E) AAUAAUCUGGA
21. When a fertilized egg implants in the uterine lining, the lining is not shed in menstruation, but instead remains to support the pregnancy. What initially signals this change?

(A) The release of hormones by the newly developing embryo
(B) The release of estrogen by the ovaries
(C) The release of enzymes by the uterine wall
(D) The release of enzymes by the placenta
(E) The release of hormones from the pituitary gland

22. Gaps in the fossil record, the only direct evidence for historical evolution, may be attributed to all of the following EXCEPT

(A) fossilization is an improbable event
(B) fossilization requires sedimentary rock
(C) erosion
(D) many fossils have yet to be found
(E) specimens were enclosed in rocks formed from hardened sediments

23. You are told that an unidentified cell contains a single, circular DNA molecule but no defined nucleus. Which of the following is it also possible for the cell to possess?

I. Chloroplasts
II. Cell wall
III. Ribosomes

(A) I only
(B) III only
(C) I and II only
(D) II and III only
(E) I, II, and III

24. Nitrogen in the atmosphere gets converted into a usable form by

(A) photosynthesis
(B) respiration
(C) digestion
(D) nitrogen-fixing bacteria
(E) decomposition

25. Monerans are

(A) eukaryotes
(B) fungi
(C) prokaryotes
(D) multicellular
(E) plants

26. Which of the following was NOT a component of the Earth's early atmosphere?

(A) Oxygen
(B) Water
(C) Methane
(D) Hydrogen
(E) Ammonia

27. A blood vessel has thick muscular walls. This blood vessel is

I. an artery
II. carrying oxygenated blood
III. carrying blood away from the heart

(A) I only
(B) III only
(C) I and II only
(D) I and III only
(E) I, II, and III
28. Which of the following statements is true about the flow of energy through the food pyramid?

(A) The most energy is at the top of the pyramid, with the tertiary consumers, because the energy increases at each level.
(B) The most energy is at the bottom of the food pyramid because some is lost as it is passed from producer to each level of consumer.
(C) The energy is distributed equally at each level of the pyramid; very little is lost or added moving from producers to tertiary consumers.
(D) Energy doesn’t flow through the food pyramid; each level receives energy from the sun.
(E) It depends on the ecological community; in some, there is more energy at the top of the food pyramid, and in others, there is more energy at the bottom.

29. The toxic chemical produced by anaerobic respiration is

(A) pyruvate
(B) lactic acid
(C) acetyl-CoA
(D) NADH
(E) coenzyme

30. One of the functions of human white blood cells is to ingest and destroy harmful agents, such as bacteria, that find their way into the bloodstream. In order to perform this function, you could expect a white blood cell to have a higher than average number of

(A) ribosomes
(B) peroxisomes
(C) chloroplasts
(D) lysosomes
(E) chromosomes
Questions 31–35 refer to the diagram below.

31. The depicted process is also known as
   (A) aerobic respiration
   (B) photophosphorylation
   (C) light-dependent photosynthesis
   (D) light-independent photosynthesis
   (E) anaerobic respiration

32. This process occurs in the
   (A) stroma of chloroplasts
   (B) cytoplasm of palisade cells
   (C) inner membrane of mitochondria
   (D) nucleus
   (E) endoplasmic reticulum

33. ATP stands for
   (A) accelerated transport protein
   (B) adenosine triphosphate
   (C) activated transphosphate
   (D) adenine tripeptide
   (E) adenosine diphosphate

34. The synthesized glucose will most likely be stored as
   (A) sucrose
   (B) starch
   (C) cellulose
   (D) glycogen
   (E) glucose

35. How is the Calvin cycle similar to the Krebs cycle?
   (A) The starting compound is regenerated at the end of the cycle.
   (B) Multiple molecules of ATP are produced.
   (C) Both occur in mitochondrial inner membranes.
   (D) Both produce oxygen gas.
   (E) Each is present in all prokaryotes.
In an experiment, presoaked bean seeds were placed in three sterile petri dishes. They were covered with tissue paper and cotton, which was subsequently wet with tap water. The dishes were closed and taped shut. Dish 1 was affixed to the wall of a dark box with the transparent bottom facing out. Dish 2 was attached to the side of the windowsill, and dish 3 was laid flat on the sill, each with bean seeds visible. After several days, the experimenter checked the new seedlings.

36. In dish 1, several pale shoots have started to reach downward. This is most likely an example of

(A) thigmotropism  
(B) negative phototropism  
(C) positive gravitropism  
(D) negative gravitropism  
(E) wilting

37. The seeds in dish 1 were kept in a dark box to

(A) study the effect of light on their emergence  
(B) decrease experimental variables  
(C) simulate conditions when planted  
(D) study the effects of phototropism  
(E) keep the temperature down

38. The physical growth associated with tropisms is caused by

(A) auxin  
(B) lactic acid  
(C) associative behavior  
(D) nitrogen  
(E) excess carbon dioxide

39. What process is NOT occurring in the dish 1 seedlings?

(A) Photosynthesis  
(B) Respiration  
(C) Mitosis  
(D) Glycolysis  
(E) Absorption
Questions 40–44 refer to the following illustration of a cell in solution, where a "+" indicates the presence of a sodium ion.

40. The figure depicts an animal cell in a 10% sodium solution. What is likely to occur?
   (A) Water exits the cell by osmosis.
   (B) Sodium ions enter by diffusion.
   (C) The cell swells and bursts.
   (D) Sodium is pumped out of the cell.
   (E) No change

41. Relative to the cell, the sodium solution is
   (A) hypotonic
   (B) hydrophobic
   (C) isotonic
   (D) hypertonic
   (E) equivalent

42. The process by which the carrier protein might bring sodium into the cell is called
   (A) simple diffusion
   (B) facilitated diffusion
   (C) active transport
   (D) osmosis
   (E) phosphorylation

43. The cell membrane is composed of two layers of
   (A) phospholipids
   (B) enzymes
   (C) amino acids
   (D) proteins
   (E) steroids

44. Which of the following molecules could NOT easily and independently pass through the membrane?
   (A) Nitrogen
   (B) Water
   (C) Glucose
   (D) Carbon dioxide
   (E) Oxygen
A copperhead snake (*Agkistrodon contortrix*) and a canary (*Serinus canaria*) are both being studied in a zoological laboratory.

45. During the night, the air temperature in the lab falls. What happens to the two organisms’ metabolic rates?
   (A) Both remain stable
   (B) Both increase
   (C) Snake’s decreases, canary’s remains stable
   (D) Both decrease
   (E) Canary’s decreases, snake’s increases

46. The copperhead has tiny leg bones along its skeleton. These structures are
   (A) mutations
   (B) homologous
   (C) analogous
   (D) vestigial
   (E) convergent

47. All of the following are true about endotherms EXCEPT
   (A) They inhabit a wide range of environments.
   (B) They typically become more active with warmer temperatures.
   (C) They maintain body temperatures higher than their surroundings.
   (D) They are all heterotrophs.
   (E) They evolved relatively later than ectotherms.

48. Which of the following characteristics distinguishes the canary from the copperhead?
   (A) Four-chambered heart
   (B) Thick-shelled eggs for survival on land
   (C) Vertebral column
   (D) Bony skeleton
   (E) Closed circulatory system
BIOLOGY E/M TEST—Continued

Red cabbage (*Brassica oleracea capitata rubra*) can serve as a natural indicator—it's pigments change color in response to varying pH levels. A student chops and boils half a red cabbage head for ten minutes and then strains it to obtain a purple liquid. The liquid is then cooled to room temperature and separated into beakers. The student adds various substances to each beaker and observes the changes.

