PRACTICE EXAM 17: LIVING ENVIRONMENT REGENTS SIMULATION

Answer all questions in this part.

1. Which of the following is NOT one of the universal characteristics shared by all living organisms?

A. The ability to maintain a stable internal environment

B. The ability to obtain and use energy from the surroundings

C. The ability to respond to changes in stimuli

D. The ability to move from place to place independently

2. A scientist examining a cell under an electron microscope observes a structure that controls the movement of materials into and out of the cell. This structure is most likely the:

A. nucleus

B. cell membrane

C. mitochondrion

D. Golgi apparatus

3. Which organelle is responsible for converting the chemical energy stored in glucose into ATP through aerobic respiration?

A. mitochondrion

B. chloroplast

C. ribosome

D. lysosome

4. The function of ribosomes in a living cell is to:

A. break down worn-out cell parts and debris

B. store water and dissolved materials in solution

C. assemble amino acids into chains of protein

D. package and ship products around the cell

5. Which statement best describes the relationship between structure and function in living things?

A. Structure has no effect on the function of a body part

B. The structure of a body part is closely related to the function it performs

C. Function determines the size of a cell but not its shape

D. Structure and function are entirely independent properties

6. The diffusion of materials across a cell membrane does NOT require:

A. a concentration gradient between regions

B. a permeable or semipermeable barrier

C. random molecular motion of particles

D. an input of cellular energy in the form of ATP

7. An organism that requires oxygen to release the chemical energy stored in food molecules is best described as:

A. autotrophic

B. anaerobic

C. aerobic

D. heterotrophic

8. Enzymes function as biological catalysts within cells by:

A. lowering the activation energy of a chemical reaction

B. providing chemical energy for the reaction to proceed

C. raising the temperature of the cell where they act

D. permanently combining with the products of the reaction

9. Which sequence correctly orders the levels of biological organization from smallest to largest?

A. cell → tissue → organism → organ → system

B. tissue → cell → system → organ → organism

C. organ → tissue → cell → organism → system

D. cell → tissue → organ → system → organism

10. The primary function of red blood cells in the human body is to:

A. fight bacterial and viral infections in tissues

B. transport oxygen from the lungs to body tissues

C. form clots at the site of an open wound

D. produce antibodies against foreign antigens

11. In humans, the liver carries out which homeostatic function?

A. exchange of gases between blood and atmospheric air

B. absorption of water from undigested food materials

C. filtering of harmful substances from the circulating blood

D. production of digestive enzymes for the stomach lining

12. Which of the following is an example of negative feedback maintaining homeostasis?

A. Body temperature rising slightly causes sweating, which cools the body to normal

B. A small wound triggers more clotting, which triggers even more clotting indefinitely

C. Ingestion of food stretches the stomach, signaling additional stretching of the stomach

D. Hormone release during labor causes more hormone release that intensifies contractions

13. The genetic information of a eukaryotic cell is stored primarily within molecules of:

A. ATP

B. mRNA

C. protein

D. DNA

14. Which sequence of bases in DNA would be complementary to the sequence A-T-G-C-C-A?

A. A-T-G-C-C-A

B. T-A-C-G-G-T

C. U-A-C-G-G-U

D. T-A-G-C-C-A

15. During protein synthesis, the role of messenger RNA (mRNA) is to:

A. carry instructions from DNA to the ribosome

B. transfer amino acids to the ribosome surface

C. catalyze the formation of peptide bonds

D. cut the DNA molecule at specific sequences

16. A change in the sequence of bases in a gene is best described as a:

A. translation

B. transcription

C. mutation

D. replication

17. Which of the following events occurs during mitosis but NOT during meiosis?

A. Production of haploid daughter cells

B. Production of two genetically identical daughter cells

C. Pairing of homologous chromosomes side by side

D. Crossing over between homologous chromosomes

18. Sexual reproduction increases genetic variation in offspring primarily because of:

A. binary fission of the parent cell

B. the use of DNA replication during gamete formation

C. asexual budding of new individuals

D. independent assortment of chromosomes and random fertilization

19. In humans, the chromosomes that determine biological sex are:

A. the X and Y chromosomes

B. the 22 autosome pairs

C. the mitochondrial chromosomes

D. the chromosomes found within ribosomes

20. An organism's phenotype is best described as:

A. the alleles it carries on each chromosome

B. only the dominant alleles found in its genome

C. the observable physical and biochemical traits it expresses

D. only the recessive alleles inherited from its parents

21. Two brown-eyed parents produce a blue-eyed child. Blue eye color is recessive to brown. The genotypes of the parents must both be:

A. homozygous dominant

B. heterozygous

C. homozygous recessive

D. one homozygous dominant and one homozygous recessive

22. Which scientist is most closely associated with the theory that species change over time through the process of natural selection?

A. Gregor Mendel

B. Louis Pasteur

C. Robert Hooke

D. Charles Darwin

23. Which of the following provides the most direct evidence that two modern species share a common ancestor?

A. Similar DNA base sequences in homologous genes

B. Living in the same geographic region in the present day

C. Having similar diets and habitats today

D. Reaching adulthood at roughly the same age

24. Variation within a population is important for natural selection because it:

A. ensures that all individuals will reproduce successfully

B. eliminates the need for any environmental change

C. provides differences upon which selection can act

D. prevents harmful mutations from ever occurring

25. In an undisturbed ecosystem over thousands of years, the gradual replacement of one community by another is best described as:

A. predation

B. mutualism

C. competition

D. ecological succession

26. Which of the following best describes the role of producers in an ecosystem?

A. They consume other living organisms for energy

B. They convert solar energy into chemical energy stored in organic compounds

C. They decompose dead organic matter into recycled nutrients

D. They transfer parasites between hosts in the food web

27. Which type of relationship is illustrated by lichen, in which a fungus and an alga both benefit from living together?

