PRACTICE EXAM 14: LIFE SCIENCE: BIOLOGY SIMULATION (50 QUESTIONS)

1. A biologist places a few drops of iodine solution onto a slice of potato, and the area turns blue-black. This color change indicates that the potato contains:

A. Glucose, a simple sugar that directly powers cellular respiration

B. Protein, a compound that is built from long chains of amino acids

C. Starch, a complex carbohydrate that is used for energy storage

D. Lipid, a compound used by cells for their long-term energy storage

2. Water is often called the "universal solvent" and is essential for life. One important property of water that supports life processes inside cells is that it:

A. Dissolves many substances, allowing chemical reactions to occur in cells

B. Cannot pass through any cell membrane without the help of proteins

C. Releases large amounts of energy when it is broken down by the cell

D. Provides the carbon atoms used to build sugars during photosynthesis

3. The fluid mosaic model describes the cell membrane as a flexible layer made mostly of two layers of phospholipids with proteins embedded throughout. One major function of these embedded proteins is to:

A. Provide the cell with most of its stored genetic information

B. Produce the ATP that the cell uses to power all of its activities

C. Carry out photosynthesis to make food for the entire cell

D. Help transport certain materials across the cell membrane

4. A scientist compares two cells under a microscope. One has a cell wall, a large central vacuole, and chloroplasts; the other has none of these but does have a nucleus. The scientist can correctly conclude that:

A. Both cells are bacterial cells, since both of them contain genetic material

B. The first cell is a plant cell and the second is an animal cell

C. The first cell is an animal cell and the second is a plant cell

D. Both cells must be from the same organism and from the same tissue

5. In a diffusion lab, a student places a bag made of a selectively permeable membrane filled with starch solution into a beaker of iodine solution. After an hour, the contents of the bag turn blue-black but the beaker does not change color. The best explanation is that:

A. The starch molecules passed out of the bag into the surrounding beaker

B. The iodine and the starch both moved freely in both directions equally

C. The small iodine molecules entered the bag but the large starch could not leave

D. No molecules moved at all because the membrane blocked everything completely

6. During photosynthesis, the products are glucose and oxygen, while during aerobic respiration, the products are carbon dioxide and water. These two processes are described as interconnected in an ecosystem because:

A. The products of one process serve as the reactants of the other process

B. Both processes occur only inside the chloroplasts of plant leaf cells

C. Both processes release light energy that is used to power the ecosystem

D. The two processes both destroy matter and create new energy from nothing

7. A muscle cell that is very active during exercise contains a large number of mitochondria. The presence of many mitochondria in such a cell is most directly related to the cell's need to:

A. Store large amounts of genetic information for rapid cell division

B. Build the long protein fibers used for the contraction of the muscle

C. Remove waste products quickly from the inside of the muscle cell

D. Produce large amounts of ATP to supply energy for muscle activity

8. In humans, maintaining a stable body temperature near 37°C is an example of homeostasis. When a person becomes too cold, the body may begin to shiver. Shivering helps restore normal body temperature because the rapid muscle movements:

A. Reduce the blood flow to the skin so that less heat is lost outward

B. Release heat as a byproduct of the energy used by contracting muscles

C. Cause the person to sweat, which warms the surface of the skin quickly

D. Slow down the body's metabolism to conserve its remaining stored heat

9. A nerve impulse reaches the end of one neuron and must be passed to the next neuron across a tiny gap, where chemical messengers are released. The gap between two neurons is called the:

A. Axon, the long fiber that carries the impulse away from the cell body

B. Dendrite, the branch that receives incoming signals from other neurons

C. Synapse, the small space across which the chemical signal must travel

D. Reflex, the rapid automatic response to a particular kind of stimulus

10. After a meal, blood glucose rises, the pancreas detects this rise and releases insulin, and the blood glucose level returns toward normal. This self-regulating control, in which the response reverses the original change, is known as:

A. Negative feedback, a process that helps maintain homeostasis in the body

B. Positive feedback, a process that amplifies the original change in the body

C. Differentiation, the process by which cells become specialized for tasks

D. Active transport, the movement of substances against their concentration gradient

11. In protein synthesis, the genetic information in DNA is first used to build a strand of mRNA. This first step, in which an mRNA copy is made from a DNA template, is called:

A. Replication, in which a complete copy of the entire DNA molecule is produced

B. Translation, in which the mRNA is read to assemble a chain of amino acids

C. Mutation, in which a permanent change occurs in the sequence of DNA bases

D. Transcription, in which an mRNA molecule is built from a DNA template

12. A segment of DNA has the base sequence T–A–C–G–G–A. During transcription, what is the base sequence of the mRNA strand produced from this DNA template?

