# PRACTICE EXAM 13: LIVING ENVIRONMENT REGENTS SIMULATION

**Time Allowed: 3 hours | Total Points: 85 | Passing: 65 scaled | Mastery: 85 scaled**

**PART A — CORE CONTENT MULTIPLE CHOICE (30 Questions, 30 Points)**

Answer all questions in this part.

1. Which of the following best illustrates an organism responding to a stimulus?

A. A maple tree growing taller each year by adding new cells

B. A sunflower turning its head to face the sun throughout the day

C. A bacterium splitting into two genetically identical cells

D. A protein being synthesized at a ribosome inside a cell

2. The building blocks of DNA and RNA are

A. fatty acids

B. amino acids

C. simple sugars

D. nucleotides

3. The endoplasmic reticulum studded with ribosomes is primarily involved in

A. the synthesis and processing of proteins for export from the cell

B. the breakdown of worn-out organelles for recycling in the cell

C. the storage of water and dissolved sugars in the cytoplasm

D. the production of ATP through oxidative phosphorylation reactions

4. Active transport differs from diffusion in that active transport

A. moves molecules from regions of high to low concentration without any input

B. occurs only across the membranes of plant cells, not animal cells

C. requires the cell to expend energy to move substances against a gradient

D. takes place only when temperature is exactly at the cell's optimum point

5. A scientist observes that an enzyme breaks down compound X but has no effect on compound Y, even though X and Y are similar molecules. This selectivity is best explained by

A. the temperature of the solution being lower than the enzyme's optimum

B. the size of the enzyme being larger than the substrate molecules involved

C. the random collision frequency between the enzyme and the two compounds

D. the specific shape of the enzyme's active site matching only one substrate

6. The raw materials needed for photosynthesis are

A. glucose and oxygen

B. carbon dioxide and water

C. nitrogen and phosphorus

D. ATP and amino acids

7. In humans, cellular respiration is essential because it

A. produces oxygen that is exhaled from the lungs into the atmosphere

B. removes excess water from cells through specialized channels

C. releases the energy stored in glucose for cellular activities

D. converts amino acids into glucose for use in the body

8. In DNA, the base adenine always pairs with

A. thymine

B. guanine

C. uracil

D. cytosine

9. DNA replication is described as semiconservative because

A. only the leading strand is copied while the lagging strand is discarded

B. half of the new DNA molecules are made from RNA components

C. only one of the two parent strands is preserved in the new molecules

D. each new DNA molecule contains one original strand and one newly synthesized strand

10. The enzyme that synthesizes a strand of RNA from a DNA template is called

A. DNA ligase

B. RNA polymerase

C. DNA polymerase

D. restriction enzyme

11. The amino acid that will be added to a growing protein chain is specified by

A. a three-base sequence (codon) on the mRNA strand

B. the chromosome number of the cell synthesizing the protein

C. the temperature of the cytoplasm during translation

D. the order in which the genes appear in the cell nucleus

12. A mutation that changes a single amino acid in the middle of a long protein chain will most likely

A. produce a completely unrelated protein with totally different function

B. always restore lost function in a previously defective protein

C. alter the protein's three-dimensional shape and possibly its function

D. duplicate the entire gene that codes for the protein involved

13. During the prophase stage of mitosis, the chromosomes

A. line up along the equator (center) of the cell in pairs

B. separate and move to opposite poles of the cell rapidly

C. decondense into long, thin chromatin fibers within the nucleus

D. condense into visible structures and the nuclear membrane begins to disappear

14. During meiosis, the event that contributes most to genetic variation among gametes is

A. the duplication of DNA before the first meiotic division

B. crossing over and independent assortment of homologous chromosomes

C. the separation of the cell membrane into two daughter cells

D. the formation of the spindle fibers in early prophase I

15. In snapdragons, a cross between a red-flowered plant (RR) and a white-flowered plant (WW) produces all pink-flowered offspring (RW). This pattern of inheritance is best described as

A. incomplete dominance, in which the heterozygote shows a blended phenotype

B. codominance, in which both alleles are fully expressed at the same time

C. simple Mendelian dominance, in which one allele masks the other completely

D. sex-linked inheritance, in which the trait depends on chromosome sex

16. In humans, the ABO blood group system is an example of a trait that is controlled by

A. a single pair of alleles, one of which is always dominant

B. multiple genes located on different chromosomes in the human genome

C. multiple alleles (more than two) for a single gene in the population

D. environmental factors that determine blood type after birth

17. Skin color in humans is controlled by several different genes, each contributing a small effect. This kind of inheritance is called

A. simple dominance with one gene controlling the trait

B. polygenic inheritance with multiple genes contributing

C. sex-linked inheritance carried on the X chromosome

D. codominant inheritance with both alleles expressed equally

18. Red-green color blindness is more common in males than in females because

A. the color blindness allele is found only on the Y chromosome of males

B. females have specific enzymes that prevent the color blindness allele from being expressed

C. males have more X chromosomes than females and so receive more copies of the allele

D. males have only one X chromosome, so a single recessive allele produces the trait

19. Which of the following is the raw material upon which natural selection acts?

A. heritable variation among individuals within a population

B. acquired characteristics gained during an organism's lifetime

C. behaviors learned by observing parents and other group members

D. environmental stability across many generations of organisms

20. The presence of similar genetic codes in nearly all living organisms suggests that

A. all organisms reproduce in exactly the same way using genetic material

B. genetic codes change rapidly in response to environmental change pressures

C. all living things share a common ancestor from which they descended

D. each species independently developed its own unique genetic system

21. In an experiment, dark-colored mice on a sandy beach are eaten more often by hawks than sand-colored mice. Over generations, this results in

A. all surviving mice becoming dark in color through learned camouflage

B. an increase in the frequency of sand-colored mice in the population

C. random mutations producing a completely new mouse species rapidly

D. the hawks evolving a preference for sand-colored prey species

22. The Galápagos finches studied by Darwin are believed to have evolved from a single ancestral species into many different species. This process is called