A. mutualism

B. parasitism

C. commensalism

D. predation

28. In the nitrogen cycle, atmospheric nitrogen gas (N_2) is converted into a usable form for plants primarily by:

A. forest fires acting alone on the soil

B. photosynthesis in the leaves of green plants

C. nitrogen-fixing bacteria living in the soil

D. evaporation from lakes and oceans

29. A population that has reached the carrying capacity of its environment will most likely show:

A. continued exponential increase in size

B. fluctuation around a relatively stable population size

C. immediate extinction of the species

D. complete absence of any reproduction

30. Which human activity is most likely to result in a long-term decrease in biodiversity?

A. Establishment of national parks and wildlife reserves

B. Recycling of paper, glass, and plastic materials

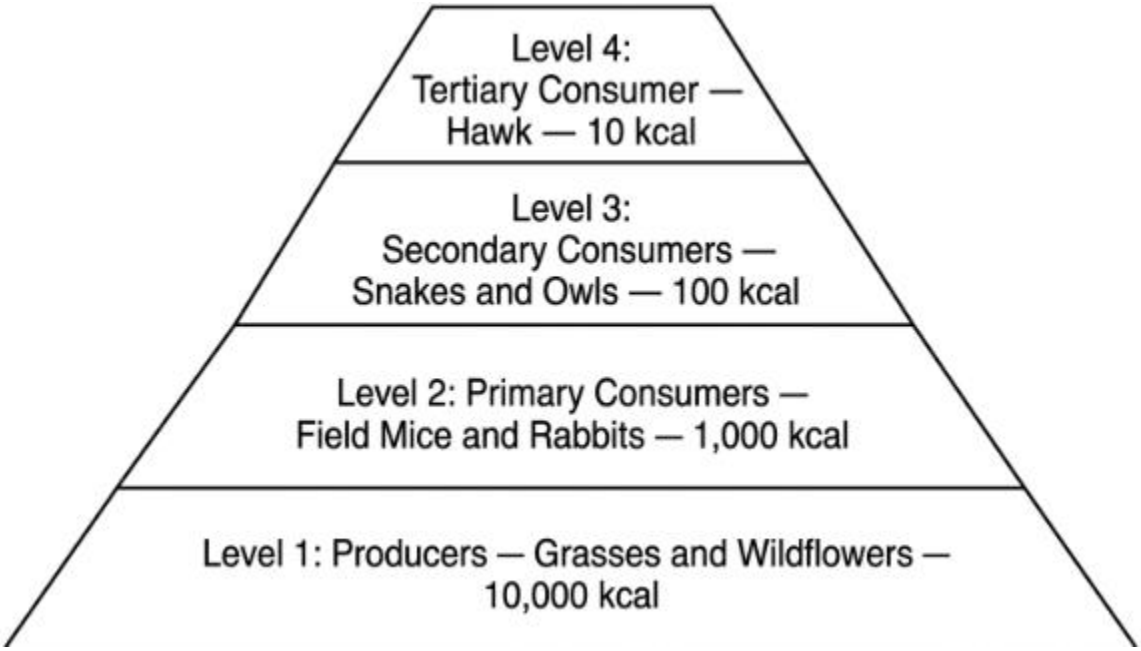
C. Use of public transportation in place of private cars

D. Clearing large areas of tropical rainforest for agriculture

PART B-1

Answer all questions in this part.

Base your answers to questions 31 through 34 on the diagram below and on your knowledge of biology. The diagram represents an energy pyramid in a meadow ecosystem.



31. The organisms at Level 1 of this pyramid are classified as autotrophs because they:

A. capture sunlight and convert it into chemical energy stored in glucose

B. consume primary consumers in order to obtain their energy

C. decompose dead organic matter into reusable nutrients

D. carry out cellular respiration but not photosynthesis

32. Approximately what percentage of the energy available at Level 1 is transferred to organisms at Level 2?

A. 1%

B. 50%

C. 10%

D. 90%

33. The narrowing shape of the energy pyramid is best explained by the fact that:

A. organisms at lower levels are always larger in body size

B. most of the energy at each level is lost as heat through cellular respiration

C. higher trophic levels contain more total biomass than lower levels

D. producers store none of the energy they capture from sunlight

34. If a disease eliminated most of the field mice and rabbits from this ecosystem, which short-term effect would most likely occur?

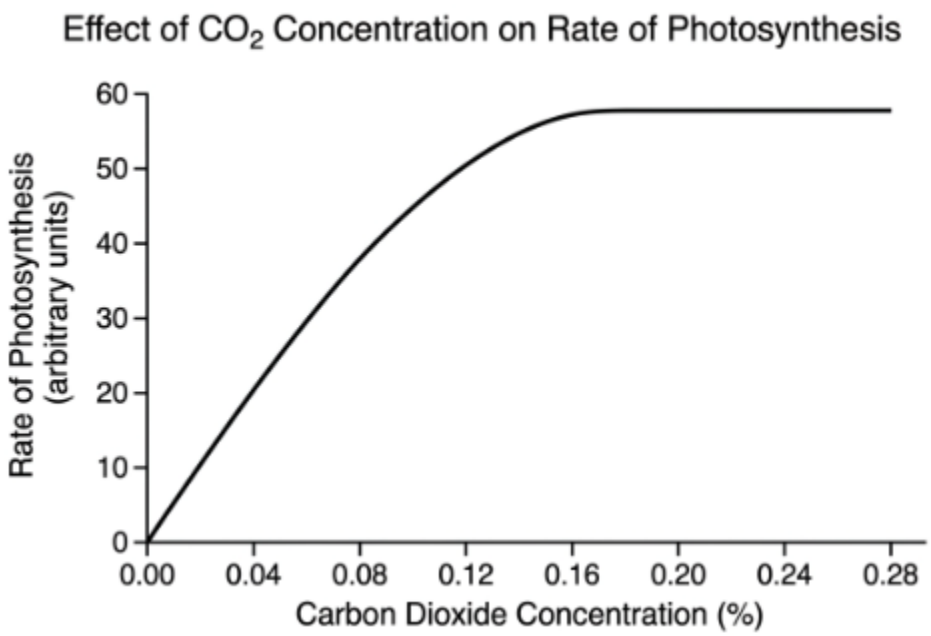
A. The grasses and wildflowers would immediately die off

B. The total amount of solar energy reaching the meadow would decrease

C. The decomposer population would drop to zero almost immediately

D. The snake, owl, and hawk populations would decline due to reduced food

Base your answers to questions 35 through 37 on the graph below and on your knowledge of biology. The graph shows the effect of carbon dioxide concentration on the rate of photosynthesis in a green plant. All other environmental factors were held constant during the investigation.