A. T–A–C–G–G–A, an exact copy of the original DNA template strand

B. A–U–G–C–C–U, with uracil pairing with adenine in the new strand

C. A–T–G–C–C–T, with thymine used in place of uracil in the strand

D. U–A–G–C–C–A, formed by shifting the bases one position to the side

13. A geneticist crosses two organisms and records that the offspring show a 3:1 ratio of a dominant trait to a recessive trait. This ratio most strongly suggests that the two parents in the cross were:

A. Both heterozygous for the gene controlling the trait being studied

B. Both homozygous dominant for the gene controlling the trait studied

C. Both homozygous recessive for the gene controlling the trait studied

D. One homozygous dominant and one homozygous recessive parent

14. In humans, hemophilia is a sex-linked recessive condition carried on the X chromosome. A father who has hemophilia and a mother who is not a carrier have a daughter. Regarding the hemophilia allele, the daughter will be:

A. Affected with hemophilia, since she inherits the allele from her father

B. Free of the allele entirely, since the father cannot pass his X to her

C. A carrier of the allele, since she inherits her father's affected X chromosome

D. Unable to inherit the allele at all, since only sons can ever carry it

15. A mutation occurs in a gene within a sex cell (gamete) of an organism. Compared with a mutation that occurs in a body cell, a mutation in a sex cell is significant because it:

A. Always causes the immediate death of the organism that carries it

B. Can never have any effect on the organism or on its future offspring

C. Will change the traits of every body cell in the parent organism

D. Can be passed on to the organism's offspring during reproduction

16. Scientists use techniques to make many identical copies of a particular gene or organism. Producing a group of genetically identical organisms from a single original is known as:

A. Selective breeding, in which organisms with desired traits are chosen to mate

B. Cloning, in which genetically identical copies are produced from one original

C. Crossing over, in which homologous chromosomes exchange genetic material

D. Mutation, in which the sequence of DNA bases is permanently changed

17. A farmer wants to develop a variety of wheat that produces more grain and resists a common plant disease. Over many generations, the farmer breeds together only the plants with the most grain and the best disease resistance. This practice is an example of:

A. Selective breeding, choosing organisms with desired traits to reproduce

B. Natural selection, in which the environment alone selects the survivors

C. Genetic engineering, in which genes are directly inserted into the wheat

D. Cloning, in which exact genetic copies of one plant are mass-produced

18. The cells of a developing embryo all contain the same DNA, yet they develop into many different specialized cells, such as nerve, muscle, and skin cells. The best explanation for how identical DNA produces different cell types is that:

A. Each cell type randomly loses the genes that it does not need anymore

B. The DNA is copied incorrectly in some cells, creating the different cell types

C. Different genes are turned on or off in different cells during development

D. Each specialized cell receives a completely different set of genes at first

19. Charles Darwin proposed that species change over time through natural selection. Which of the following must be present in a population for natural selection to occur?

A. A complete absence of any inherited variation among the individuals

B. Inherited variation among individuals and competition for limited resources

C. An environment that never changes at all over many successive generations

D. Reproduction in which every individual produces the same number of offspring

20. Two islands near each other have finches with slightly different beak shapes, each suited to the different foods available on that island. The most likely explanation for these differences in beak shape is that:

A. The finches deliberately changed their own beak shapes to fit the food

B. The beak differences are caused entirely by the diet of each individual bird

C. The two finch populations are completely unrelated and never shared ancestors

D. Natural selection favored different beak shapes on each island over time

21. The bones in the front limb of a human arm, a whale flipper, and a bat wing show the same basic arrangement, even though the limbs perform very different functions. Structures that share a common underlying structure due to shared ancestry are called:

A. Homologous structures, indicating descent from a common ancestor

B. Vestigial structures, which have lost their original function over time

C. Analogous structures, which evolved independently for the same function

D. Acquired structures, which an individual develops during its own lifetime

22. Scientists find that the DNA sequences of two bird species are far more similar to each other than to the DNA of a particular reptile species. Based only on this molecular evidence, the scientists can best conclude that:

A. The two bird species are more distantly related to each other than to the reptile

B. All three species evolved at exactly the same time from one shared ancestor

C. The two bird species share a more recent common ancestor with each other

D. The reptile species is the direct ancestor of both of the bird species studied

23. The widespread use of a particular pesticide is followed, several years later, by the appearance of insect populations that are no longer affected by it. The best explanation for the rise of these resistant populations is that:

A. The pesticide caused brand-new resistance genes to form in every insect

B. Insects that already carried resistance survived and passed it to their offspring

C. The surviving insects taught the others how to resist the pesticide directly

D. The pesticide became weaker and lost its effect on the insects over the years

24. In an ecosystem, the organisms that capture energy from sunlight and convert it into chemical energy stored in food are essential because they:

A. Break down dead organisms and return their nutrients back to the soil

B. Feed only on other animals at the very top of the ecosystem's food web

C. Consume the producers in order to obtain their energy and their nutrients

D. Form the base of the food web, supplying energy to all other organisms

25. A grassland food chain is: grass → grasshopper → frog → snake → hawk. If the grass at the base of this chain captures 20,000 units of energy, approximately how much energy would be available to the hawk at the top of the chain?

A. About 2 units, because only about 10% of the energy passes to each next level

B. About 2,000 units, because half the energy is lost at each level of the chain

C. About 10,000 units, because most of the energy is passed to the next level

D. About 20,000 units, because energy is fully conserved along the food chain

26. In a community, two species of birds both nest in the same kind of tree and feed on the same insects at the same time of day. According to the competitive exclusion principle, the most likely long-term outcome is that:

A. The two species will combine into a single new species over many generations

B. Both species will increase in number because they share all of their resources

C. One species may outcompete the other, or the two will divide the resources

D. Both species will leave the area entirely and never return to that habitat again

27. A lake near farmland receives runoff rich in fertilizer. Over the following weeks, algae grow rapidly across the surface, then die, and bacteria decompose them, after which fish in the lake begin to die. The most direct cause of the fish deaths is that:

A. The algae released a poison that killed the fish directly in the water

B. The decomposing bacteria used up much of the oxygen dissolved in the water

C. The fertilizer chemically burned the gills of the fish in the lake water

D. The algae blocked all of the sunlight that the fish needed to see their prey

28. A toxic chemical that does not break down easily enters a food chain at the level of the producers. As the chemical is passed up through the food chain, its concentration in the organisms tends to:

A. Decrease at each level, since most of the chemical is broken down by digestion

B. Stay exactly the same at every level, since the chemical does not change form

C. Decrease at each level, since the chemical is excreted faster than it is taken in

D. Increase at each level, becoming most concentrated in the top predators

29. A bare rock surface left behind by a retreating glacier is gradually colonized first by lichens, then by mosses, then by small plants, and eventually by larger plants and trees as soil slowly forms. This sequence of community development is best described as:

A. Secondary succession, which begins in an area that already contains soil

B. Eutrophication, the nutrient enrichment of a body of water over time

C. Primary succession, which begins in a lifeless area lacking any soil

D. Biomagnification, the buildup of toxins in higher levels of a food web

30. A population of rabbits grows quickly until it reaches a size that the meadow's food supply can support, after which it levels off and stays roughly constant. The maximum population size that the meadow can support over time is the meadow's:

A. Carrying capacity for the rabbit population in that meadow

B. Biotic potential, the fastest rate at which rabbits could possibly breed

C. Limiting factor, the single resource that restricts the population growth

D. Trophic level, the position the rabbits occupy in the food web there

31. Bees visit flowers to gather nectar for food and, in doing so, carry pollen from flower to flower, which helps the plants reproduce. In this relationship, both the bees and the flowering plants benefit. This type of relationship is best described as:

A. Predation, in which one organism captures and consumes another organism

B. Mutualism, in which both of the organisms involved benefit from the relationship

C. Parasitism, in which one organism benefits while the other one is harmed

D. Competition, in which both organisms struggle for the same limited resource

32. A clownfish lives among the stinging tentacles of a sea anemone, where it is protected from predators. The clownfish is unharmed by the stings, while the anemone is neither helped nor harmed by the clownfish's presence. This relationship is best classified as:

A. Mutualism, in which both the clownfish and the anemone gain a clear benefit

B. Parasitism, in which the clownfish benefits while the anemone is clearly harmed

C. Predation, in which the clownfish captures and eats the sea anemone for food

D. Commensalism, in which the clownfish benefits while the anemone is unaffected

33. Nitrogen gas makes up most of the atmosphere, but most organisms cannot use nitrogen directly in that form. Certain soil bacteria convert nitrogen gas into compounds that plants can absorb and use. These bacteria play a key role in the:

A. Carbon cycle, by returning carbon dioxide to the atmosphere from the soil

B. Water cycle, by moving water from the soil into the atmosphere as vapor

C. Nitrogen cycle, by changing nitrogen into a form that plants can use

D. Energy pyramid, by storing most of an ecosystem's energy in the soil

34. Human activities can disrupt natural ecosystems in many ways. Which of the following human activities would most likely lead to a decrease in the biodiversity of a region?

A. Clearing a large tropical rainforest to create farmland and grazing land

B. Setting aside a large area of forest as a permanently protected reserve

C. Restoring a wetland by removing pollution and replanting native species

D. Passing laws that protect endangered species from being hunted or harmed

35. Burning fossil fuels such as coal, oil, and natural gas releases large amounts of carbon dioxide into the atmosphere. Many scientists are concerned about this because increased carbon dioxide in the atmosphere is associated with:

A. A steady cooling of the global climate over the past several decades

B. A rise in average global temperatures linked to the greenhouse effect

C. A large and rapid increase in the amount of oxygen in the atmosphere

D. The complete loss of the protective ozone layer in the upper atmosphere

36. Living things are organized into levels of increasing complexity. Which of the following lists these levels correctly from the least complex to the most complex?

A. Organism, organ system, organ, tissue, cell, in order of decreasing size

B. Tissue, cell, organ, organism, organ system, in order of increasing size

C. Organ, cell, tissue, organ system, organism, in order of increasing size

D. Cell, tissue, organ, organ system, organism, in order of increasing complexity

37. Single-celled organisms must carry out all of the basic life functions, such as obtaining nutrients, removing wastes, and reproducing, within a single cell. In a complex multicellular organism, these various life functions are mainly carried out by:

A. A single cell that performs every function for the whole organism at once

B. The organism's genetic material, which directly performs the life functions

C. Specialized cells, tissues, and organs that each carry out particular functions

D. The nucleus of each cell, which independently performs every life function

38. A doctor tells a patient that a certain bacterial infection can be treated with antibiotics, but that a viral infection such as influenza cannot be treated with the same antibiotics. The main reason antibiotics do not work against viruses is that:

A. Viruses lack the cellular structures and processes that antibiotics target

B. Viruses are far too large for the antibiotic molecules to affect them at all

C. Antibiotics are designed to strengthen viruses rather than to destroy them

D. Viruses can only be killed by being frozen, which antibiotics cannot do

39. Vaccines have greatly reduced the occurrence of many serious diseases. A vaccine typically contains a weakened or inactivated form of a pathogen, or part of one. The vaccine protects a person from disease by:

A. Directly killing any pathogens that are already inside the person's body

B. Supplying antibiotics that the body uses to destroy the invading bacteria

C. Replacing the person's white blood cells with stronger, healthier ones

D. Stimulating the immune system to produce antibodies and memory cells

40. During strenuous physical activity, a person's heart rate and breathing rate both increase. These increases help the body meet the higher demands of exercise by:

A. Decreasing the amount of oxygen that the working muscle cells receive

B. Delivering more oxygen to the muscles and removing more carbon dioxide

C. Lowering the body's overall metabolic rate to conserve its stored energy

D. Stopping the production of carbon dioxide in the active muscle cells entirely

41. The human body has several lines of defense against disease. The skin acts as a first line of defense against pathogens mainly because it:

A. Produces antibodies that specifically target and destroy invading pathogens

B. Engulfs and digests any pathogens that come into contact with its surface

C. Forms a physical barrier that blocks many pathogens from entering the body

D. Releases memory cells that respond rapidly to pathogens it has seen before

42. A scientist designs an experiment to test whether the amount of light affects the rate of photosynthesis in a water plant. In this experiment, the amount of light the plant receives is the:

A. Independent variable, the factor that the scientist deliberately changes

B. Dependent variable, the factor that the scientist measures as the result

C. Control group, which receives no light at all during the experiment

D. Hypothesis, the explanation the scientist proposes before experimenting

43. In the same photosynthesis experiment, the scientist measures the rate of photosynthesis by counting the number of oxygen bubbles the plant produces each minute. The number of oxygen bubbles produced per minute is the:

A. Independent variable, the factor that the scientist deliberately changes

B. Control group, which is used as a baseline for comparison in the study

C. Hypothesis, the prediction the scientist makes before the experiment begins

D. Dependent variable, the factor that the scientist measures as the result

44. A student reads about a scientific study claiming that a certain herb cures the common cold. Before accepting this claim, the student should be most concerned with whether:

A. The herb has an interesting and memorable name that is easy to remember

B. The study was repeated and produced consistent results that others can verify

C. The herb is grown locally and can be purchased at a nearby grocery store

D. The scientist who carried out the study is personally well liked by other people

45. A scientist observes that plants in a shaded part of a forest tend to have larger leaves than the same kind of plants growing in full sunlight. Which of the following is the best hypothesis the scientist could form based on this observation?

A. The plants in the shade are a completely different species from those in the sun

B. Larger leaves are always harmful to plants no matter where they happen to grow

C. Plants in shaded areas may grow larger leaves to capture more available light

D. The amount of light a plant receives has no effect at all on the size of its leaves

46. A population of beetles includes individuals ranging from light gray to dark gray. After a factory coats the nearby tree trunks with dark soot, dark beetles become much harder for birds to see than light beetles. Over several generations, the beetle population would most likely:

A. Shift toward a higher proportion of dark beetles surviving and reproducing

B. Shift toward a higher proportion of light beetles, which are now easier to see

C. Stay exactly the same, since beetle color has no effect on their survival

D. Become entirely free of any color variation within just a single generation

47. A keystone species, such as the sea otter in a kelp forest, has an effect on its ecosystem far larger than its numbers alone would suggest. If a keystone species is removed from an ecosystem, the most likely result is:

A. No noticeable change, because every species in an ecosystem is equally important

B. A major change in the ecosystem, possibly altering many other populations

C. An immediate increase in the total number of species living in the ecosystem

D. The instant extinction of every other species that lives in the ecosystem

48. Ecologists studying a forest want to estimate the population of a certain ground beetle without counting every individual. They set traps in several small sample areas, count the beetles caught, and use the results to estimate the population of the whole forest. This method is called:

A. A controlled experiment with both a treatment group and a control group

B. Direct observation, in which every single individual is counted one by one

C. Biomagnification, the increase in a chemical's concentration up a food chain

D. Sampling, in which data from small areas is used to estimate the whole

49. An ecosystem with high biodiversity contains many different species filling many different roles. Compared with an ecosystem that has low biodiversity, an ecosystem with high biodiversity is generally:

A. Less able to recover after a disturbance such as a fire or a disease outbreak

B. More likely to collapse completely if a single species is ever removed from it

C. More stable and better able to recover from disturbances over time

D. Identical in stability, since biodiversity has no real effect on an ecosystem

50. Many human activities, such as recycling materials, conserving water, and protecting natural habitats, are intended to support sustainability. Sustainability is best described as:

A. Using resources in a way that meets present needs without harming the future

B. Using up all of the available natural resources as quickly as possible right now

C. Removing all human influence from every natural ecosystem on the planet

D. Replacing every natural ecosystem with farms to maximize food production

PRACTICE EXAM 14—–ANSWERS KEYS AND EXPLANATIONS

1. C — Iodine solution turns blue-black in the presence of starch, making it the standard indicator for this complex carbohydrate. The blue-black color in the potato confirms it stores energy as starch. Iodine does not produce this reaction with simple sugars, proteins, or lipids.
2. A — Water's polarity lets it dissolve many ionic and polar substances, so it serves as the medium in which the cell's chemical reactions take place. Dissolved reactants can move and interact within this watery environment. This solvent property is central to nearly all metabolic processes inside cells.
3. D — Many membrane proteins act as channels or carriers that move specific materials across the cell membrane, controlling what enters and leaves. This selective transport is essential to homeostasis. Genetic storage, ATP production, and photosynthesis are functions of other cell structures, not membrane proteins.
4. B — A cell wall, large central vacuole, and chloroplasts are features of plant cells, while an animal cell has a nucleus but lacks all three. The scientist can therefore identify the first as a plant cell and the second as an animal cell. Both have a nucleus, so neither is a bacterial (prokaryotic) cell.
5. C — Iodine molecules are small enough to pass through the selectively permeable membrane into the bag, where they react with the trapped starch to turn it blue-black. The starch molecules are too large to leave the bag, so the beaker stays unchanged. This demonstrates how membrane pore size determines which molecules can diffuse through.
6. A — Photosynthesis produces glucose and oxygen, which are the reactants of respiration, while respiration produces carbon dioxide and water, the reactants of photosynthesis. Each process supplies what the other needs, linking them in a continuous cycle. This interdependence keeps matter cycling through the ecosystem.

7. D — Mitochondria are the sites of aerobic respiration, where ATP is produced, so cells with high energy demands contain many of them. An active muscle cell needs abundant ATP to power contraction, which explains its large number of mitochondria. The quantity of mitochondria reflects the cell's energy requirements.
8. B — Shivering involves rapid, repeated muscle contractions that require energy, and these contractions release heat as a byproduct. This added heat helps raise the body temperature back toward normal when a person is cold. It is a homeostatic response that counteracts heat loss.
9. C — The synapse is the small gap between two neurons across which a chemical messenger (neurotransmitter) carries the signal. The axon and dendrite are parts of the neuron itself, not the gap. Identifying the synapse is key to understanding how impulses pass from one neuron to the next.
10. A — Insulin lowering elevated blood glucose back toward normal is a classic example of negative feedback, where the response reverses the original change. This keeps blood sugar within a stable range, maintaining homeostasis. Positive feedback, by contrast, would amplify the change rather than correct it.
11. D — Transcription is the process in which an mRNA molecule is synthesized using a DNA strand as a template. It is the first step of gene expression, preceding translation at the ribosome. Replication copies the whole DNA molecule, and translation builds the protein, so transcription is the correct term here.
12. B — Pairing each DNA base with its mRNA complement (A–U, T–A, G–C, C–G) converts the template T–A–C–G–G–A into the mRNA A–U–G–C–C–U. RNA uses uracil in place of thymine, which is why U appears opposite each A. This complementary pairing is how the genetic message is transcribed.
13. A — A 3:1 phenotypic ratio of dominant to recessive offspring is the classic result of crossing two heterozygotes (Aa × Aa). The cross yields three offspring with at least one dominant allele for every one homozygous recessive. This ratio is the signature of a monohybrid cross between two heterozygous parents.
14. C — The father (X^hY) passes his only X, which carries the hemophilia allele, to every daughter, while the non-carrier mother passes a normal X. The daughter therefore receives one affected and one normal X, making her a carrier. She is unaffected because the normal allele is dominant over the recessive hemophilia allele.
15. D — A mutation in a sex cell (gamete) can be passed on to offspring during reproduction, unlike a mutation in a body cell, which affects only the individual. This is why germ-line mutations have evolutionary and hereditary significance. The change becomes part of the genetic material inherited by the next generation.
16. B — Cloning produces genetically identical copies of a gene or organism from a single original. This differs from selective breeding and crossing over, which generate new combinations of traits, and from mutation, which changes the DNA. The defining feature of cloning is genetic identity to the original.
17. A — Selective breeding is the practice of choosing organisms with desired traits, such as high grain yield and disease resistance, to reproduce so those traits become more common. The breeder, not the natural environment, directs which individuals mate. This human-guided selection distinguishes it from natural selection.
18. C — All cells in an organism carry the same DNA, but cells become specialized because different genes are switched on or off in different cell types during development. This differential gene

expression produces nerve, muscle, and skin cells from identical genetic instructions. Cells do not lose or receive different genes; they simply use different ones.