A. coevolution between two interacting species over time

B. competitive exclusion of one species by another in the same niche

C. natural selection acting in a single ancestral environment only

D. adaptive radiation, in which one ancestral species gives rise to many

23. An organism's ecological niche refers to

A. only the physical area where the organism lives in an ecosystem

B. the average lifespan of all members of a particular species

C. the role an organism plays in its environment, including its resource use and interactions

D. the genetic relationships between an organism and its closest evolutionary relatives

24. A population that has unlimited resources and no environmental pressure will tend to grow

A. exponentially, producing a J-shaped growth curve

B. linearly, with a constant increase per unit time

C. logarithmically, with growth slowing immediately

D. cyclically, oscillating up and down each season

25. Which of the following is a density-independent factor that can limit population growth?

A. an outbreak of disease that spreads more rapidly in crowded conditions

B. competition among individuals for limited nesting space and territory

C. predation that increases when prey numbers reach high densities

D. a severe winter storm that affects all individuals regardless of population size

26. In any food web, the organisms with the largest total biomass are generally the

A. tertiary consumers, since they sit at the top of the web

B. producers, because they capture the original energy from sunlight

C. decomposers, which receive energy from all trophic levels

D. secondary consumers, which feed on primary consumers

27. Photosynthesis and cellular respiration together cycle carbon between

A. the atmosphere (as $CO_2$) and living organisms (as carbon compounds)

B. living organisms and the deep ocean sediments only

C. fossil fuel deposits and the upper layers of soil

D. the upper atmosphere and the surface of rocks worldwide

28. Most plants are unable to use atmospheric nitrogen ($N_2$) directly because

A. plants cannot tolerate the presence of nitrogen gas in their environment

B. nitrogen gas immediately damages the chloroplasts in plant cells

C. plants lack the enzymes needed to break the triple bond in $N_2$ gas

D. nitrogen gas is too small to be absorbed by plant root cells

29. When the level of carbon dioxide in the blood rises above normal, the body responds by

A. decreasing the rate of breathing to conserve oxygen in the lungs

B. increasing the rate and depth of breathing to remove the excess $CO_2$

C. increasing the production of red blood cells to absorb more $CO_2$

D. lowering the body temperature to slow down metabolic activity

30. The specific recognition of a particular pathogen by the immune system is carried out by

A. red blood cells that have absorbed the pathogen's antigens

B. platelets that form clots around the invading pathogens

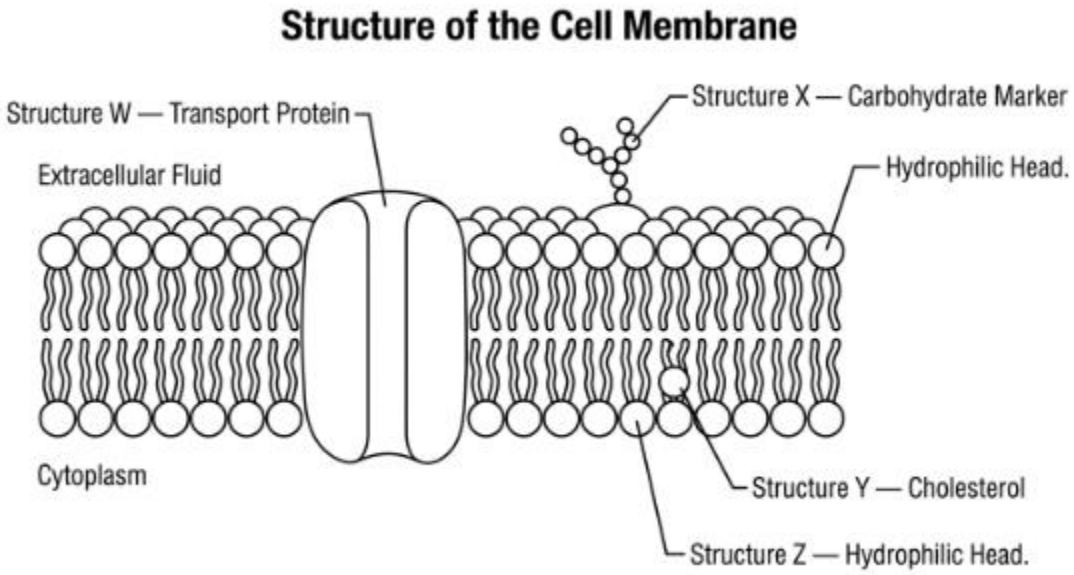
C. enzymes in saliva that destroy pathogens entering the mouth

D. lymphocytes that produce antibodies against the pathogen's antigens

**PART B-1 — DATA-BASED MULTIPLE CHOICE (13 Questions, 13 Points)**

Answer all questions in this part. Base your answers to questions 31-34 on the diagram below and on your knowledge of biology.

31. A student examines a diagram of a cell membrane showing the phospholipid bilayer with four labeled components.




Based on the diagram, which structure allows specific molecules to cross the membrane?

A. Structure W, the protein with a channel spanning the membrane

B. Structure X, the carbohydrate chain on the outer surface

C. Structure Y, the round molecule embedded among lipid tails

D. Structure Z, the hydrophilic head of a phospholipid molecule

32. Referring to the same diagram, the component most responsible for cell-to-cell recognition is

A. Structure W, the protein spanning the entire membrane

B. Structure Y, the molecule embedded among the lipid tails

C. Structure X, the carbohydrate chain attached to the outer surface

D. Structure Z, the hydrophilic head of the phospholipid molecule

33. Referring to the same diagram, the orientation of the phospholipid heads (Structure Z) toward both the extracellular and intracellular fluids indicates that the heads are

A. hydrophobic and repel water on both sides of the membrane

B. hydrophilic and attracted to water on both sides of the membrane

C. nonpolar molecules with no specific orientation in the membrane

D. composed of carbohydrate rather than lipid material entirely

34. Referring to the same diagram, the overall structure of the cell membrane is best described as a

A. rigid, single-layered structure made of carbohydrate molecules

B. continuous solid sheet of pure protein molecules layered together

C. random arrangement of lipids with no clear functional structure

D. fluid mosaic of phospholipids, proteins, and other molecules

Base your answers to questions 35-37 on the graph below and on your knowledge of biology.