35. At which carbon dioxide concentration is the rate of photosynthesis most clearly limited by the amount of CO_2 available to the plant?

A. 0.20%

B. 0.24%

C. 0.04%

D. 0.28%

36. Which factor most likely limits the rate of photosynthesis at carbon dioxide concentrations above 0.16%?

A. The carbon dioxide concentration in the air around the plant

B. The amount of glucose stored in the plant's leaves

C. The number of stomata on the underside of each leaf

D. Another environmental factor such as light intensity or chlorophyll content

37. Based on the data, a greenhouse grower whose tomato plants are currently exposed to a CO_2 level of 0.04% would obtain the greatest increase in photosynthesis by:

A. doing nothing, because CO_2 has no effect on photosynthesis

B. decreasing the CO_2 to below 0.02%

C. increasing the CO_2 concentration to approximately 0.16%

D. increasing the CO_2 concentration to 0.50% or higher

Base your answers to questions 38 through 40 on the data table below and on your knowledge of biology. The table shows the population sizes of two species of beetles raised together in a single laboratory enclosure with a limited food supply.

Population Sizes of Beetle Species X and Y Over 24 Weeks.		
Week	**Species X Population**	**Species Y Population**
0	50	50
4	90	45
8	150	30
12	220	18
16	280	9
20	320	3
24	340	0

38. Which conclusion is best supported by the data in the table?

A. Both species reproduced equally well throughout the entire study

B. Species X outcompeted Species Y for the limited food supply

C. Species Y consumed and eliminated Species X as a predator

D. The two species formed a mutualistic relationship over time

39. The relationship between Species X and Species Y in this enclosure is best described as:

A. competition for limited resources

B. mutualism in which both species benefit

C. commensalism in which one benefits and the other is unaffected

D. parasitism in which Species Y feeds on Species X

40. Which factor would most likely allow both species to coexist in a natural environment instead of one being eliminated?

A. A reduction in the total amount of food available to both

B. Identical reproductive rates and identical food preferences

C. Confinement of both species to the smallest possible habitat

D. Each species occupying a slightly different niche or food source

Base your answers to questions 41 through 43 on the food web below and on your knowledge of biology.

Figure PQ-4

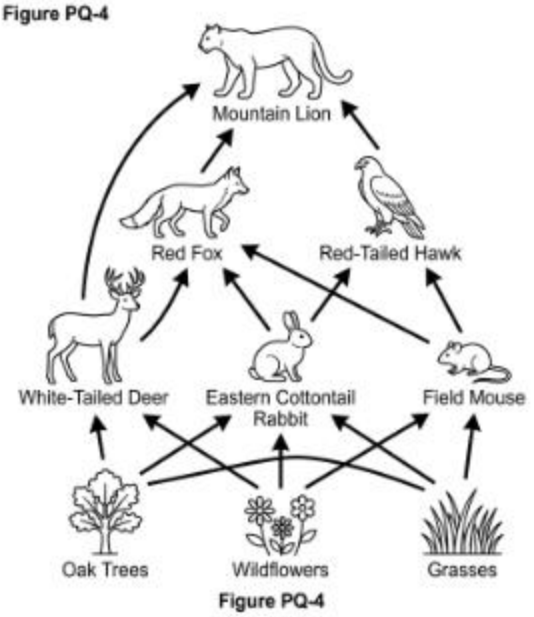


Figure PQ-4

41. Which organism in this food web is best classified as a primary consumer?

A. Mountain Lion

B. Eastern Cottontail Rabbit

C. Red Fox

D. Red-Tailed Hawk

42. Which organism in this food web obtains its energy by feeding at more than one trophic level?

A. White-Tailed Deer

B. Eastern Cottontail Rabbit

C. Red Fox

D. Mountain Lion

43. Which of the following best describes the role of the wildflowers and grasses in this food web?

A. They are decomposers that recycle nutrients from dead organisms

B. They are tertiary consumers at the top of the food web

C. They are autotrophic producers that capture solar energy

D. They are secondary consumers feeding on field mice

PART B-2

Answer all questions in this part.

44. In a controlled experiment investigating the effect of fertilizer concentration on plant height, the independent variable is the:

A. height of each plant at the end of the study

B. amount of water given to each plant daily

C. concentration of fertilizer applied to each plant

D. number of leaves on each plant at the start

45. Which of the following is the best example of a well-formed scientific hypothesis?

A. Plants are interesting because they grow everywhere

B. If a plant receives more sunlight, then it will grow taller because sunlight drives photosynthesis

C. All plants in the world are healthy and grow tall

D. Plants probably grow somehow in the soil they live in

46. A student wants to test whether music affects how quickly mice complete a maze. Which group acts as the control?

A. Mice that run the maze without any music playing

B. Mice that run the maze while loud rock music plays

C. Mice that run the maze while classical music plays

D. Mice that listen to music but never run the maze

47. Which of the following laboratory tests is used to detect the presence of starch in a sample?

A. Benedict's solution turning brick-red when heated

B. Bromothymol blue turning yellow on exposure to CO_2

C. Lugol's (iodine) solution turning blue-black

D. Litmus paper turning pink in the sample

48. Plasmids used in genetic engineering are best described as:

A. tightly coiled chromosomes located inside the cell nucleus

B. small, circular molecules of DNA found mainly in bacteria

C. linear strands of RNA that catalyze chemical reactions

D. ribosomes responsible for the assembly of proteins

49. A direct application of recombinant DNA technology in modern medicine is the production of:

A. tap water and bottled drinking water for hospitals

B. table salt and refined cane sugar for diet planning

C. human insulin made by genetically modified bacteria

D. iron and zinc supplements mined from natural minerals

50. When a person becomes dehydrated, which physiological response helps maintain water balance?

A. The kidneys reabsorb more water and produce more concentrated urine

B. The skin sweats more heavily to release excess body water

C. The lungs exhale large amounts of water to remove waste

D. The stomach absorbs all incoming fluids and stores them indefinitely

51. Which of the following best describes the role of antibodies in the immune response?

A. They convert pathogens into harmless nutrients used by body cells

B. They release oxygen from hemoglobin during cellular respiration

C. They recognize and bind to specific antigens, marking pathogens for destruction

D. They produce ATP by carrying out aerobic respiration in white blood cells

52. A person infected with a virus develops a fever and feels tired. The fever is part of the body's:

A. nonspecific immune response that creates an unfavorable environment for the pathogen

B. digestive response to an increased nutrient demand

C. process of meiosis to produce more immune cells

D. mechanism for storing additional iron in red blood cells

53. Which of the following statements about cancer is most accurate?

A. Cancer cells stop dividing entirely after one generation

B. Cancer is caused exclusively by inherited genetic factors

C. Cancer cells display normal regulation of the cell cycle

D. Cancer involves uncontrolled cell division due to disrupted regulation of the cell cycle

54. Which of the following statements about hormones is correct?

A. Hormones are produced by the central nervous system and travel only through nerves

B. Hormones are chemical messengers released by glands that travel through the bloodstream

C. Hormones are digestive enzymes secreted into the small intestine

D. Hormones are forms of solid waste excreted by the kidneys

55. When a person exercises vigorously, both heart rate and breathing rate increase. This response helps to:

A. deliver more oxygen to working muscles and remove more carbon dioxide

B. cool the body by exhaling water vapor through the lungs

C. eliminate excess nitrogen waste through the respiratory system

D. allow muscles to undergo asexual reproduction during exertion

PART C

Answer all questions in this part.

56. During embryonic development, which structure provides the developing fetus with oxygen and nutrients from the mother's blood?

A. amniotic sac

B. umbilical fluid

C. placenta

D. ovary

57. The first cell of a new human individual, formed by the union of a sperm and an egg, is called the:

A. embryo

B. blastula

C. fetus

D. zygote

58. Genetic counselors sometimes use pedigree charts to:

A. determine whether a person has been recently exposed to a virus

B. track the pattern of inheritance of a trait through several generations

C. measure the rate of cellular respiration in human tissues

D. estimate the total caloric needs of an unborn child

59. Sickle-cell anemia is a genetic disorder caused by a single base change in the gene that codes for hemoglobin. This is an example of how:

A. a small mutation can have a significant effect on protein structure and function

B. all mutations are always harmful and never beneficial

C. environmental factors directly cause changes in DNA sequence

D. proteins are made up entirely of carbohydrate units

60. Two populations of squirrels living on opposite sides of a deep canyon gradually develop differences in fur color, body size, and mating calls until they can no longer interbreed. This process is an example of:

A. ecological succession in a disturbed area

B. artificial selection carried out by humans

C. speciation through geographic isolation

D. parasitism between the two groups of squirrels

61. A barren rock surface left exposed by a retreating glacier is colonized first by lichens and mosses. These early colonizers are best described as:

A. apex predators of the new ecosystem

B. pioneer species of primary succession

C. climax community species at equilibrium

D. parasites on the rock surface itself

62. Which of the following is a density-independent factor that may limit a population's growth?

A. Competition for available nesting sites

B. Spread of contagious disease through a population

C. Predation pressure from other species

D. A severe drought or hurricane affecting a region

63. Zebra mussels were accidentally introduced into the Great Lakes from Europe and have since clogged water-intake pipes and crowded out native species. The zebra mussel is best described as a(n):

A. native climax species of the lakes

B. endangered pioneer species needing protection

C. invasive non-native species

D. specialized symbiotic species

64. Which of the following is a direct biological consequence of global climate change?

A. Shifts in the geographic ranges of many plant and animal species

B. An immediate increase in the diversity of all polar ecosystems

C. A complete halt to the global carbon cycle

D. The disappearance of all tropical rainforests within one year

65. Acid rain, formed when sulfur and nitrogen oxides combine with water in the atmosphere, harms aquatic ecosystems mainly by:

A. raising the pH of lakes and rivers to alkaline levels

B. providing extra nutrients that increase plant growth

C. introducing harmless solid particles into water bodies

D. lowering the pH of lakes and rivers, harming fish and invertebrates

66. Which of the following human practices best helps preserve biodiversity?

A. Clearing wetlands for new housing developments

B. Setting aside protected wildlife reserves and national parks

C. Spraying broad-spectrum pesticides across all farmland

D. Releasing exotic pet species into local waterways

67. Bioremediation is the use of organisms — often bacteria or fungi — to:

A. break down pollutants and clean up contaminated environments

B. produce large quantities of plastic from petroleum

C. generate electricity in coal-fired power plants

D. construct concrete dams and bridges for infrastructure

68. Which of the following best explains why preserving wetlands is important?

A. Wetlands generate fossil fuels that humans can burn for energy

B. Wetlands are devoid of any wildlife and therefore require no protection

C. Wetlands filter pollutants from water and provide habitat for many species

D. Wetlands are the main source of all atmospheric oxygen on Earth

69. Which of the following pairs correctly matches a renewable energy source with its primary advantage?

A. Coal — releases no greenhouse gases when burned

B. Solar energy — does not consume a finite resource and produces no direct CO_2 emissions during use

C. Petroleum — replenishes itself rapidly in nature

D. Natural gas — produces no carbon dioxide when used

70. Photosynthesis and cellular respiration are complementary processes in the biosphere because:

A. both processes occur only in animal cells

B. photosynthesis releases carbon dioxide while respiration releases oxygen

C. both processes produce ATP through identical chemical pathways

D. photosynthesis stores energy in glucose and releases O_2, while respiration releases energy from glucose and consumes O_2