<table>
<thead>
<tr>
<th>Additive</th>
<th>pH</th>
<th>Solution Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lemon juice</td>
<td>2.0</td>
<td>Pink</td>
</tr>
<tr>
<td>Vinegar</td>
<td>2.2</td>
<td>Pink-red</td>
</tr>
<tr>
<td>Baking soda</td>
<td>8.3</td>
<td>Blue-green</td>
</tr>
</tbody>
</table>

49. What can the student determine about red cabbage as a natural indicator?

(A) It turns pink in the presence of acids.
(B) It turns red in the presence of bases.
(C) It turns blue-green in the presence of acids.
(D) It is purple at a pH lower than 7.
(E) It is a poor indicator of acidic or basic solutions.

50. What would the student observe if sodium hydroxide (NaOH) was slowly added to the vinegar solution?

(A) The solution would turn from pink-red to purple to blue-green.
(B) The solution would turn from pink-red to pink to yellow.
(C) Nothing—the reaction has already occurred.
(D) A white precipitate would form at the bottom.
(E) The solution would turn clear.

51. Plants get much of their color from pigments, such as chlorophyll. What is the function of red cabbage pigments in nature?

(A) Indicate the pH of the soil
(B) Contribute to photosynthesis
(C) Keep down heat absorption
(D) None: vestigial structure
(E) Attract animals

52. When added directly to leaves of red cabbage, such as in salad, vinegar effects no color change. What best explains why?

(A) Vinegar is too weak a substance to change the indicator.
(B) Nothing can penetrate the epidermis of plant cells.
(C) Red cabbage neutralizes the vinegar.
(D) Hydrogen ions cannot independently cross cell membranes.
(E) The indicator only works at higher temperatures.
The common fruit fly (*Drosophila melanogaster*) is usually found with red eyes and normal wings. A series of experimental crosses were run to examine their recessive traits: white eyes and vestigial (shrunken) wings. In the F₁ generation, a female with red eyes and normal wings was crossed with a male having white eyes and vestigial wings. The results are given below.

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>F₁ Males</th>
<th>F₁ Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red eyes, normal wings</td>
<td>21</td>
<td>20</td>
</tr>
<tr>
<td>White eyes, normal wings</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Red eyes, vestigial wings</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>White eyes, vestigial wings</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>F₂ Males</th>
<th>F₂ Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red eyes, normal wings</td>
<td>62</td>
<td>123</td>
</tr>
<tr>
<td>White eyes, normal wings</td>
<td>59</td>
<td>0</td>
</tr>
<tr>
<td>Red eyes, vestigial wings</td>
<td>18</td>
<td>39</td>
</tr>
<tr>
<td>White eyes, vestigial wings</td>
<td>21</td>
<td>0</td>
</tr>
</tbody>
</table>

53. Based on the data, which of these characteristics is sex-linked in fruit flies?
   (A) Wing shape
   (B) Eye color
   (C) Vestigial wings
   (D) Red eyes
   (E) All of the above

54. What is the likelihood of observing female offspring with white eyes and vestigial wings in the F₂ generation?
   (A) Impossible: females cannot have white eyes
   (B) Much less likely than any other phenotype
   (C) As likely as seeing males with white eyes and vestigial wings
   (D) As likely as seeing females with red eyes and vestigial wings
   (E) Unable to determine without actually breeding flies

55. What is the ratio of phenotypes in F₂ males?
   (A) 4:1
   (B) 3:1
   (C) 3:3:1:1
   (D) 3:0:1:0
   (E) 1:1:1:1

56. If the allele for white eyes was dominant, approximately how many F₂ males would have white eyes (out of a possible 160 males)?
   (A) 20
   (B) 40
   (C) 60
   (D) 80
   (E) 120
BIOLOGY E/M TEST—Continued

An experimenter was testing the effects of temperature on egg production and hatching rates in fruit flies. She kept separate communities of 50 fruit flies at different temperatures, counting the eggs produced and hatchlings for each day of the experiment.

<table>
<thead>
<tr>
<th></th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>5°C</td>
<td>Eggs (total)</td>
<td>0</td>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Hatchlings</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20°C</td>
<td>Eggs (total)</td>
<td>3</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Hatchlings</td>
<td>0</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>30°C</td>
<td>Eggs (total)</td>
<td>4</td>
<td>20</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>Hatchlings</td>
<td>0</td>
<td>1</td>
<td>44</td>
</tr>
<tr>
<td>45°C</td>
<td>Eggs (total)</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Hatchlings</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

57. According to this data, the experimenter can conclude fertility rates of fruit flies are highest at temperatures near

(A) 5°C  
(B) 15°C  
(C) 30°C  
(D) 40°C  
(E) 50°C

58. The majority of egg production occurs between days

(A) 1–2  
(B) 2–3  
(C) 3–4  
(D) 4–5  
(E) after day 5

59. This graph best represents the experiment at

(A) 10°C  
(B) 20°C  
(C) 30°C  
(D) 40°C  
(E) 50°C

60. Constructing a hypothesis about fertility rates for fruit flies at different temperatures could be strengthened by

(A) conducting tests at temperatures higher than 45°C  
(B) measuring the growth of the individual organisms  
(C) increasing temperatures by 5°C each day  
(D) testing different species of insects  
(E) charting the survival of the original 50 flies on each day

GO ON TO THE NEXT PAGE
BIOLOGY E SECTION

If you are taking the Biology E test, continue with questions 61-80.
If you are taking the Biology M test, go to question 81 now.

Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Some questions pertain to a set that refers to a laboratory or experimental situation. For each question, select the one choice that is the best answer to the question and then fill in the corresponding oval on the answer sheet.

61. A particularly strong sensation is felt when
(A) a neuron fires an action potential with a greater charge than normal
(B) a neuron fires an action potential with a lower charge than normal
(C) a neuron fires an action potential that lasts a longer time than usual
(D) a neuron fires action potentials more frequently than usual
(E) interneurons rather than sensory neurons carry the action potential

65. In addition to gas exchange, the respiratory system helps regulate
(A) the immune response
(B) body temperature
(C) pH balance in the blood
(D) enzyme production
(E) osmotic pressure

66. A particular food chain consists of mice, which feed on grass, snakes that feed on the mice, and hawks, which feed on both mice and snakes. Rank the animals from most to least numerous in this particular environment.
(A) mice, snakes, hawks
(B) hawks, snakes, mice
(C) hawks, mice, snakes
(D) mice, hawks, snakes
(E) snakes, mice, hawks

62. All of the following are part of the cytoskeleton EXCEPT
(A) microtubules
(B) microfilaments
(C) flagella
(D) cilia
(E) ribosomes

63. As a means to avoid predators, an insect and a squirrel both develop flaps between their legs that allow them to glide in the air. This is an example of
(A) divergent evolution
(B) speciation
(C) convergent evolution
(D) coevolution
(E) biological magnification

64. The common house cat is inadvertently introduced to a small island that previously contained no cats. The cats begin to feed on local rodents, and the cat population grows very rapidly in the first few years, after which it begins to level off. At this point, the population of cats has reached the
(A) maximum yield
(B) carrying capacity
(C) tertiary level
(D) climax community
(E) extinction point
67. The area from II to III is known as the
   (A) pelagic zone
   (B) neritic zone
   (C) abyssal plain
   (D) intertidal zone
   (E) aphotic zone

68. What organismal characteristics are most likely found in zone IV?
   (A) Autotrophic
   (B) Exclusively unicellular
   (C) Heterotrophic
   (D) Highly advanced eyesight
   (E) Silicate shells

69. Of the following, which organism is LEAST likely to be found in the intertidal zone?
   (A) Heterotrophic clams
   (B) Photosynthetic kelp
   (C) Heterotrophic starfish
   (D) Chemosynthetic bacteria
   (E) Photosynthetic algae

70. The ocean participates in which of the following cycles?
   I. Water cycle
   II. Carbon cycle
   III. Nitrogen cycle

   (A) I only
   (B) I and II only
   (C) I and III only
   (D) II and III only
   (E) I, II, and III
Questions 71–75 refer to the following diagram.