35. A scientist measures the rate of cellular respiration in yeast cells at different temperatures.

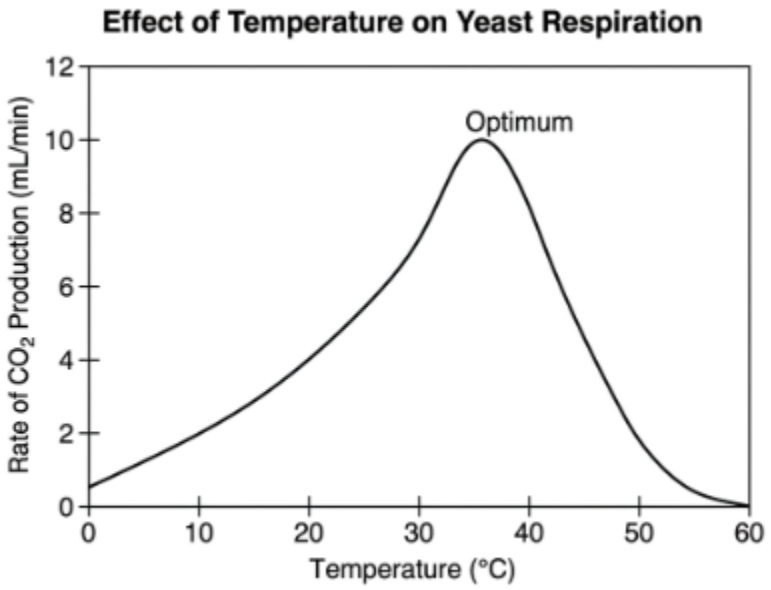



**Figure PQ-2**

Based on the graph, the optimum temperature for yeast respiration in this experiment is approximately

A. 37°C

B. 25°C

C. 50°C

D. 10°C

36. Based on the same graph, the sharp decline in respiration above 40°C is best explained by

A. yeast cells migrating to cooler regions of the test tube

B. an increase in available glucose at higher temperatures

C. denaturation of the enzymes involved in respiration

D. the freezing of water inside the yeast cells gradually

37. Based on the same graph, if a brewer wanted to maximize $CO_2$ production by yeast in dough, the dough should be kept at approximately

A. 5°C, the temperature of a typical refrigerator

B. 37°C, near the optimum temperature for these yeast cells

C. 55°C, near the temperature at which enzymes denature

D. 100°C, the boiling point of pure water at sea level

Base your answers to questions 38-40 on the data table below and on your knowledge of biology.

38. A scientist measures the population growth of two competing species of plankton (Species A and Species B) grown together in the same container over 30 days.

| Day | Species A (cells/mL) | Species B (cells/mL) |
|---|---|---|
| 0 | 100 | 100 |
| 5 | 250 | 220 |
| 10 | 500 | 400 |
| 15 | 750 | 350 |
| 20 | 1,000 | 200 |
| 25 | 1,200 | 80 |
| 30 | 1,400 | 20 |

Based on the data, the relationship between Species A and Species B is best described as

A. competition, with Species A outcompeting Species B over time

B. mutualism, with both species benefiting from each other's presence

C. commensalism, with Species A benefiting and Species B unaffected

D. predation, with Species A directly consuming Species B as food

39. Based on the same data, the principle that best explains why Species B declined while Species A increased is

A. random fluctuations in cell counts due to measurement error

B. the failure of Species B to reproduce sexually in the container

C. the absence of predators that would normally control both populations

D. competitive exclusion, in which one species outcompetes another for shared resources

40. Based on the same data, if Species A were removed from the container, Species B would most likely

A. continue to decline at the same rate as observed in the data

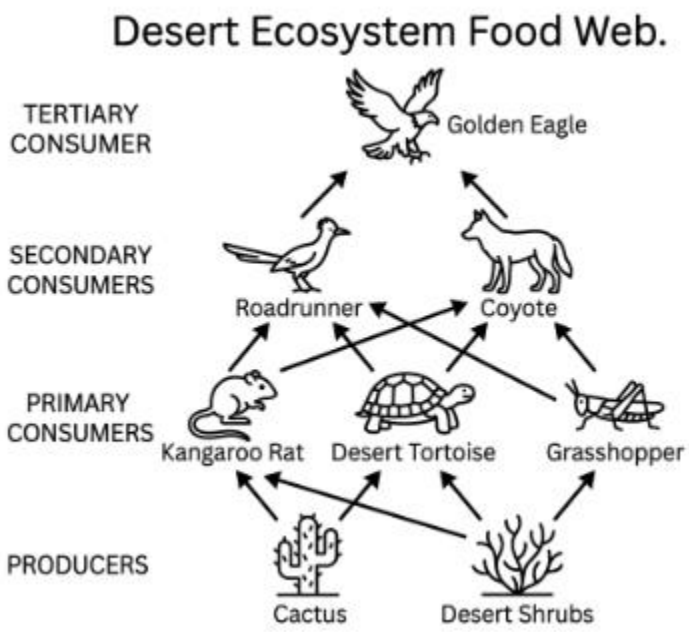
B. immediately begin to consume the remaining Species A cells

C. recover and increase in population, given the freed resources

D. evolve into a new species within a single growing season

Base your answers to questions 41-43 on the diagram below and on your knowledge of biology.

41. A student examines a food web for a desert ecosystem.




Based on the food web, the Kangaroo Rat is classified as a

A. producer, since it lives among the cacti and shrubs

B. tertiary consumer that occupies the highest trophic level

C. primary consumer that feeds directly on producers

D. decomposer that breaks down dead organic material in the desert

42. Based on the same food web, the Roadrunner and the Coyote may be considered competitors because they both

A. feed on the Kangaroo Rat as part of their diet

B. occupy the same physical territory in the desert at night

C. consume the same plant material when other food is scarce

D. produce the same number of offspring each year in the desert

43. Based on the same food web, an environmental change that reduced the Grasshopper population would most likely also reduce the

A. Desert Shrubs, since grasshoppers spread their seeds across the desert

B. Cactus, since grasshoppers pollinate desert cacti flowers each spring

C. Kangaroo Rat, since rats depend on grasshoppers for most of their food

D. Roadrunner, since grasshoppers are one of its main prey items

**PART B-2 — MIXED FORMAT (12 Questions, 12 Points)**

Answer all questions in this part.