71. A plant cell carries out photosynthesis in its chloroplasts and cellular respiration in its mitochondria. This shows that:

A. plant cells require both organelles to capture energy from sunlight and to release it for cellular work

B. plant cells cannot survive without consuming other organisms

C. chloroplasts and mitochondria perform identical functions in the cell

D. plant cells use only one of these processes at any given time

72. Two organisms living in the same habitat compete most directly when they:

A. live on opposite sides of the world

B. belong to two unrelated kingdoms of life

C. occupy the same ecological niche and use the same limited resources

D. reproduce at completely different times of the year

PART D

Answer all questions in this part.

73. A student is performing the "Making Connections" lab, in which the relationship between pulse rate and exercise is investigated. Before adding any exercise, the student measures the resting pulse rate by counting beats for 30 seconds and multiplying by two. What variable is being controlled in this step?

A. The amount of exercise performed before measurement

B. The method of measuring pulse rate, so that all measurements are comparable

C. The age of the student being measured during the trial

D. The type of food consumed before the lab begins

74. In the "Beaks of Finches" lab, students use various tools to pick up seeds during a simulated feeding period. The tools represent:

A. different food sources available to finches in nature

B. predators that hunt finches in the wild

C. weather conditions on the Galapagos Islands

D. variations in the shape and size of finch beaks

75. When using a compound light microscope, a student notices that the field of view appears too dark to see the specimen clearly. The best adjustment is to:

A. switch to the lowest magnification objective immediately

B. wipe the eyepiece thoroughly with a clean tissue

C. increase the amount of light using the diaphragm or light source

D. add more water under the coverslip on the slide

76. A student observing onion cells in the "Diffusion Through a Membrane" lab places a drop of salt water on the slide. After several minutes, the cell membrane appears to pull away from the cell wall. This observation indicates that:

A. water has moved out of the cells by osmosis, because the surrounding solution is hypertonic

B. the salt molecules have moved into the cells through active transport

C. the cells have begun to undergo mitosis at a rapid rate

D. the chloroplasts have been chemically destroyed by the salt

77. During the "Relationships and Biodiversity" lab, students compare Botana curus to four related species using physical, biochemical, and DNA tests. The most reliable evidence of evolutionary relationship comes from comparing:

A. flower color and overall plant height

B. DNA base sequences in homologous genes

C. average soil temperature in each species' habitat

D. the size of the leaves and stems of each species

78. Paper chromatography is used to separate the pigments in a leaf extract. The pigments separate from one another because:

A. they have different temperatures at which they evaporate

B. they each contain a different number of electrons per molecule

C. they reproduce at different rates on the paper surface

D. they have different solubilities in the solvent and adhere to the paper to different degrees

79. When dissecting a specimen in biology lab, the most important safety precaution is to:

A. wear safety goggles and handle sharp instruments carefully, cutting away from the body

B. work as quickly as possible to reduce unpleasant odors

C. share scalpels between lab groups to save equipment

D. consume snacks at the lab bench during the procedure

80. A student records the following volumes of gas collected during a respiration experiment with germinating seeds: 2.4 mL, 2.6 mL, 2.3 mL, 2.5 mL, and 2.7 mL. The best way to summarize this data set is to report the:

A. single highest value collected during the trial

B. single lowest value collected during the trial

C. average (mean) of the five measurements

D. mode of the small data set

81. A graduated cylinder used to measure liquid volume in a biology lab should be read at the:

A. top of any bubble that forms on the surface of the liquid

B. base of the cylinder where it touches the laboratory bench

C. uppermost ring of the meniscus, viewed from above

D. bottom of the meniscus, at eye level

82. A student designs an experiment to test whether varying amounts of water affect bean seed germination. To minimize random error in the results, the student should:

A. use only one seed in each experimental group

B. repeat each treatment with several seeds and calculate averages

C. perform the experiment only a single time to save effort

D. change two variables simultaneously to save time

83. When recording observations during a lab investigation, the student should:

A. record exactly what is observed, even if the data do not support the original hypothesis

B. record only data that match the predicted outcome of the experiment

C. round all measurements to whole numbers without recording the original value

D. write down personal opinions in place of recorded measurements

84. A bar graph is the most appropriate way to display:

A. continuous changes in temperature over a 24-hour period

B. the path of an object across a coordinate grid

C. comparisons of the average heights of four different plant species

D. the gradual approach of a population to its carrying capacity

85. When a student writes a conclusion for an investigation, the conclusion should:

A. simply list all of the materials used in the procedure

B. summarize the data and state whether the hypothesis was supported, with reasoning based on the evidence

C. include only information about why the hypothesis must be correct

D. avoid mentioning the data, focusing only on broad opinions

EXPLAINED ANSWER KEY – PRACTICE EXAM 17

1. D — All living things share homeostasis, energy use, and response to stimuli, but independent locomotion is not universal — plants, fungi, and sessile animals such as corals and barnacles cannot move from place to place. Independent movement is therefore a characteristic of some living things, not a defining feature of life.

2. B — The cell membrane (plasma membrane) is a selectively permeable boundary that regulates which substances enter and leave the cell. The nucleus controls genetic activity, the mitochondrion produces ATP, and the Golgi apparatus packages proteins.