71. Structure 6 is called a
(A) petal
(B) sepal
(C) ovule
(D) leaf
(E) stamen

72. The pollen tube runs through structure
(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

73. The function of structure 1 is to
(A) spread pollen
(B) receive gametes
(C) photosynthesize
(D) release pheromones
(E) emit spores

74. If pollinated, fruit will grow from structure
(A) 1
(B) 3
(C) 4
(D) 5
(E) 6

75. This could be an illustration of a
(A) brachyophyte
(B) conifer
(C) fungus
(D) dicot
(E) fern
A field biologist was studying the behavior of several similar species of warblers that had all recently been introduced to a national park. All the birds fed on the same leaf-eating insects on the same spruce trees at the same time of day. Over a period of several years, she observed the species' ranges of typical appearance in spruce trees, in terms of height.

76. The segregation of warblers in the tree demonstrates
(A) convergent evolution
(B) adaptation
(C) predation
(D) mutation
(E) climax community

77. An organism's niche is determined by which of the following factors?
(A) Habitat location
(B) Food
(C) Temperature
(D) Behavior
(E) All of the above

78. What is the primary consumer in this community?
(A) Cape May warbler
(B) Spruce
(C) Bay-breasted warbler
(D) Insect
(E) Blackburnian warbler

79. What can the experimenter conclude from her observations?
(A) Interspecies competition sorts warblers into different niches.
(B) Competing warblers kill off any intruders in their zone.
(C) The population of Blackburnian warblers falls dramatically in the presence of other species.
(D) Warblers will change their diets under new selection pressure.
(E) Spruce trees cannot support multiple species of warblers.

80. If a fungus killed off a large percentage of the spruces' insect populations in the park, which of the following is a predictable result?
(A) The warblers consume all the available insects and die off.
(B) The bay-breasted warbler replaces the other species.
(C) Each population of warbler species falls in number until a new carrying capacity is reached.
(D) Warblers migrate to new insect-rich forests.
(E) Different species mate to give rise to better-adapted warblers.
81. A nitrogenous base found in RNA but not in DNA is
   (A) adenine
   (B) guanine
   (C) cytosine
   (D) thymine
   (E) uracil

   T  t
   T  TT  Tt
   t  Tt  tt

   T=tall, t=short

82. Which of the following can be inferred from the Punnett square above?
   I. The genotypic ratio is 50% hybrid tall, 25% pure tall, and 25% pure short.
   II. The genotypic ratio is 75% tall, 25% short.
   III. The phenotypic ratio is 50% hybrid tall, 25% pure tall, and 25% pure short.
   IV. The phenotypic ratio is 75% tall, 25% short.
   V. These results are typically found in sex-linked inheritance.
   (A) I, IV
   (B) I, III, V
   (C) I, III
   (D) II, III
   (E) II, IV, V

83. Divergent evolution might result in
   (A) biological magnification
   (B) reproductive isolation
   (C) analogous traits
   (D) mutations
   (E) succession

84. Which of the following can greatly affect the speed of an enzymatic reaction?
   I. Temperature
   II. pH
   III. Presence of coenzymes or inhibitors
   (A) I only
   (B) II only
   (C) III only
   (D) I and III only
   (E) I, II, and III

85. What principle states that in a large, randomly mating population in which evolutionary forces such as selection, migration, and mutation do not occur, the allele and genotype frequencies will remain constant from generation to generation?
   (A) Natural selection
   (B) Homeostasis
   (C) Balanced mutation
   (D) Stabilizing selection
   (E) Hardy-Weinberg equilibrium

86. Of the following, which statement is true of glycolysis?
   (A) Breaks glucose down to pyruvate
   (B) Also called fermentation
   (C) Produces no ATP
   (D) Not part of the aerobic respiratory pathway
   (E) Occurs inside mitochondria
Cystic fibrosis (CF) is caused by gene mutation on an autosomal chromosome, where a single nucleotide is omitted during the copying of a normal DNA sequence.

87. This type of mutation is known as
   (A) frameshift
   (B) point mutation
   (C) insertion
   (D) silent mutation
   (E) crossing-over

88. The CF gene is recessive. Assuming his genes are not the product of mutations, a CF patient must have inherited CF genes from
   (A) mother only
   (B) father only
   (C) both parents
   (D) mother if the child is male
   (E) one parent who is a CF patient

89. Mutations can occur during
   I. transcription
   II. translation
   III. meiosis
   (A) I only
   (B) II only
   (C) III only
   (D) I and II only
   (E) I, II, and III

90. Why are frameshift mutations particularly dangerous?
   (A) They shorten the length of chromosomes.
   (B) No other mutation changes phenotypes.
   (C) They prevent transcription from occurring.
   (D) They affect all codons following the mutation.
   (E) Future offspring will be sterile.
Questions 91–96 refer to the following figures of molecules.

91. What reaction occurs when two molecules of Figure 3 combine?
   (A) Glycolysis
   (B) Dehydration synthesis
   (C) Hydrolysis
   (D) Phosphorylation
   (E) Oxidation

92. What type of bond is formed in the above reaction?
   (A) Hydrogen
   (B) Peptide
   (C) Double
   (D) Triple
   (E) Polymer

93. When two molecules of Figure 5 combine, what is the resulting chemical formula?
   (A) C_{n-n}H_{2n-1}O_{n-1}
   (B) C_{n-1}H_{2n-1}O_{n-1}
   (C) C_{n-2}H_{2n-3}O_{n-1}
   (D) C_{n-3}H_{2n-5}O_{n-1}
   (E) C_{n-4}H_{2n-7}O_{n-1}

94. Which of these molecules readily forms polymers?
   I. Figure 1
   II. Figure 2
   III. Figure 4
   (A) I only
   (B) II only
   (C) III only
   (D) II and III only
   (E) I, II, and III

95. The phosphate group in Figure 1 becomes the molecule's
   (A) hydrophilic head
   (B) hydrophobic head
   (C) active site
   (D) functional group
   (E) hydrophobic tail

96. Figure 2 is a
   (A) nucleotide
   (B) carbohydrate
   (C) polypeptide
   (D) steroid
   (E) triglyceride
BIOLOGY M SECTION—Continued

In constructing evolutionary relationships, scientists examine sequences of nucleotides or amino acids from molecules common to all organisms, such as hemoglobin. By identifying the relative differences in the sequences between species, scientists can chart degrees of evolutionary relatedness: the smaller the dissimilarity, the closer the relation. The following table records differences in the amino acid sequences of beta-hemoglobin from seven different species of primates.

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Figure 1

A phylogenetic tree can be built from this data to show when and how organisms diverged.

46 million years ago

present

Figure 2

97. What organism should be listed in the branch labeled E?

(A) Lemur  
(B) Squirrel monkey  
(C) Gorilla  
(D) Gibbon  
(E) Rhesus monkey

GO ON TO THE NEXT PAGE
98. Based on this evidence, which of these organisms share the most recent common ancestor?
   I. Humans and gorillas
   II. Gorillas and chimpanzees
   III. Humans and gibbons

   (A) I
   (B) II
   (C) III
   (D) I and II
   (E) I, II, and III

99. Which of the following statements is true?
   (A) Humans evolved from modern-day lemurs.
   (B) Humans and lemurs share a common ancestor.
   (C) Humans are not related to lemurs.
   (D) Lemurs look just like their ancestors did millions of years ago.
   (E) Humans and lemurs demonstrate convergent evolution.