44. A scientist makes the following statement: "If plants are grown with vitamin B added to their water, they will grow taller than plants without added vitamin B." This statement is best described as

A. a scientific theory based on extensive previous evidence

B. a testable hypothesis that can be investigated experimentally

C. a scientific law that always holds true under all conditions

D. a definitive conclusion based on completed experiments

45. In the experiment described above, the independent variable is

A. the presence or absence of vitamin B added to the water

B. the height of the plants at the end of the experiment

C. the species of plant chosen for the experiment

D. the amount of sunlight received by each plant per day

46. A student measures the same quantity five different times and obtains slightly different values each time. This variation in measurements is best described as

A. systematic error caused by a faulty measuring instrument

B. random error caused by the student's lack of training in the lab

C. random variation that is normal in scientific measurements

D. fabricated data that should be reported to the laboratory teacher

47. A pea plant with the dominant phenotype for tallness is crossed with a known short (homozygous recessive) plant. The offspring are observed to be a mix of tall and short plants in roughly equal numbers. The genotype of the original tall parent is most likely

A. homozygous recessive (tt)

B. carrying a third allele in addition to T and t

C. homozygous dominant (TT)

D. heterozygous (Tt)

48. A change in the DNA sequence of a gene is called a

A. translation

B. mutation

C. transcription

D. replication

49. Although a liver cell and a skin cell in the same person both contain identical genetic information, they look and function very differently. This difference is best explained by

A. different genes being expressed (turned on or off) in each cell type

B. the gradual loss of unneeded genes from each specialized cell type

C. random mutations occurring at different rates in each tissue type

D. environmental factors directly changing the DNA in each cell type

50. Comparisons of cytochrome c (a respiratory protein) show that humans and chimpanzees have identical amino acid sequences, while humans and yeast differ by many amino acids. This evidence supports the conclusion that

A. chimpanzees descended directly from yeast through evolution

B. cytochrome c is more important in humans than in yeast cells

C. humans and chimpanzees share a more recent common ancestor than humans and yeast

D. yeast cells are evolving faster than chimpanzees in modern times

51. An advantage of asexual reproduction over sexual reproduction is that asexual reproduction

A. produces offspring with greater genetic variation than sexual reproduction

B. allows the species to adapt more quickly to environmental changes

C. requires the participation of two parents from the same population

D. requires no mate and can produce many offspring quickly under favorable conditions

52. During the early stages of human development, the embryo begins as a single fertilized cell that divides repeatedly. By the time the embryo has many cells, the cells begin to specialize into different tissues. This process is called

A. fertilization, which combines the parents' DNA into one zygote

B. cellular differentiation, in which cells take on specific roles

C. crossing over, which exchanges chromosome segments during meiosis

D. mitosis, in which DNA is duplicated for the next cell division

53. A couple has a family history of a particular genetic disorder and is considering having a child. They would most appropriately consult a

A. genetic counselor, who can analyze the family history and explain risks

B. forensic scientist, who can compare their DNA to public records

C. ecologist, who can assess the environmental causes of disease

D. paleontologist, who can compare them to ancestral populations

54. Crops that have been genetically modified to resist insect pests are best described as

A. naturally occurring varieties found in the wild forests

B. produced by selective breeding between unrelated species

C. genetically engineered organisms with genes added in the laboratory

D. cloned organisms identical to a single ancestral plant only

55. A man and a woman who are both heterozygous for a rare recessive disorder (Aa × Aa) have four children. What is the probability that any one of their children will be affected with the disorder?

A. 0%

B. 25%

C. 50%

D. 100%

**PART C — EXTENDED CONSTRUCTED RESPONSE (17 Questions, 17 Points)**

Answer all questions in this part.

56. The function of the valves in the human heart is to

A. prevent the backflow of blood as the heart chambers contract

B. produce the electrical signals that cause the heart to beat

C. exchange oxygen and carbon dioxide between blood and lungs

D. filter waste products from the blood as it passes through

57. During inhalation, air enters the lungs because

A. the lungs actively pump air inward through muscle contraction

B. carbon dioxide in the blood pushes air into the lungs from outside

C. air molecules are attracted to the warmth of the lungs internally

D. the diaphragm contracts and the chest cavity expands, lowering pressure inside the lungs

58. The enzyme pepsin in the stomach breaks down which type of macromolecule?

A. carbohydrates such as starch and sugar

B. lipids such as fats and oils found in food

C. proteins from meat, eggs, and other foods

D. nucleic acids such as DNA from food sources

59. When the thyroid gland produces too much thyroid hormone, the pituitary gland responds by reducing its release of thyroid-stimulating hormone (TSH). This regulatory pattern is an example of

A. positive feedback amplifying the original change in hormone level

B. negative feedback maintaining hormonal homeostasis in the body

C. random hormonal fluctuation unrelated to any feedback mechanism

D. competitive inhibition between two competing hormones in the gland

60. The structural and functional unit of the nervous system is the

A. neuron

B. nephron

C. alveolus

D. ribosome

61. The skin, mucous membranes, and stomach acid are part of the body's

A. adaptive immune response, which is specific to particular pathogens

B. blood clotting system, which prevents loss of blood after injury

C. nonspecific (innate) defenses, which block or destroy many types of pathogens

D. nervous system, which detects and responds to environmental stimuli

62. When a high percentage of a population is vaccinated against a particular disease, even unvaccinated individuals may be protected because

A. the vaccine kills the pathogen in the environment around all individuals

B. unvaccinated individuals develop natural immunity by contact with vaccinated people

C. vaccines permanently eliminate all pathogens from a geographic region

D. fewer people can spread the disease, reducing the chance that any individual is exposed

63. A person with sickle-cell anemia produces red blood cells that take on an abnormal sickle shape under low-oxygen conditions. This shape change leads to medical complications because

A. the sickled cells are larger than normal and rupture other body cells

B. the sickled cells get stuck in small blood vessels and reduce blood flow

C. the sickled cells contain less iron than normal red blood cells

D. the sickled cells live longer than normal red blood cells, accumulating waste

64. Cancer cells differ from normal cells primarily in that cancer cells

A. divide uncontrollably and may invade nearby tissues

B. produce more ATP through more efficient metabolism overall

C. lack the ability to make any proteins because of damaged DNA

D. die more rapidly than normal cells in the same tissue

65. A potential medical use of stem cells is to

A. permanently replace all of a patient's chromosomes with healthy ones

B. produce antibodies that destroy all pathogens in the body forever

C. replace damaged or destroyed cells in tissues such as the heart or spinal cord

D. cure all known infectious diseases through a single injection

66. Forensic scientists can identify a suspect from a small drop of blood at a crime scene by

A. matching the shape of the red blood cells to a known database

B. determining the color of the suspect's blood through a chemical test

C. measuring the age of the blood sample with radioactive isotopes

D. analyzing the DNA pattern in the blood sample and comparing it to a suspect's DNA

67. Pesticides that do not break down quickly can accumulate to higher concentrations at each level of a food chain. This process is called