3. A — Mitochondria are the sites of aerobic cellular respiration, where glucose is broken down in the presence of oxygen to produce large amounts of ATP. Because of this role, they are often called the "powerhouses" of the cell.

4. C — Ribosomes are the protein-assembly organelles of the cell; they read messenger RNA codons and link amino acids together by peptide bonds. They can be found floating freely in the cytoplasm or attached to the rough endoplasmic reticulum.

5. B — A core principle of biology is that structure is closely matched to function — the shape and composition of a cell, tissue, or organ reflect the specific job it performs. Examples include the long projections of nerve cells for signaling and the flattened shape of red blood cells for gas exchange.

6. D — Diffusion is a passive process driven by random molecular motion down a concentration gradient through a permeable barrier; it does not require ATP. Active transport, by contrast, is the process that uses ATP to move substances against their concentration gradient.

7. C — Aerobic organisms require oxygen to fully break down glucose and harvest the chemical energy stored in food, producing CO_2, H_2O, and ATP. Anaerobic organisms, by contrast, release energy from food in the absence of oxygen.

8. A — Enzymes are protein catalysts that lower the activation energy required for a chemical reaction, allowing the reaction to proceed much faster at body temperature. Enzymes are not consumed in the reaction and can be reused many times.

9. D — Levels of biological organization from smallest to largest in a multicellular organism proceed: cell → tissue → organ → organ system → organism. Each level is built from many units of the level below it.

10. B — Red blood cells contain hemoglobin, an iron-rich protein that reversibly binds oxygen in the lungs and releases it in body tissues. This oxygen-transport function is their primary role; immune defense and clotting are carried out by other blood cell types.

11. C — The liver removes toxins, drugs, and metabolic waste products such as excess amino acids (which it converts to urea) from the bloodstream, helping maintain homeostasis. Gas exchange occurs in the lungs, water absorption in the large intestine, and stomach enzyme secretion in the stomach lining.

12. A — Negative feedback occurs when a change in a regulated variable triggers a response that reverses that change and returns the system toward its set point. Sweating in response to a temperature rise is a textbook example; the other options describe positive feedback, which amplifies rather than reverses the change.

13. D — In eukaryotic cells, genetic information is stored in DNA molecules located primarily within the nucleus (with small amounts also in mitochondria and chloroplasts). DNA's base sequence encodes the instructions for building all of the cell's proteins.

14. B — Base pairing in DNA follows the rules A–T and C–G. Reading complementary bases for A-T-G-C-C-A gives T-A-C-G-G-T. Option C uses uracil (U), which appears in RNA, not in DNA.

15. A — Messenger RNA (mRNA) is transcribed from DNA in the nucleus and carries the genetic instructions out to the ribosome, where the message is translated into a protein. Transfer RNA (tRNA) brings amino acids, and ribosomal RNA (rRNA) helps catalyze peptide bond formation.

16. C — A mutation is any change in the sequence of DNA bases in a gene, including substitutions, insertions, and deletions. Replication copies DNA, transcription makes mRNA from DNA, and translation makes a protein from mRNA — none of these change the underlying sequence.

17. B — Mitosis produces two daughter cells that are genetically identical to the parent and to each other. Meiosis, by contrast, produces four genetically varied haploid cells through homologous pairing and crossing over.

18. D — Sexual reproduction generates genetic variation through independent assortment of chromosomes and crossing over during meiosis, and through the random pairing of gametes at fertilization. Binary fission and budding are forms of asexual reproduction, which produce genetically identical offspring.

19. A — In humans, biological sex is determined by the 23rd pair of chromosomes: XX results in a typical female, XY in a typical male. The other 22 pairs are autosomes and are not involved in sex determination.

20. C — Phenotype refers to an organism's observable traits, including physical features, biochemistry, and behavior, as expressed from the underlying genotype and shaped by the environment. Genotype, by contrast, refers to the specific alleles the organism carries.

21. B — Because both parents show the dominant phenotype but produce a recessive (blue-eyed) child, each parent must carry one recessive allele while displaying the dominant trait — that is, each must be heterozygous (Bb). A Bb × Bb cross produces a 1 in 4 chance of a homozygous recessive (bb) child.

22. D — Charles Darwin published *On the Origin of Species* in 1859, in which he proposed that species change over time through natural selection acting on heritable variation. Mendel founded genetics, Pasteur worked on microbiology, and Hooke first described cells.

23. A — Similar DNA base sequences in homologous genes provide the most direct molecular evidence of shared ancestry, because closely related species inherit nearly identical sequences from a common

ancestor. Shared habitat, diet, or developmental timing can result from convergent evolution rather than common ancestry.

24. C — Natural selection acts on existing heritable variation — without differences among individuals, no individuals could be favored over others. Variation is therefore the raw material upon which selection operates.

25. D — Ecological succession is the gradual, predictable change in the species composition of a community over time, eventually leading toward a more stable climax community. Predation, mutualism, and competition are interactions among species, not community-level changes.

26. B — Producers (autotrophs) use chlorophyll to capture solar energy and convert it into chemical energy stored in glucose during photosynthesis. They are the energetic base of nearly every ecosystem on Earth.

27. A — In mutualism, both partners benefit from the relationship. In lichen, the fungus provides structure and water retention while the alga (or cyanobacterium) provides sugars from photosynthesis, so both gain.

28. C — Atmospheric N_2 has a strong triple bond that plants cannot break; nitrogen-fixing bacteria, both free-living in soil and within root nodules of legumes, convert N_2 into ammonia (NH_3), which is then available for plant uptake. Without these bacteria, ecosystems would be severely nitrogen-limited.

29. B — At carrying capacity, birth and death rates roughly balance, so the population size oscillates around K rather than continuing to grow or crashing entirely. This pattern is captured in the logistic growth model.

30. D — Clearing tropical rainforest destroys habitat for an enormous number of species (rainforests contain a large fraction of Earth's biodiversity), and the habitat does not recover quickly. National parks, recycling, and public transportation all reduce, rather than increase, biodiversity loss.