100. Relative to the other primates, a horse actually demonstrates fewer differences in amino acids (~28) for beta-hemoglobin than does a lemur. What best explains this?

   (A) Humans are more closely related to horses than lemurs.
   (B) The horse is a mutant.
   (C) The same amino acids can be coded for by very different sequences of nucleotides.
   (D) Molecular methods for identifying evolutionary relationships don't work.
   (E) The evolutionary tree for horses has few branches.

STOP
IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS TEST ONLY. DO NOT TURN TO ANY OTHER TEST IN THIS BOOK.
## Answers to SAT II Biology Practice Test I

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Calculating Your Score

Your raw score for the SAT II Biology test is based on the number of questions you answer correctly and incorrectly. Once you have determined your raw score, use the conversion table on page 18 of this book to calculate your scaled score.

To Calculate Your Raw Score

1. Count the number of questions you answered correctly: ________ (A)
2. Count the number of questions you answered incorrectly and multiply that number by $\frac{1}{4}$: ________ (B) $\times \frac{1}{4} = ________ (C)$
3. Subtract the value (C) from the value in (A): ________ (D)
4. Round the number in (D) to the nearest whole number.
   This is your raw score: ________ (E)

Biology E/M Classification Questions

1. B Organic and Biochemistry
   Monosaccharides, such as glucose, are carbohydrates that contain carbon, hydrogen, and oxygen in a 1:2:1 ratio.

2. C Organic and Biochemistry
   Lipid compounds usually contain nonpolar hydrocarbon chains, which are not soluble in water.

3. A Organic and Biochemistry
   Enzymes, which catalyze biological reactions, are protein molecules, consisting of one or more chains of amino acids.

4. D Ecology
   Because energy is lost between each level of the food pyramid, there is progressively less biomass as the levels become more complex. Therefore tertiary consumers, at the top of the pyramid, have the fewest organisms.

5. A Ecology
   Producers create glucose molecules from carbon dioxide and sunlight through the process of photosynthesis.
6. C Ecology
Omnivores are animals that eat both plants and other animals. They are not primary consumers because of the fact that they eat other animals, but they are usually not tertiary consumers because they eat plants as well. They are most often secondary consumers.

7. D Cell Processes
In glycolysis, glucose is enzymatically broken down to pyruvic acid. Glycolysis leads the way for either anaerobic or aerobic respiration (Krebs cycle), depending on the presence of oxygen. Glycolysis is one of the oldest energy-producing reactions to evolve in living organisms.

8. A Cell Processes
In the Krebs cycle (or citric acid cycle), acetyl-coenzyme A reacts with oxaloacetate to form citric acid. The oxaloacetate is regenerated while acetyl-CoA is oxidized to CO₂.

9. E Cell Processes
In fermentation, yeast is added to a sugar solution (like fruit juice) and denied oxygen. Anaerobic respiration occurs, with the by-product of ethanol.

10. B Organismal Biology
Habituation is when an animal’s reaction to a repeated stimulus is lessened or disappears, so long as the stimulus does not cause any damage. This is a temporary behavior: if the stimulus is halted for a period and restarted, the animal will no longer ignore it.

11. C Organismal Biology
Conditioning is when an animal learns to associate two stimuli, one of which is usually neutral. The classic example is Pavlov’s experiment. Whenever Pavlov fed his dogs, he rang a bell. Soon the dogs began to salivate at the sound of the bell, even if there was no food in sight.

12. A Organismal Biology
Imprinting is an instinctive reaction to a stimulus that triggers a social bond, such as when a baby bird imprints “mother” on the first moving thing it sees. This moving object is usually its mother in the wild, but scientists have gotten birds to imprint on a variety of objects, including balloons and humans.
13. **E** Evolution and Diversity

Similarities between organisms are most pronounced at the species level. Differences between organisms are most obvious at the kingdom level. A Persian cat and a tabby cat (species level) are far more similar than a sponge and an elephant (kingdom level). The sequential order of taxonomic divisions is kingdom-phylum-class-order-family-genus-species. Members of a family will have more in common than members of an order. Members of a phylum will have more in common than members of a kingdom but less in common than members in a class, order, family, or species.

14. **E** The Cell

Levels of cellulose would be significantly higher in the plant cell sample because the cell walls of plants are made out of cellulose, while animal cells do not have cell walls or cellulose.

15. **D** Ecology

Only D fits the definition of exponential growth, which refers to unlimited growth. All of the other answers are examples of limited growth, except for answer E, which is not growth at all and should be eliminated right off the bat. Note that exponential growth is not really possible in nature, as there will always be some factor limiting this growth.

16. **B** Organismal Biology

Red blood cells contain hemoglobin, which binds to oxygen in the lungs and delivers it to the body's tissues. If there are too few red blood cells or if their hemoglobin content is too low, then this could cause a person to become anemic. A common variant is sickle cell anemia, a condition in which red blood cells are distorted and sickly, unable to carry as much oxygen to the body.

17. **E** Evolution and Diversity

Natural selection refers to the mechanism of evolution proposed by Charles Darwin. It asserts that organisms produce more offspring than can survive, and these organisms compete for limited natural resources. Because of variations in genotype within species, some organisms have phenotypes that offer a better chance for reproduction and survival. Therefore, these adaptive characteristics will appear in future generations by natural selection. The theory of acquired characteristics E was part of an evolutionary theory, proposed by Lamarck, that collapsed under scientific scrutiny.
18. **D** Ecology
An ecological community consists of a group of populations that coexist and interact within a specific environment. Combined with nonliving factors such as soil, weather, and geography, the community is known as an ecosystem.

19. **A** Organic and Biochemistry
Proteins are amino acids linked together in a chain called a polypeptide. Answer **B** is wrong because amino acids do not generally form rings. Answer **C** describes a nucleic acid, answer **D** describes a carbohydrate, and answer **E** describes a lipid molecule.

20. **E** Genetics
When DNA is transcribed to RNA, RNA bases pair with DNA bases to form an RNA molecule that is the inverse copy of the original DNA strand. DNA’s thymine pairs with RNA’s adenine, guanine pairs with cytosine, cytosine pairs with guanine, and adenine pairs with uracil (because RNA does not contain thymine). In other words, in the RNA sequence, DNA’s T becomes A, G becomes C, C becomes G, and A becomes U. Therefore, choice **E** is the correct RNA sequence. Given that thymine (T) is not present in RNA, you should have been able to eliminate choices A, C, and D quite easily.

21. **A** Organismal Biology
The correct answer is **A**. When an embryo implants into the uterine lining, it releases human chorionic gonadotropin (HCG), which prolongs the life of the corpus luteum in the ovary. The corpus luteum then continues to release progesterone, and the uterine lining remains to support the developing embryo.

22. **E** Evolution and Diversity
Far from describing how a gap in the fossil record might arise, **E** actually describes the first phase of fossil formation. All of the other choices give plausible reasons why gaps in the fossil record might appear.

23. **D** The Cell
The fact that the DNA molecule is circular and the cell does not have a nucleus means that the cell is prokaryotic. Prokaryotes do not contain membrane-bound organelles, such as chloroplasts, so we can eliminate choices A, C, and E. Prokaryotic cells can, however, possess a simple cell wall made of peptidoglycan, and every living cell contains ribosomes. Thus, the correct answer is D, II and III only.