A. biomagnification

B. eutrophication

C. denitrification

D. photosynthesis

68. When fertilizer runoff from farms enters a lake, it often causes a sudden bloom of algae followed by the death of many fish. The fish die because

A. the fertilizer chemicals are directly toxic to fish at low concentrations

B. decomposing algae consume the oxygen in the water, suffocating the fish

C. algae release a poisonous gas that fish cannot tolerate in any amount

D. the fertilizer changes the temperature of the water rapidly, killing the fish

69. One of the most effective ways to protect endangered species is to

A. introduce non-native predators to control the population size

B. transfer all individuals of the species to zoos and aquariums permanently

C. remove all human activity from the entire planet immediately

D. preserve and protect their natural habitats from further destruction

70. Rising global temperatures are causing many species to

A. evolve thicker fur and feathers to deal with the changing climate

B. permanently increase their reproductive rates over a few generations

C. shift their geographic ranges toward the poles or to higher elevations

D. develop entirely new digestive systems to handle new foods

71. In ecological succession, the climax community is best described as

A. the very first community of pioneer species to colonize bare rock

B. a relatively stable community that persists until major disturbance occurs

C. a temporary community that exists for only a few months at a time

D. a community made up entirely of decomposers and detritivores

72. The relationship between a tick that feeds on a deer's blood and the deer is best classified as

A. parasitism, in which the tick benefits and the deer is harmed

B. mutualism, in which both the tick and the deer benefit equally

C. commensalism, in which the tick benefits and the deer is unaffected

D. competition, in which the tick and the deer compete for resources

**PART D — LABORATORY PRACTICAL (13 Questions, 13 Points)**

Answer all questions in this part.

73. In the Diffusion Through a Membrane laboratory, a student tests the contents of the dialysis tubing for starch and finds that starch is present. The student then tests the surrounding water for starch and finds no starch. The best conclusion is that

A. starch was created inside the dialysis tubing during the experiment

B. starch was destroyed in the water by the iodine surrounding the bag

C. starch and water cannot exist together in the same container at once

D. starch molecules are too large to pass through the pores of the dialysis tubing

74. In the Beaks of Finches simulation, students typically perform multiple rounds of seed-picking using different tools. The repeated rounds are important because they

A. make the simulation more interesting and competitive for students

B. allow students to practice using their tools more skillfully each round

C. simulate multiple generations, showing how traits change in a population over time

D. ensure that the most popular tool always wins the simulation overall

75. When a student examines a slide under low power and sees the specimen in the upper right of the field of view, switching to high power without first centering the specimen will most likely cause the specimen to

A. become much brighter in the field of view at higher magnification

B. move out of the field of view because the field becomes smaller

C. appear at the bottom left of the field of view at higher magnification

D. become invisible due to a change in the wavelength of light

76. In a biology laboratory, the cells of an onion epidermis are typically measured in

A. micrometers (μm), since cells are very small structures

B. centimeters (cm), since cells are visible to the naked eye

C. meters (m), since this is the standard SI unit of length

D. kilometers (km), since cells form large continuous tissues

77. A student adds an unknown solution to bromothymol blue indicator and the solution turns yellow. The unknown solution most likely contained

A. high concentrations of starch dissolved in water

B. high concentrations of glucose dissolved in water

C. mostly pure water with a neutral pH value

D. carbon dioxide, which forms a weak acid in water

78. In the Relationships and Biodiversity laboratory, students perform a paper chromatography test on different plant samples. Bands of similar color and position on the chromatography paper suggest that

A. the plants live in similar geographic areas today

B. the plants have identical genetic codes throughout their genomes

C. the plants contain similar pigments and may be closely related

D. the plants will be able to interbreed under laboratory conditions

79. In the Making Connections laboratory, students often use a clothespin clamping activity to test the effect of exercise on muscle fatigue. The number of clamps per minute typically decreases over time because

A. muscles fatigue as they continue working and produce less force per minute

B. clothespins become harder to grip as a student's hand temperature rises

C. the student's brain refuses to send signals to the hand after several minutes

D. clothespins lose their spring tension after being squeezed many times

80. While using a microscope, a student accidentally cracks the slide and notices a small cut on her finger. The first action she should take is to

A. continue working carefully until the laboratory period is over

B. notify the teacher immediately and wash and treat the cut

C. ignore the cut, since small cuts heal naturally without treatment

D. wrap the cut tightly with paper towels and continue working

81. Before preparing a wet-mount slide, a student should make sure that the specimen is

A. thoroughly dried so that no water will spread on the slide surface

B. cut into a thick block so that more cell layers can be observed at once

C. thin enough to allow light to pass through it for observation

D. stained heavily so that all internal structures show up dark

82. In a biology laboratory, the most appropriate instrument for measuring the temperature of a water sample is

A. a graduated cylinder marked in milliliters

B. an electronic balance that measures in grams

C. a meter stick or ruler marked in centimeters

D. a thermometer marked in degrees Celsius

83. When sketching what is seen through a microscope, a student should

A. draw only what is actually observed, without adding details from textbooks

B. include drawings of structures that should be present based on the textbook

C. add color to all structures, even if they appeared colorless on the slide

D. label the drawing with the names of every cell organelle ever discovered

84. A student investigates whether an enzyme works better at warm or cold temperatures. To make the experiment fair, the student must

A. test the enzyme at one temperature only and assume the result

B. keep all factors constant except temperature in the different trials

C. change temperature, pH, and enzyme concentration at the same time

D. use different enzymes for each temperature being tested

85. After completing an experiment, a student writes a conclusion that states whether the data supported the hypothesis. A complete conclusion should also

A. apologize for any mistakes made during the experiment that day

B. omit any sources of error to make the experiment appear flawless

C. promise that the experiment will always work the same way in the future

D. discuss possible sources of error and suggest improvements for future trials

# EXPLAINED ANSWER KEY – PRACTICE EXAM 13

**1. B** — Response to stimuli is one of the universal characteristics of life, and the sunflower turning to face the sun (phototropism) is a clear example. Growth, reproduction, and protein synthesis are other life processes but do not specifically demonstrate response to an external stimulus.