31. A — Autotrophs make their own food by capturing solar energy in chlorophyll and converting it into chemical energy stored in glucose through photosynthesis. The grasses and wildflowers at Level 1 perform this energy capture for the entire meadow.

32. C — The classic 10% rule states that roughly 10% of the energy at one trophic level is incorporated into biomass at the next. The pyramid shows this: 10,000 kcal at Level 1 yields 1,000 kcal at Level 2.

33. B — At each trophic level, organisms use most of the energy they consume for respiration, movement, and other life processes, releasing it as heat. Only a small fraction (~10%) becomes biomass available to the next level, producing the pyramid's narrowing shape.

34. D — The snakes, owls, and hawk depend (directly or indirectly) on the primary consumers as their food supply, so eliminating most field mice and rabbits would cause higher trophic levels to decline. Producers, solar input, and decomposers are not directly tied to the primary consumer population in the short term.

35. C — At very low CO_2 concentrations (such as 0.04%), the curve is rising steeply — adding more CO_2 directly increases the photosynthesis rate, the signature pattern of a limiting factor. At the plateau, additional CO_2 produces no further increase.

36. D — Once the curve flattens at high CO_2, CO_2 is no longer the limiting reagent; some other factor — light intensity, chlorophyll content, or temperature — has become the bottleneck. Increasing CO_2 further produces no additional benefit until that other factor is also raised.

37. C — The graph shows the steepest gains in photosynthesis between 0.04% and roughly 0.16% CO_2, after which the rate plateaus. Increasing CO_2 to ~0.16% therefore captures nearly all of the available benefit; pushing higher gives no further improvement.

38. B — Over 24 weeks, Species X grew from 50 to 340 while Species Y declined from 50 to 0. With a shared limited food supply, this pattern of one species thriving while the other is eliminated is the hallmark of competitive exclusion.

39. A — The two species were raised together with a single limited resource — food — and one was eliminated. This is interspecific competition for limited resources, the central mechanism of the competitive exclusion principle.

40. D — When competing species occupy different niches — eating slightly different foods, foraging at different times, or using different microhabitats — competition is reduced, and both species can coexist. This is the principle of niche differentiation observed in many natural communities.

41. B — Primary consumers (herbivores) feed directly on producers. The Eastern Cottontail Rabbit eats wildflowers and grasses, placing it at the second trophic level as a primary consumer.

42. D — The Mountain Lion eats White-Tailed Deer (a primary consumer) and Red Fox (a secondary consumer), drawing energy from two different trophic levels. This dietary breadth is typical of apex predators in many ecosystems.

43. C — Wildflowers and grasses are green plants that capture solar energy through photosynthesis and convert it into chemical energy stored in glucose. As autotrophs, they form the producer base of the food web.

44. C — The independent variable is the factor the experimenter deliberately changes to test its effect — in this case, the concentration of fertilizer applied. Plant height is the dependent variable, while water amount and starting leaf count would be controlled.

45. B — A good scientific hypothesis is a testable, falsifiable "if … then … because …" statement that proposes a mechanism. Option B identifies an independent variable (sunlight), a predicted outcome (taller growth), and a reasoned cause (photosynthesis); the other options are vague, untestable, or sweeping generalizations.

46. A — A control group differs from the experimental groups only in the variable being tested. Mice running the maze with no music provide the baseline against which the music-exposed groups can be compared.

47. C — Lugol's iodine solution turns from amber to a deep blue-black color in the presence of starch. Benedict's solution detects reducing sugars, bromothymol blue indicates CO_2/pH, and litmus tests acidity.

48. B — Plasmids are small, circular, double-stranded DNA molecules found in bacteria, separate from the main bacterial chromosome. Their ability to be cut, spliced with foreign DNA, and reintroduced into cells makes them workhorses of genetic engineering.

49. C — Human insulin for treating diabetes was one of the first commercial products of recombinant DNA technology: the human insulin gene was inserted into bacteria, which then produced large quantities of human insulin protein. This replaced the older practice of extracting insulin from animal pancreases.

50. A — When water is in short supply, the pituitary releases ADH (antidiuretic hormone), which signals the kidneys to reabsorb more water from the filtrate. The result is a smaller volume of more concentrated urine, conserving body water.

51. C — Antibodies are Y-shaped proteins made by B lymphocytes that bind to specific antigens on pathogens. This binding neutralizes the pathogen or tags it for destruction by other immune cells — the molecular basis of the adaptive immune response.

52. A — Fever is part of the body's innate (nonspecific) immune response. Mildly elevated body temperature slows pathogen replication and enhances the activity of immune cells, helping the body fight the infection.

53. D — Cancer is fundamentally a disease of disrupted cell-cycle regulation, in which mutated cells divide uncontrollably and form tumors. The cause is multifactorial — genetic mutations and environmental factors both contribute — and cancer cells fail the normal checkpoint controls that limit healthy cell division.

54. B — Hormones are chemical messengers produced by endocrine glands and carried throughout the body in the bloodstream, where they bind to specific target-cell receptors. This is distinct from the nervous system's electrical signaling along nerve cells.

55. A — Vigorous exercise raises muscle demand for O_2 and produces more CO_2. The cardiovascular and respiratory systems respond by increasing heart rate and breathing rate, delivering more oxygen to muscle tissue and clearing carbon dioxide more rapidly — a homeostatic response.

56. C — The placenta is a temporary organ that forms during pregnancy and serves as the interface between maternal and fetal blood. Through it, oxygen, nutrients, and antibodies pass from mother to fetus while waste products move in the opposite direction, without mixing the two bloodstreams directly.

57. D — A zygote is the single diploid cell that results when a sperm fertilizes an egg, containing the complete set of chromosomes for the new individual. Cleavage of the zygote then produces the embryo and later the fetus.