24. **D** Ecology
In the nitrogen cycle, special nitrogen-fixing bacteria take the N₂ from the atmosphere and convert it into a form that plants can use, such as ammonia (NH₃) or nitrate (NO₃).
25. C  Evolution and Diversity
Monerans are prokaryotes—single-celled organisms that lack a membrane-bound nucleus and membrane-bound organelles. Fungi and plants are single-celled or multicellular eukaryotes and have a membrane-bound nucleus and organelles.

26. A  Evolution and Diversity
The Earth's early atmosphere was composed of water, methane, hydrogen, and ammonia. Anaerobic organisms that didn't require oxygen predominated. Early autotrophs released oxygen as a waste product, and over time, free oxygen gas became a major component in the atmosphere.

27. B  Organismal Biology
If a blood vessel has muscular walls, it is an artery and not a vein. All arteries carry blood away from the heart. Remember that while arteries typically carry oxygenated blood, this is not always true—the pulmonary arteries, going from the heart to the lungs, carry deoxygenated blood.

28. B  Ecology
The producers, at the bottom of the food pyramid, receive their energy from the sun and possess the largest energy of all the trophic levels. As it is passed from level to level, energy is lost to heat and biological processes (e.g., respiration), and in the end only about 10 percent of it gets passed on to each succeeding level.

29. B  Cell Processes
If while doing exercises, your muscles use up available oxygen, the cells will produce lactic acid, which causes a burning sensation, muscle fatigue, and muscle soreness. A and D are components of glycolysis. A, C, D, and E are found in the Krebs cycle.

30. D  The Cell
Lysosomes are small, membrane-bound packages of enzymes that have the ability to break down aging cell structures or, in the case of white blood cells, foreign bodies that are ingested into the cell by endocytosis. A good strategy would be to eliminate answer C right away because chloroplasts are not found in animal cells and answer E because chromosomes are simply formations of genetic material that condense during cell division, which has nothing to do with the function of the white blood cell. Ribosomes serve as the sites of protein synthesis, a function unrelated to the digestion of harmful bacteria. Peroxisomes, like lysosomes, are membrane-bound structures containing enzymes, but the enzymes in peroxisomes help to break down fats and protect the cell from toxic hydrogen peroxide.
31. **B** Cell Processes
You should know that the Calvin-Benson cycle is the last stage of photosynthesis. Since light affects the earliest part of photosynthesis, the Calvin cycle is also known as light-independent photosynthesis, or the “dark reactions.” ATP and NADPH produced by the “light reactions” of photosynthesis provide the energy for the fixation of carbon from CO₂ into glucose; however, the Calvin cycle itself needs no light to operate.

32. **A** Cell Processes
All of photosynthesis occurs inside the chloroplasts of plant cells. Since no other answer choice is inside chloroplasts, you should quickly identify A as correct. The inner space of the chloroplast, called the stroma, is the site of the Calvin cycle.

33. **B** Organic and Biochemistry
Adenosine triphosphate is the energy currency of all cells. Its three phosphate groups (triphosphate) form high-energy bonds, one of which is broken to provide energy for photosynthesis. When a molecule of ATP loses a phosphate group, it becomes ADP, or adenosine diphosphate.

34. **B** Cell Processes
Photosynthesis produces 3-carbon molecules that combine to form glucose (C₆H₁₂O₆). However, plants store glucose as starch, a polysaccharide consisting of long chains of glucose molecules. Sucrose **A** is a disaccharide of glucose and fructose molecules and not the preferred storage molecule. Although some glucose is synthesized into cellulose **C** for cell walls, plants do not retrieve glucose from cellulose, so it is not storage. Glycogen **D** is the glucose storage favored by animals.

35. **A** Cell Processes
In comparing the similarities of the Calvin and Krebs cycles, you can immediately eliminate the wrong answers for either one. The Calvin cycle consumes ATP rather than producing it, as apparent in the diagram, which rules out B. Photosynthesis occurs in chloroplasts, which negates C. The Krebs cycle of aerobic respiration consumes oxygen rather than producing it D. Finally, many prokaryotes are heterotrophs, unable to photosynthesize **E**. You could also answer with the definition of the word cycle. The Calvin cycle starts when ribulose bisphosphate (RuBP) joins with carbon dioxide. After a series of chemical changes, the RuBP is regenerated to start the whole thing over. Similarly, the Krebs cycle, sometimes called the citric acid cycle, begins when oxaloacetic acid joins acetyl-CoA to form citric acid. By the end of the cycle, oxaloacetic acid is regenerated.
36. C Organismal Biology
Tropisms are plants’ responses to specific stimuli, including light, gravity, and touch. They are “positive” when the plant responds in the direction of the stimulus and “negative” when the plant draws away from the stimulus. In the case of the shoots, they turn downward in the direction of gravity, which is positive gravitropism. Since there is no light allowed in the box, the shoots cannot react either positively or negatively to it; phototropism is not an option. Thigmotropism A is a plant’s response to touch.

37. B Organismal Biology
Keeping the seeds in a dark box eliminates the possibility of phototropism. In effect, it decreases the variables acting on the seeds. A is incorrect, as the experimenter does not observe what occurs after their emergence from the box; temperature E is also not part of the experiment. Although the box may simulate subterranean darkness, this is part of the control for testing tropisms, which occur in many different environments.

38. A Organismal Biology
You should know that auxin is a common plant hormone affecting cell elongation. Auxin has been shown to function in plants’ growth in response to stimuli. Lactic acid B is a by-product of anaerobic respiration. Associative behavior C implies that plants can learn and have brains. Nitrogen D is an important chemical for plants but does not directly cause cell growth. Excess carbon dioxide E is incorrect, as plants exhibit tropisms in equal distributions of carbon dioxide, such as in nature.

39. A Organismal Biology
Since the dish 1 seedlings are kept in the dark, photosynthesis cannot occur. All of the other answer choices can be eliminated. The plants do undergo glycolysis D as a part of respiration B. The plants must undergo mitosis C to grow. They also absorb the water from the damp cotton E.

40. A The Cell
Concentration differences across a membrane will cause diffusion to balance the concentrations; for water, this diffusion is called osmosis. In the diagram, the concentration of sodium ions is higher outside the cell. However, since they are ions, they cannot diffuse across the cell membrane’s hydrophobic interior by themselves. Instead, water flows out of the cell by osmosis to try and balance the concentrations across the membrane.

41. D The Cell
The tonicity of a solution is defined by how much solute it has relative to what’s in it. The diagram shows a higher concentration of sodium ions outside the cell. Therefore,
the solution is hypertonic: it has a higher concentration of solute than the cell it surrounds. As a guideline, cells commonly shrink in hypertonic solutions. Solutions are isotonic C when they have the same concentrations of solutes as whatever is in them. A hypotonic solution A is the opposite of hypertonic, having less solute than what it contains, as when cells are put in distilled water.

42. B The Cell
When solutes cannot pass membranes on their own, they must be transported. Sodium ions want to move down their concentration gradient into the cell by diffusion. However, since ions cannot cross the membrane by themselves, simple diffusion is out A. They require a protein to facilitate their diffusion. Think of it as passive transport. Active transport C pumps ions against their concentration gradient; in this case, as if sodium ions were moving out of the cell. Osmosis D refers to water alone. Phosphorylation E has nothing to do with this scenario.

43. A The Cell
Cell membranes are made up of many molecules of phospholipids, which arrange themselves into two opposing layers, often called bilayers. The phospholipids’ hydrophilic heads (the phospho- part) align to form membranes’ external surfaces, while hydrophobic tails (the lipid part) arrange themselves in the interior space of the membrane.