**2. D** — DNA and RNA are nucleic acids built from repeating units called nucleotides, each consisting of a sugar, a phosphate group, and a nitrogenous base. Fatty acids build lipids, amino acids build proteins, and simple sugars build carbohydrates.

**3. A** — The rough ER (endoplasmic reticulum studded with ribosomes) synthesizes proteins destined for secretion, membrane insertion, or organelle delivery, then packages them for transport. Other organelles such as lysosomes, vacuoles, and mitochondria handle breakdown, storage, and ATP production respectively.

**4. C** — Active transport uses ATP to move substances against their concentration gradient, while diffusion is passive and moves substances down the gradient without energy input. This distinction is essential for processes like nutrient uptake and ion balance in cells.

**5. D** — Enzymes are specific because each active site has a precise 3D shape that fits only certain substrates (the lock-and-key model). Even small structural differences between similar molecules prevent the wrong one from binding and being catalyzed.

**6. B** — Photosynthesis combines carbon dioxide (from the air) and water (from the soil) using light energy to produce glucose and oxygen: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$. Glucose and oxygen are products, not raw materials.

**7. C** — Cellular respiration breaks down glucose ($C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + ATP$) to release the chemical energy stored in its bonds and convert it into ATP. This ATP powers virtually every active cellular process in the body.

**8. A** — In DNA, adenine always pairs with thymine via two hydrogen bonds, and guanine pairs with cytosine via three. Uracil replaces thymine only in RNA, not DNA.

**9. D** — Each DNA molecule produced by replication contains one original template strand and one newly synthesized strand. This semiconservative pattern, demonstrated by Meselson and Stahl, ensures faithful copying of genetic information to daughter cells.

**10. B** — RNA polymerase reads a DNA template and assembles a complementary RNA strand during transcription. DNA polymerase replicates DNA, DNA ligase joins DNA fragments, and restriction enzymes cut DNA at specific sequences.

**11. A** — During translation, the ribosome reads three-base codons on the mRNA, and each codon specifies a particular amino acid that tRNA delivers. The genetic code is therefore read in triplets, with 64 possible codons coding for 20 amino acids and stop signals.

**12. C** — A change in a single amino acid in the middle of a protein can disrupt how the chain folds, altering the protein's 3D shape and potentially its function. Many genetic disorders, such as sickle cell anemia, arise from exactly this kind of single-amino-acid substitution.

**13. D** — In prophase, the diffuse chromatin condenses into visible distinct chromosomes and the nuclear envelope breaks down so that spindle fibers can attach to the chromosomes. Alignment occurs in metaphase, separation in anaphase, and decondensation in telophase.

**14. B** — Crossing over (exchange of segments between homologous chromosomes in prophase I) and independent assortment (random orientation of chromosome pairs in metaphase I) together generate enormous genetic variation in gametes. These processes are why siblings, except identical twins, are not genetically identical.

**15. A** — Incomplete dominance produces a heterozygous phenotype that is intermediate between the two homozygous phenotypes — in snapdragons, RR (red) × WW (white) gives RW (pink). In codominance, by contrast, both alleles would be fully expressed simultaneously, producing patches of red and white.

**16. C** — The ABO blood group is controlled by a single gene with three different alleles in the population (I^A, I^B, and i), so it is a classic example of multiple-allele inheritance. Although any one person has only two alleles, the population as a whole carries more than two.

**17. B** — Polygenic inheritance occurs when several different genes each contribute a small additive effect to a single trait, producing a continuous range of phenotypes. Human skin color, height, and weight are textbook examples of polygenic traits.

**18. D** — Color blindness is an X-linked recessive trait, and males (XY) have only one X chromosome. A single recessive allele on that X is therefore enough to produce the trait in a male, whereas a female needs two copies for expression.

**19. A** — Natural selection can only act on differences that already exist in a population and that can be passed to offspring — that is, heritable variation. Acquired traits and learned behaviors are not transmitted genetically, so they do not contribute to evolutionary change.

**20. C** — The near-universal genetic code (the same codons specify the same amino acids in bacteria, plants, and humans) is best explained by descent from a single common ancestor that originally used this code. Independent origins of life would not be expected to produce identical codes.

**21. B** — Sand-colored mice on a sandy beach are harder for hawks to see, so they survive longer and produce more offspring than dark-colored mice. Over generations, the frequency of the sand-colored alleles in the population rises through natural selection.

**22. D** — Adaptive radiation is the rapid diversification of a single ancestral species into many descendant species occupying different niches, exactly what Darwin's finches illustrate. Each Galápagos island offered different food sources, selecting for different beak shapes.

**23. C** — A niche is the full set of biological and physical conditions an organism uses — its food, habitat, behavior, and interactions with other species. It is more comprehensive than simply where the organism lives (its habitat), which is only part of the niche concept.

**24. A** — With unlimited resources and no checks, populations grow at an accelerating rate as more individuals reproduce, producing a J-shaped exponential growth curve. This pattern is only seen temporarily in nature because environmental limits eventually slow growth.

**25. D** — Density-independent factors limit populations regardless of how crowded they are; severe storms, floods, and fires kill individuals whether the population is large or small. Disease, competition, and predation typically become more important as density rises and are therefore density-dependent.

**26. B** — Because energy decreases by roughly 90% at each trophic level, producers at the base must contain the greatest total biomass to support all the consumers above them. This is why ecological pyramids of biomass usually have a wide base and a narrow top.

**27. A** — Plants take $CO_2$ out of the atmosphere during photosynthesis and incorporate the carbon into organic molecules, while respiration in all organisms (including plants) returns $CO_2$ to the atmosphere. Together these two processes complete the short-term biological carbon cycle.

**28. C** — Atmospheric $N_2$ has a strong triple bond that plants cannot break, so they depend on nitrogen-fixing bacteria (in soil or root nodules) to convert $N_2$ into ammonia and nitrates that plant roots can absorb. Without these bacteria, the nitrogen cycle would stall.

**29. B** — When blood $CO_2$ levels rise, chemoreceptors trigger the breathing center in the medulla to increase the rate and depth of breathing, expelling more $CO_2$. This negative feedback loop keeps blood gas levels and pH within homeostatic limits.