58. B — A pedigree is a family-tree diagram that tracks the inheritance of a particular trait across generations, using standardized symbols for affected and unaffected males and females. Genetic counselors use pedigrees to estimate the probability that a future child will inherit a genetic condition.

59. A — Sickle-cell anemia results from a single base change (A → T) in the gene for the beta-globin subunit of hemoglobin, which causes a single amino acid substitution. That one change alters the protein's shape under low oxygen and makes red blood cells sickle, dramatically demonstrating how a tiny genetic change can produce a major phenotypic effect.

60. C — When two populations of a single species become geographically separated, gene flow between them stops; over many generations, they accumulate genetic differences and eventually become unable to interbreed — the classical model of allopatric speciation.

61. B — Pioneer species are the first organisms to colonize bare, lifeless surfaces during primary succession. Lichens and mosses tolerate harsh conditions and gradually break down rock into soil, paving the way for grasses, shrubs, and trees to follow.

62. D — Density-independent factors affect a population regardless of how many individuals are present; they are typically abiotic events such as droughts, hurricanes, floods, fires, or extreme temperatures. Competition, disease, and predation are density-dependent because their impact grows as population density increases.

63. C — Zebra mussels are not native to North America and have spread aggressively through the Great Lakes, where they outcompete native mussels and clog water systems. By definition, they are an invasive non-native species.

64. A — As temperatures shift, many plant and animal species move poleward or upslope to track conditions within their tolerance range. These observed range shifts are among the most well-documented biological responses to global climate change.

65. D — Sulfur and nitrogen oxides from burning fossil fuels combine with atmospheric water to form sulfuric and nitric acids, which fall as acid rain. Lower pH in lakes and streams kills sensitive fish, amphibian eggs, and aquatic invertebrates and damages whole food webs.

66. B — Protected reserves and national parks safeguard intact habitat and the species that depend on it, addressing the leading cause of biodiversity loss — habitat destruction. The other options harm rather than help biodiversity.

67. A — Bioremediation harnesses living organisms — often bacteria, fungi, or plants — to break down or sequester pollutants, transforming contaminants into less harmful substances. It is widely used for oil spills, contaminated soils, and wastewater treatment.

68. C — Wetlands act as natural filters, trapping sediments and absorbing nutrients and pollutants before they reach larger water bodies. They also provide critical habitat for many fish, amphibians, birds, and invertebrates, supporting both biodiversity and water quality.

69. B — Sunlight is effectively inexhaustible on human timescales, so solar energy is renewable; converting sunlight to electricity through photovoltaic panels produces no direct CO_2 emissions during operation. Coal, petroleum, and natural gas are all finite fossil fuels and release CO_2 when burned.

70. D — Photosynthesis builds glucose and releases O_2 using solar energy, while cellular respiration breaks down glucose using O_2 to release energy as ATP, producing CO_2 and H_2O. The two processes use each other's products, forming a complementary cycle of carbon and energy.

71. A — Chloroplasts capture solar energy and store it in glucose, while mitochondria release that stored energy to make ATP for cellular work. Plant cells need both organelles to capture sunlight and to convert its energy into a usable form.

72. C — Competition is strongest between organisms whose niches overlap most — that is, those using the same limited resources at the same time in the same place. The competitive exclusion principle predicts that two species with identical niches cannot coexist indefinitely.

73. B — Standardizing the measurement technique — counting beats for the same time interval and using the same calculation method — keeps the procedure consistent across trials. This control prevents differences in technique from being mistaken for real differences in pulse rate.

74. D — In the "Beaks of Finches" lab, each tool is a stand-in for a different beak shape or size. Students compare how well each "beak" gathers food, modeling how beak variation can affect feeding success and ultimately reproductive fitness.

75. C — A dim field of view is corrected by opening the iris diaphragm or increasing the light source intensity to allow more light to pass through the specimen. Switching objectives, cleaning the eyepiece, or adding water does not address the illumination issue.

76. A — A saltwater solution has a higher solute concentration than the inside of the cell, making it hypertonic. Water moves out of the cell by osmosis, the cytoplasm shrinks, and the membrane pulls away from the rigid cell wall — a process known as plasmolysis.

77. B — Comparing DNA base sequences in homologous genes is the most powerful test of evolutionary relatedness because shared sequence reflects shared ancestry directly at the molecular level. Physical traits can be misleading due to convergent evolution.

78. D — In paper chromatography, pigment molecules differ in how strongly they dissolve in the moving solvent and in how strongly they adhere to the stationary paper. Pigments with greater solubility and weaker paper attachment travel farther up the strip, producing separated colored bands.

79. A — Safety goggles protect the eyes from splashes and tissue fragments, and sharp instruments must be handled carefully and cut away from the body to avoid injury. Rushing, sharing scalpels, and eating in lab all increase the risk of accidents.

80. C — When repeated measurements show small variation around a true value, the arithmetic mean is the best single summary because it incorporates every data point and averages out random error. Reporting only the highest, lowest, or most frequent value would ignore most of the data.

81. D — Liquids in narrow tubes form a curved surface called a meniscus due to surface tension. The standard practice is to read the volume at the bottom of the meniscus, with the eye level with the liquid, to avoid parallax error.

82. B — Repeating each treatment with several seeds and averaging the results minimizes the influence of random variation in any individual seed. Larger sample sizes also make patterns easier to detect and conclusions more reliable.

83. A — Honest, accurate recording of all observed data — including those that contradict the hypothesis — is a cornerstone of scientific integrity. Unexpected results often lead to important new questions or to refinement of the hypothesis itself.

84. C — Bar graphs are best for comparing values across discrete categories, such as the average heights of different plant species. Continuous changes over time or smooth relationships between variables are better shown with line graphs.

85. B — A scientific conclusion should summarize what the data showed, state whether the hypothesis was supported, and explain the reasoning based on the evidence. It may also discuss possible sources of error and suggest follow-up investigations.