44. C The Cell
To pass through cell membranes independently, a molecule must be very small and have no charge. Water easily passes through cell membranes by osmosis. Other small, uncharged molecules may pass by diffusion, including the gases nitrogen (N₂), carbon dioxide (CO₂), and oxygen (O₂). Glucose (C₆H₁₂O₆) is too large to cross the membrane by itself.

45. C Evolution and Diversity
To answer this question, you must know that snakes, like all reptiles, are ectothermic, or cold-blooded. Their body temperatures and processes are affected by the surrounding temperature; hence, a snake’s metabolism will slow down in colder air. Birds and mammals are endothermic, or warm-blooded, and able to maintain a constant temperature in fluctuating temperatures. The canary’s metabolic rate will remain stable.

46. D Evolution and Diversity
The withered leg bones serve no use to the copperhead and are remnants of a distant ancestor. They are vestigial structures. A is incorrect, because although evolution works through random mutation, the appearance of legs is extremely unlikely to result from a single mutation. Homologous structures B are versions of a particular feature
from an ancestor that, through divergent evolution, have taken on varying forms in different animals, such as the forelegs of a horse and the flippers of a whale. Analogous structures C, such as the wings of birds and butterflies, are a product of convergent evolution and share no direct ancestral source.

47. B Evolution and Diversity
Because endotherms can regulate body temperature to maintain a constant level, the activity or metabolic rates of endotherms are not directly affected by changes in surrounding temperatures, so B is the answer.

48. A Evolution and Diversity
This question asks about evolutionary diversity and what animals have evolved greater complexity. As vertebrates, both birds and snakes share answers C, D, and E. Reptiles also have tough-skinned eggs for laying on land B, though amphibians do not. However, both reptiles and amphibians have three-chambered hearts, while all birds and mammals evolved four-chambered hearts. Memorize this progressive sequence of evolution in major groups of animals: fish, amphibians, reptiles, birds, and mammals.

49. A Organismal Biology
This question asks you to identify the general properties of an indicator from specific data. The solution turns pink in the presence of acids, such as lemon juice and vinegar. Acids have a pH lower than 7. The indicator solution is purple at neutral pH (7) and blue-green in the presence of bases, which have pHs higher than 7.

50. A Organic and Biochemistry
Indicators can change gradually during a pH change, which makes them effective at distinguishing between solutions. Sodium hydroxide (NaOH) is a strong base, and the vinegar solution is acidic. If NaOH was slowly added to the solution, the indicator would change from pink-red (acidic) to purple (neutral) and finally to blue-green (basic). B and E are wrong, as there is no data suggesting that the solution would turn yellow or clear. C is false, as indicators can change gradually, and D is wrong, as the addition of a base to an indicator does not form white precipitate.

51. B Organismal Biology
If you don’t know about plant pigments, the mention of chlorophyll should give this away. Pigments absorb light and transform the energy for use in photosynthesis. Chlorophyll is not the only pigment that contributes to this process. There are two types of chlorophyll, a and b, as well as other pigments in plants. A is incorrect, as cabbages could not perceive their own color change. C is false, as color absorbs rather than reflects light energy for heat. There is no reason to believe that redness is a vestigial characteristic B. It is also not in the best interests of a cabbage to be eaten E.
52. **B** Organismal Biology

Acids and bases can be defined by the types of ions they release. Acids, such as HCl, release a hydrogen ion (H⁺) into solution, and bases, such as NaOH, release a hydroxide ion (OH⁻). These ions cannot cross cell membranes on their own to interact with the indicator inside the red cabbage. Remember: the red cabbage had to be pulverized and boiled, which broke membranes and released the indicator pigment into solution. Answers A, C, and E are directly contradicted by the data given for the experiment. B is wrong, because the epidermis of plants is frequently crossed during gas exchange and transpiration.

53. **B** Organismal Biology

Sex-linked traits appear in different ratios between males and females. Because males have only one X chromosome, they are much more likely to express X-linked traits. The table data shows that there are no females with white eyes, whereas there are males with white eyes, so eye color is an X-linked trait. Answer D is incorrect, as eye color has two alleles for red and white. Male and female offspring with normal vs. vestigial wings have a common phenotype ratio of 3:1, common to autosomal traits, so A and C are also false.

54. **B** Genetics

Punnett squares are good for numbers and ratios, but you can answer this question about the probability of offspring by elimination and logic. Throw out E right away: the core of Mendelian genetics is that the results of genetic crosses are predictable. Since white eyes are a recessive trait, they will not occur more frequently than dominant red eyes, so D can be quickly eliminated. Similarly, as always with X-linked traits, its frequency in males is much higher than in females, eliminating C. A is incorrect, as it is possible for a female to express an X-linked recessive trait if she receives the allele from both male and female parents. Although no F₂ females have white eyes, some are carriers of the recessive white eyes allele. These F₂ females need only mate with a white-eyed male with at least one recessive allele for vestigial wings to have a chance at producing a white-eyed, vestigial-winged female.

55. **C** Organismal Biology

Phenotype ratios are comparisons of different traits appearing in individuals. By looking at the data, you can see that there are four different phenotypes (eye colors and wing shapes) for F₂ males. Therefore, you can immediately eliminate A and B, which have only two phenotypes, and also D, which has zeros. Some phenotype counts are three times as large as others, so E is also false. Calculating the ratio is simple arithmetic: divide each amount by the largest-possible factor that still gives whole numbers; in this case, 20. Often the numbers will not be exact, but you should be able to round to the nearest value that gives sensible results.
56. D Genetics  
Although X-linked traits are typically recessive, males with the allele will express the trait whether it's dominant or recessive, because males only have one X chromosome to begin with. You would observe the same number of white-eyed males in either case. Count up the total number of white-eyed F2 males to get 80. Wing shape has no bearing on eye color and doesn't affect your count.

57. C Organismal Biology  
Fertility rates would be highest when egg production and hatchlings are both at their maximums. Data in the table shows that the highest numbers of eggs and hatchlings produced are found at 30°C.

58. C Organismal Biology  
To find the time of greatest egg production, look at successive columns in the table for the largest day-to-day increases in eggs. Although there are more total eggs on day 5, the greatest net increase occurs between days 3 and 4. No information is given about egg production after day 5, so E is not valid.

59. A Organismal Biology  
This graph shows egg production increasing with time but with a very low rate of hatching. The closest measurement to this trend in the table is at 5°C, and A is the closest match. Temperatures above 10°C would have higher hatching rates. Temperatures near 45°C produce few hatchlings, but there are also virtually no eggs produced.

60. E Organismal Biology  
Experiments are strengthened by identifying and controlling variables. This question asks you to consider what variable is important to fertility rates in fruit flies when temperature is tested. A would likely add no significant data, as very few eggs or hatchlings would be produced at high temperatures. B could possibly relate to fertility but does so indirectly. C changes the variable being tested—temperature—and D would shed no light on fruit flies. E is correct: if the fruit flies themselves do not survive, they cannot produce eggs. Losses in the parental generation greatly affects the ability to compare data across the table.
Biology E Solitary Multiple Choice

61. D  Organismal Biology
A strong sensation has nothing to do with a "stronger" action potential or a longer-lasting potential. In fact, the voltage and duration of action potentials usually remain constant in a neuron. Sensation also has nothing to do with the type of neuron carrying the potential. Rather, the frequency of action potentials affects the intensity of the sensation as perceived by the brain.