**30. D** — Specific (adaptive) immunity depends on lymphocytes — B cells produce antibodies that bind unique antigens on pathogens, and T cells recognize infected cells. This antigen-specific recognition is the basis of long-term immunity and vaccination.

**31. A** — Structure W, the transport protein with a channel running through the membrane, allows specific molecules to cross the otherwise impermeable phospholipid bilayer. Ion channels and carrier proteins of this kind are essential for nutrient uptake, ion balance, and signaling.

**32. C** — Carbohydrate markers (Structure X) attached to membrane proteins and lipids on the cell's outer surface act as identification tags that other cells, antibodies, and pathogens can recognize. This system underlies blood typing and immune recognition of "self" versus "foreign."

**33. B** — The phospholipid heads orient toward the watery environments on both sides of the membrane because they are polar (hydrophilic) and attracted to water, while the hydrophobic tails cluster in the membrane interior away from water. This arrangement is what makes the bilayer self-assemble and remain stable.

**34. D** — The fluid mosaic model describes the membrane as a "fluid" of phospholipids in which proteins, cholesterol, and carbohydrates are embedded in a mosaic-like pattern, with the components able to move laterally. This dynamic structure underlies the membrane's flexibility and selective permeability.

**35. A** — The graph peaks at 37°C, identifying it as the optimum temperature for yeast respiration in this experiment. This is consistent with yeast enzymes functioning best near mammalian body temperature.

**36. C** — Temperatures above the optimum disrupt the hydrogen bonds and other interactions that hold respiratory enzymes in their proper 3D shape, causing denaturation and loss of catalytic activity. Without functional enzymes, respiration drops sharply, as shown on the graph.

**37. B** — Yeast respiration produces $CO_2$, which causes dough to rise; keeping the dough near 37°C (the enzyme optimum) maximizes the rate of $CO_2$ production according to the graph. Refrigeration slows it dramatically, and high heat denatures the enzymes.

**38. A** — Species A grows steadily while Species B rises briefly and then crashes — a hallmark of interspecific competition in which one competitor outperforms the other for limited resources. There is no evidence of direct consumption, mutual benefit, or commensalism in the data.

**39. D** — Gause's competitive exclusion principle states that two species competing for exactly the same limiting resources cannot coexist indefinitely; one will outcompete and eliminate the other. The decline of Species B alongside the rise of Species A is a classic outcome of this principle.

**40. C** — If the dominant competitor (Species A) were removed, Species B would no longer face competition for shared resources and would be expected to rebound and increase. Populations of weaker competitors often recover quickly when their competitor is reduced or removed.

**41. C** — The Kangaroo Rat feeds directly on producers (Cactus and Desert Shrubs), placing it at the first consumer trophic level — making it a primary consumer (herbivore). It is neither a producer nor a decomposer, and it does not sit at the top of the food web.

**42. A** — Both the Roadrunner and the Coyote prey on the Kangaroo Rat, so they depend on the same food resource and are in direct competition for it. Sharing a prey species is the defining condition for competition between two consumers.

**43. D** — The Roadrunner feeds on Grasshoppers (and on Kangaroo Rats), so a sharp decline in grasshoppers would reduce one of the Roadrunner's main food sources. Other organisms in the web do not directly depend on grasshoppers.

**44. B** — A scientific hypothesis is a clear, testable "if–then" statement about a relationship between variables that can be investigated through experimentation. The vitamin B statement fits this pattern exactly, identifying both the independent and dependent variables.

**45. A** — The independent variable is the factor the experimenter deliberately changes — here, whether vitamin B is added to the plants' water. Plant height is the dependent variable, since it is the measured outcome that may change in response.

**46. C** — Small fluctuations in repeated measurements are normal and arise from countless minor uncontrolled factors; this is called random variation or experimental error. Recognizing random variation is why scientists take multiple readings and use averages rather than relying on a single number.

**47. D** — A test cross of a heterozygous (Tt) tall plant with a homozygous recessive (tt) short plant yields approximately a 1:1 ratio of tall (Tt) to short (tt) offspring, matching the observed result. If the tall parent had been TT, all offspring would have been tall.

**48. B** — A mutation is any permanent change in the DNA sequence of a gene, ranging from a single base substitution to large insertions, deletions, or chromosomal rearrangements. Transcription, translation, and replication are normal cellular processes, not changes in sequence.

**49. A** — All body cells in an individual share the same DNA, but each cell type transcribes (expresses) a different subset of genes, producing the unique proteins that give it its specialized structure and function. This differential gene expression is the basis of cell differentiation.

**50. C** — The smaller the difference in amino acid sequence between two species' proteins, the more recently they diverged from a shared common ancestor. Identical sequences between humans and chimpanzees indicate a very recent common ancestor, while large differences with yeast point to a much older divergence.

**51. D** — Asexual reproduction requires only one parent and can produce many offspring rapidly when conditions favor the parent's genotype — a major advantage in stable, favorable environments. It does sacrifice genetic variation, which is the trade-off compared with sexual reproduction.

**52. B** — Cellular differentiation is the process by which initially similar cells in the developing embryo turn on different sets of genes and become specialized into tissues such as nerve, muscle, and skin. This regulated specialization is what builds a complex multicellular organism from a single zygote.

**53. A** — Genetic counselors are trained professionals who interpret family medical histories, calculate inheritance probabilities, and explain genetic test results to help families make informed reproductive choices. The other professionals listed do not specialize in inherited human disease.

**54. C** — Genetically modified crops are produced in the laboratory by inserting specific genes (often from another species, such as a bacterium) into the plant's genome to confer a desired trait. This is distinct from traditional selective breeding, which works only with variation already in the species.

**55. B** — A cross of Aa × Aa produces offspring in a 1 AA : 2 Aa : 1 aa ratio, so 25% (one-quarter) of offspring are homozygous recessive and show the disorder. Each pregnancy is an independent event, so this probability applies to each child individually.

**56. A** — The atrioventricular and semilunar valves open in one direction only, ensuring that blood flows forward through the heart and preventing it from leaking back into the chambers when they relax. Without these valves, the heart could not produce effective forward circulation.

**57. D** — During inhalation, the diaphragm contracts and flattens while the rib muscles lift the rib cage, increasing the volume of the chest cavity. This volume increase lowers air pressure inside the lungs below atmospheric pressure, so air flows in down the pressure gradient.