62. E  The Cell
The cytoskeleton is a network of protein fibers within the cellular cytoplasm that gives shape and movement to the cell. Microtubules are strong hollow rods that act as internal scaffolding, and microfilaments are protein fibers made of actin found on the perimeter of the cell. Flagella and cilia are built from microtubules and thrash around as the cell's propulsion source. Among the answer choices, only E, ribosomes, are not a part of the cytoskeleton.

63. C  Evolution and Diversity
Convergent evolution describes the evolution of similar traits, either physical or behavioral, in two unrelated species responding to similar selection pressure. Divergent evolution and speciation result in two related populations becoming more dissimilar; hence, choices A and B can be eliminated. Coevolution refers to the evolution of adaptations in one species in response to new adaptations in other species; for instance, the hummingbird's long, narrow bill for obtaining nectar has coevolved with long, tubular flowers that depend on the bird for fertilization. Bioaccumulation (or biological accumulation or biological magnification) refers to the accumulation up the trophic layers of toxic substances occurring in the environment.

64. B  Ecology
The carrying capacity of an environment is the maximum population of a particular organism that environment can sustain, limited by food supplies, space, and other factors. When the population of the cats on the island levels off, it has reached the point of carrying capacity on the island.

65. C  Organismal Biology
The respiratory system helps regulate pH balance by speeding up or decreasing respiration rate based on the levels of carbonic acid in the blood. By regulating the levels of carbon dioxide (the source of carbonic acid) through gas exchange in the lungs, the system regulates the overall blood pH.
66. **A** Ecology
In the food pyramid, the organisms at the bottom of the pyramid will be more numerous, and as you go higher up the pyramid, the numbers will decrease. Tertiary consumers, such as the hawk in this example, will be fairly uncommon.

**Biology E Group Multiple Choice**

67. **B** Ecology
The marine (saltwater) biome can be divided into several parts, or zones. Closest to the shore, with alternating states of being submerged and dry, is the intertidal zone D, also known as the littoral zone. The next zone out, and the correct answer for this question, is the neritic zone, which extends to the continental shelf, or a depth of about 300 meters. Beyond that is open ocean, or the pelagic zone **A**. The abyssal plain **C** refers to land at the deep bottom of the ocean. The aphotic zone **E** is deep ocean lying beyond the penetration of sunlight.

68. **C** Ecology
Based on the diagram, zone IV is below the continental shelf and at a depth beyond the reach of sunlight. This is the aphotic zone: “a-” for absence and “-photo” for light. Of the answer choices, the correct organismal characteristic for this zone is heterotrophy. Because there is no light, autotrophs **A** cannot photosynthesize. Additionally, there is no light for advanced eyesight **D** to be useful. There are many multicellular organisms found here (e.g. giant squid), which eliminates **B**, and these organisms do not necessarily have silicate shells **E**.

69. **D** Ecology
Chemosynthetic bacteria are autotrophs that make their own food in the presence of certain chemicals. In the oceans, they are typically found near deep geothermal vents. All of the other answer choices are organisms frequently found in the intertidal (or littoral) zone.

70. **E** Ecology
As they cover two-thirds of the Earth’s surface, you wouldn’t be reaching to guess that oceans participate in the water, carbon, and nitrogen cycles. Obviously, they participate in various aspects of the water cycle, including evaporation and runoff. Carbon dioxide dissolved in the ocean and the organic materials from organisms are examples of the ocean’s involvement in the carbon cycle. Nitrogen-fixing bacteria and organic excretion found in the ocean represent aspects of the nitrogen cycle.
71. **B** Organismal Biology
When a plant forms flower buds, it encases the developing structures in a case of specialized leaves, called sepals. Once the flower opens, these greenish leaflike structures have served their protective purpose and remain under the petals.

72. **C** Organismal Biology
Pollen grains land on the flower’s stigma, which is the uppermost part of the pistil—the female sexual organ of flowering plants. The pistil’s long supporting column is called the style **C**, through which pollen grains descend in a pollen tube to reach the ovule and fertilize the plant.

73. **A** Organismal Biology
A flowering plant’s male sexual component is called the stamen. Unlike the pistil, there are typically more than one stamen found in flowers. A stamen consists of a supporting column, called a filament, and a pollen-producing head, called an anther, which is identified as structure 1 in the diagram. The anther’s function is the production and distribution of pollen.

74. **D** Organismal Biology
Pollen grains, having landed on the pistil’s stigma, descend through a pollen tube to reach the plant’s female gametes, called ovules. The mature ovules become the plant’s seeds, and the surrounding ovary tissue develops into its fruit.

75. **D** Organismal Biology
Flowers only appear in angiosperms. Among the answer choices, only **D**, dicot, is a member of the angiosperm division.

76. **B** Ecology
*Laboratory*
Species sharing the same niche will compete for resources and survival until one is displaced or eliminated or their niches have diverged sufficiently for coexistence. When the different warbler species are simultaneously introduced to the same habitat, they compete for food. Over time, each species begins to feed at different locations within the spruce trees as a result of behavioral adaptation. An adaptation is any biological or behavioral change that allows an organism to increase its chances of survival. The only other conceivable answer choice, mutation, **D**, refers to changes in genetic code, which is not necessarily required for behavioral adaptations to appear.
77. E Ecology
An organism’s niche describes its unique position within a community, including physical factors such as food, climate temperature, and habitat location and behavioral factors, such as the feeding locations of different species of warblers in spruce trees.

78. D Ecology
Primary consumers feed on autotrophic primary producers. In this community, the primary producer is the spruce, and the primary consumer is the leaf-eating insect.

79. A Ecology
The warblers all initially share the same niche. This competitive situation creates new selection pressures, and the warblers adapt different feeding locations to survive. Based on the given observations, competition between species sorts them into different niches. B is false, as there are no observations of violence among the warblers. C seems logical, but the experimenter observed feeding locations and not population size; it is also conceivable that the Blackburnian warbler population didn’t shrink. The warblers continue to eat the same insect, ruling out D, and their segregation into different zones in spruce trees falsifies E.

80. C Ecology
Prey and predator relationships often follow cycles of boom and bust. An increase in available prey will likely increase the predator population. With more predators, more prey is eaten, and eventually this consumption causes a drop in the prey population. The predator population subsequently falls without an abundant food source. Though dynamic, these cycles find an equilibrium through time. If the warblers’ food source dramatically drops, so will the carrying capacities of warbler populations, which will fall to levels that the food source can sustain. A is unlikely. There is no evidence to support B, or that any warbler species has a distinct advantage over the others. D is a possibility but not a predictable result. E defies the common definition of species, which are typically unable to successfully interbreed.

Biology M Solitary Multiple Choice

81. E Cell Processes
Uracil is found exclusively in RNA. Thymine occurs only in DNA. The other bases all occur in both.
82. A  Genetics
A Punnett square depicts possible combinations of genetic crosses and the resulting offspring. The dominant allele is capitalized; hence, in this example, T (tall) is dominant over t (short). The male contribution is listed on top of the square and the female contribution is listed on the left-hand side of it. The Punnett square above indicates that the genotypic ratio (that is, the composition of the genes) is 25 percent tall (TT), 25 percent short (tt), and 50 percent hybrid tall (Tt). The phenotypic ratio, which refers to the physical characteristics of the offspring, indicates that 75 percent are tall (TT and Tt) and 25 percent are short (tt). These Punnett square results are typical of a simple single-trait Mendelian cross and do not reflect the outcome of a cross involving sex-linked traits.

83. B  Evolution and Diversity
Divergent evolution is the process in which organisms with a common ancestor evolve in different directions. Ultimately, divergent evolution will transform the organisms into distinct species because they will be so different that they can no longer reproduce. Divergent evolution therefore leads to reproductive isolation. Biological magnification A is an ecological phenomenon in which chemical substances become more concentrated as they travel up the food pyramid. Analogous traits C are produced by convergent evolution. Mutations D might help cause divergent evolution, but they are not caused by it. And succession E refers to the changing ecological characteristics of a certain geographical location.

84. E  Organic and Biochemistry
All of these factors can change the speed of an enzymatic reaction or even cause it to completely stop. Enzymes usually operate under very narrow temperature and pH conditions, and many work in conjunction with smaller proteins known as coenzymes or only in the absence of other molecules known as inhibitors that can stop the reaction.

85. E  Evolution and Diversity
The Hardy–Weinberg equilibrium describes allele and genotype frequencies in the absence of evolutionary forces. It states that in the absence of selective or geographic pressures, the overall allele frequencies in a population remain constant, and evolution stops. Natural selection A is the mechanism of evolution proposed by Darwin. Homeostasis B refers to maintaining a stable internal equilibrium (such as a constant core body temperature) or physiological environment. Balanced mutation C describes the rate at which copies of an allele are lost to mutation equals the rate at which new copies of the allele are created by mutation. Stabilizing selection D refers to a type of natural selection in which extreme individuals (mutant forms) are eliminated.
86. A Cell Processes
Glycolysis breaks glucose down into two molecules of 3-carbon pyruvate, which, depending on the presence of oxygen, then follows either an aerobic or anaerobic respiratory pathway. Therefore, B is false: glycolysis is a part of fermentation, but it is not all of fermentation. Glycolysis produces two ATP, eliminating C. Glycolysis is also the first step of the respiratory chain D. It occurs outside the mitochondria E, in the cytoplasm.

Biology M Group Multiple Choice

87. A Genetics
Genetic mutations can find frequent opportunities to occur during the copying and translating of millions of nucleotides in the lifetime of DNA strands. If a single nucleotide is omitted or added during the copying of DNA, a frameshift error results. There are two types of frameshift errors: insertion C, when a new nucleotide is sandwiched into the existing sequence, and deletion, when a nucleotide is skipped or omitted. Cystic fibrosis is a deletion frameshift error. A point mutation B is the substitution of an original nucleotide for a different one; it does not shift the frame for codons. A silent mutation D is any genetic mutation that does not express a phenotypical change. Crossing-over E occurs when chromosomes overlap and exchange genetic material in mitosis or meiosis.

88. C Genetics
Autosomal recessive traits appear only if the offspring receives a recessive allele from both parents. (As initially stated in this question group, CF appears on an autosomal chromosome.)

89. E Genetics
Mutations can occur during the copying of DNA, its transcription to mRNA, and translation during protein synthesis. Mutations can also occur during meiosis, when all of a cell’s chromosomes (wrapped strands of DNA) are copied. Meiosis is also an occasion for the exchange of genetic materials on overlapping chromosomes in an event called crossing-over.

90. D Genetics
Nucleotides are grouped in threes, called codons, which are translated into amino acids during protein synthesis. With the insertion or deletion of a single nucleotide, a frameshift error changes which nucleotide triplets are read as codons for the entire length of the DNA sequence following the error.
91. **Organic and Biochemistry**
You should be able to identify Figure 3 as the generic chemical model for an amino acid. In all amino acids, a central carbon is connected to an amino group (NH$_2$), a carboxyl group (COOH), and a functional group (R). Differences in the functional group distinguish amino acids from each other. When two amino acids combine to form a polypeptide, the opposing amino and carboxyl groups join and release a single molecule of water. Thus, this reaction is known as dehydration synthesis.

92. **Organic and Biochemistry**
The linking of amino acids by dehydration synthesis forms a polypeptide, also known as a protein. The bond forged between them is called a peptide bond, which links the carbon in the carboxyl group of one amino acid and the nitrogen in the amino group of the next.

93. **Organic and Biochemistry**
Figure 5 is the chemical formula for a monosaccharide (e.g., glucose). The dehydration synthesis reaction also occurs in the formation of polysaccharides, such as when two molecules of glucose combine to form maltose. Two glucose molecules have 12 carbons, 24 hydrogens, and 12 oxygens total. This ratio of 1:2:1 or C$_6$H$_{12}$O$_6$ holds true for all monosaccharides. When they combine, they release a single molecule of water (H$_2$O) and form maltose, with the formula C$_{12}$H$_{22}$O$_{11}$. Thus, two atoms of hydrogen and one atom of oxygen are subtracted from the general monosaccharide formula: C$_{n}$H$_{2n-2}$O$_{n-1}$.

94. **Organic and Biochemistry**
To answer this question, identify each of the depicted molecules. Figure 1 resembles a triglyceride, with one hydrocarbon chain replaced by a phosphate group. It is indeed a phospholipid, with two hydrocarbon chains and a phosphate head. Phospholipids align to form bilayers in membranes, but their association is based on polarity—hydrophilic heads aligning with each other and hydrophobic tails aligning with each other—and not chemical bonds; therefore, bilayers are not polymers. With several hydrocarbon rings, Figure 2 is another lipid called a steroid, which also does not readily form polymers. With sugar and phosphate groups supporting a nitrogenous base, Figure 4 depicts a generic nucleotide. Nucleotides form long polymers, of which DNA and RNA are typical examples.

95. **Organic and Biochemistry**
Phospholipids have a characteristic form of two long hydrocarbon “tails” and a single phosphate “head.” The nonpolar hydrocarbon chains are hydrophobic (“afraid” of polar water molecules), while the polar phosphate group is hydrophilic, having an affinity for water. When phospholipids are in abundance, their components align based on polarity to form the bilayer found in cell membranes: hydrophilic phosphate heads on the outside, hydrophobic hydrocarbon tails on the inside.
96. D Organic and Biochemistry
At their core, steroids have several connected hydrocarbon rings: three are hexagons, and a fourth is pentagonal. Steroids are lipids; examples of steroids include cholesterol and the sex hormones testosterone and estrogen.

97. D Evolution and Diversity
Evolutionary relationships can be reconstructed based on organisms’ common ancestors, or when different organisms were last the same. In the molecular analysis of beta-hemoglobin, the differences in amino acid sequence represent the proximity of relation between organisms. Organisms with large differences in amino acid sequence are more distantly related (i.e., shared a more distant common ancestor) than organisms with fewer differences. With this in mind, build out the chart based on the table data. The first major division A is pretty obviously the lemur, which has a large difference in amino acid sequence with all of the other organisms. The next branch to split off is the squirrel monkey (G), then the rhesus monkey (F), the gibbon E, the gorilla D, and the chimpanzee and human share the closest branch (C, B).

98. D Evolution and Diversity
Both humans and chimpanzees have only a single difference with gorillas in the amino acid sequence for beta hemoglobin. Humans and gibbons have three differences in this amino acid sequence. As you can see in the reconstructed chart, based on this evidence, gorillas shared the same common ancestor with chimpanzees as with humans.

99. B Evolution and Diversity
All the primates share a common ancestor, including humans and lemurs. A is false, as humans evolved from an ancestor of lemurs, not the modern variety. C is obviously incorrect. D is wrong: even though lemurs split off from the rest of the primate tree millions of years ago, they did not stop evolving. Humans and lemurs demonstrate divergent evolution, not convergent E.

100. C Evolution and Diversity
This is a tricky question. To answer it, you must recall that the genetic code is “degenerate,” which means that some nucleotide triplets, or codons, call for the same amino acid. There are only 20 amino acids found in nature and 64 possible codons. A horse’s genetic sequence can be dramatically different from primates’, but by the redundancy of some codons, this nucleotide sequence can code for many of the same amino acids.