**58. C** — Pepsin is a stomach protease that begins the chemical digestion of dietary proteins, breaking peptide bonds to release shorter polypeptides. It works best at the low pH provided by hydrochloric acid in the stomach.

**59. B** — Negative feedback occurs when the output of a process inhibits its own production, returning the system toward its set point. The pituitary's reduction of TSH in response to high thyroid hormone is a textbook example that keeps thyroid hormone levels within a narrow range.

**60. A** — The neuron is the specialized cell that transmits electrochemical signals throughout the nervous system. The other listed structures belong to the kidney (nephron), respiratory system (alveolus), and protein synthesis machinery (ribosome).

**61. C** — Innate (nonspecific) defenses are the body's first line of protection and include the physical barrier of intact skin, the mucous membranes lining body openings, and the chemical barrier of stomach acid. These defenses act against many kinds of pathogens without requiring prior exposure.

**62. D** — Herd immunity arises when so many people in a population are immune (through vaccination or prior infection) that the pathogen cannot easily spread from person to person. Even unvaccinated individuals are then less likely to encounter the pathogen and become infected.

**63. B** — In sickle cell anemia, the rigid sickle-shaped red blood cells become trapped in narrow capillaries and venules, blocking blood flow and causing pain, tissue damage, and organ injury (vaso-occlusive crises). Their abnormal shape, not their iron content or lifespan, is the central problem.

**64. A** — The defining feature of cancer is the loss of normal control over cell division, leading to unchecked proliferation that can form tumors and invade surrounding or distant tissues (metastasis). Mutations in proto-oncogenes and tumor suppressor genes drive this loss of regulation.

**65. C** — Because stem cells can divide and develop into a variety of specialized cell types, they hold therapeutic promise for replacing cells damaged by disease or injury — for example, replacing cardiac muscle after a heart attack or neurons after spinal cord injury. Current research focuses on safely directing differentiation into the desired cell type.

**66. D** — Forensic DNA analysis compares specific DNA regions (such as short tandem repeats) from a crime-scene sample with those of a suspect; matching profiles strongly suggest the same individual contributed the sample. Each person's DNA pattern (except identical twins) is unique.

**67. A** — Biomagnification is the increase in concentration of a persistent pollutant at each successive trophic level, because predators consume many contaminated prey and store the pollutant in their tissues. Mercury and DDT are classic examples, and top predators are typically most affected.

**68. B** — Excess nutrients trigger rapid algal blooms; when the algae die, bacterial decomposers consume large amounts of dissolved oxygen breaking them down. The resulting oxygen depletion (hypoxia) suffocates fish — the central problem in cultural eutrophication.

**69. D** — Habitat loss is the leading cause of species endangerment, so preserving and protecting natural habitats addresses the underlying threat most directly. Zoos and reserves can support individual populations, but only protected habitats sustain wild populations long term.

**70. C** — As temperatures rise, climates suitable for many species shift toward higher latitudes (poleward) and to higher elevations on mountains, and species track these shifts when they can. Species unable to disperse fast enough or that have no cooler refuge available face elevated extinction risk.

**71. B** — A climax community is the relatively stable, self-sustaining end stage of ecological succession, dominated by species that can reproduce and persist in the prevailing conditions until a significant disturbance restarts succession. It is the endpoint, not the beginning.

**72. A** — Parasitism is a symbiotic relationship in which one organism (the parasite) benefits at the expense of another (the host). A tick takes a blood meal — and may also transmit disease — while the deer loses blood and tissue health, fitting the parasitism definition precisely.

**73. D** — Starch is a very large polysaccharide molecule that exceeds the pore size of the dialysis tubing, so it cannot diffuse out into the surrounding water. Only smaller molecules such as iodine and glucose can pass through the simulated cell membrane.

**74. C** — Each round of the Beaks of Finches simulation represents one generation of finches, with the most successful "beak" tools surviving and reproducing into the next round. Multiple rounds therefore model how trait frequencies change over time as natural selection acts.

**75. B** — As magnification increases, the field of view becomes proportionally smaller, so any specimen not already in the center of the low-power field will fall outside the high-power field. Centering before switching objectives prevents losing the specimen and saves time refocusing.

**76. A** — Plant and animal cells typically range from about 10 to 100 micrometers, so micrometers (μm) are the standard unit for cell measurement under a light microscope. Centimeters and larger units are far too coarse for individual cellular dimensions.

**77. D** — Bromothymol blue turns yellow under acidic conditions, and dissolved $CO_2$ forms carbonic acid in water, which lowers the pH. The color change therefore signals that $CO_2$ (often produced by cellular respiration) has been added to the solution.

**78. C** — Paper chromatography separates plant pigments based on differences in their solubility and adhesion to the paper, producing characteristic band patterns. Plants with similar pigment patterns share similar biochemistry, which is one line of evidence for evolutionary relatedness.

**79. A** — As muscles work continuously, factors such as depleted ATP, accumulation of lactic acid, and impaired calcium handling cause muscle fatigue and reduce the force the muscle can generate. Fewer clamps per minute reflect this real physiological fatigue, which the lab is designed to demonstrate.

**80. B** — Any injury, even a small cut, must be reported to the teacher immediately and the wound washed and treated to prevent infection (especially when chemicals or biological materials are nearby). Continuing to work or ignoring the cut violates standard lab safety procedures.

**81. C** — A wet-mount specimen must be thin enough for light to pass through, since the microscope's light source illuminates the specimen from below. Thick specimens block light and appear as dark, indistinct shapes through the objective.

**82. D** — Temperature is measured directly with a thermometer calibrated in degrees Celsius (or Kelvin) in scientific laboratories. The other instruments measure volume, mass, or length and have no temperature scale.

**83. A** — Scientific drawings should record only what is actually observed in the field of view, free of details imagined or imported from textbooks. Honest, accurate drawings keep lab observations objective and faithful to the specimen examined.

**84. B** — A fair (controlled) test changes only the independent variable (here, temperature) and holds every other factor constant — enzyme amount, substrate, pH, time, and so on. This isolation allows any observed difference in activity to be attributed specifically to temperature.

**85. D** — A complete lab conclusion not only states whether the data support the hypothesis but also discusses possible sources of error and proposes improvements or follow-up experiments. This reflective practice strengthens the scientific value of the work and guides future investigations.