19. B — Natural selection requires inherited variation among individuals and competition for limited resources, so that better-suited individuals survive and reproduce more. Without variation there would be nothing for selection to act on. These conditions allow advantageous traits to become more common over generations.
20. D — Different beak shapes suited to each island's food are best explained by natural selection favoring the most advantageous beaks in each environment over many generations. Birds do not change their own beaks, and the differences are inherited, not merely dietary. This is the same mechanism Darwin proposed for the Galápagos finches.
21. A — Homologous structures share the same basic internal arrangement because the organisms inherited it from a common ancestor, even though the limbs now serve different functions. This shared structure is evidence of common descent. Analogous structures, by contrast, look alike due to similar function but lack shared ancestry.
22. C — Greater similarity in DNA sequence indicates a more recent common ancestor, so the two birds, whose DNA is most alike, are more closely related to each other than to the reptile. Molecular similarity is a reliable measure of evolutionary relatedness. It does not make the reptile a direct ancestor of the birds.
23. B — Resistance arises because a few insects already carried resistance alleles, survived the pesticide, and passed the trait to their offspring, so resistant populations grew over time. The pesticide selects for pre-existing resistant individuals rather than creating new resistance genes. This is natural selection acting on insect populations.
24. D — Producers capture sunlight and convert it into chemical energy in food, forming the base of the food web and supplying energy to all other organisms. Consumers and decomposers ultimately depend on the energy producers capture. Without producers, the ecosystem would have no entry point for energy.
25. A — Only about 10% of energy passes to each successive trophic level, so 20,000 units drops to roughly 2,000, then 200, then 20, and finally about 2 units at the hawk. Each step loses most of the available energy as heat and through life processes. This is why top predators receive so little of the original energy.
26. C — The competitive exclusion principle states that two species cannot occupy the exact same niche indefinitely; one usually outcompetes the other, or the species partition the resources to coexist. Identical resource use leads to intense competition. The likely outcomes are exclusion of one species or resource division.
27. B — When bacteria decompose the dead algae, they consume large amounts of dissolved oxygen, lowering oxygen levels in the water until fish suffocate. This oxygen depletion, not a direct poison, is the immediate cause of the fish deaths. It is a typical consequence of nutrient pollution and algal blooms.
28. D — A persistent toxin that is not broken down becomes more concentrated at each higher trophic level, a process called biomagnification, so top predators accumulate the highest amounts. Each consumer takes in the stored toxin from all the prey it eats. This is why apex predators are most vulnerable to such chemicals.
29. C — Primary succession begins in a lifeless area with no soil, such as bare rock left by a glacier, where pioneer species like lichens slowly build soil over time. This distinguishes it from secondary succession, which starts where soil already exists. The absence of preexisting soil is the defining feature.

30. A — Carrying capacity is the maximum population size an environment can support over time given its resources, which is the level at which the rabbit population stabilizes. When resources become limiting, growth slows and the population levels off. This balance point is set by the available food and space.
31. B — In mutualism, both species benefit, as when bees gain nectar while flowers gain pollination. Each partner's activity helps the other reproduce or obtain food. This two-way benefit distinguishes mutualism from parasitism or commensalism.
32. D — Commensalism is a relationship in which one organism benefits while the other is neither helped nor harmed, as when the clownfish gains protection without affecting the anemone. This differs from mutualism, where both benefit, and parasitism, where one is harmed. The neutral effect on the anemone defines the relationship as commensalism.
33. C — Nitrogen-fixing bacteria convert atmospheric nitrogen gas into compounds such as ammonia or nitrates that plants can absorb, a crucial step in the nitrogen cycle. Most organisms cannot use nitrogen gas directly, so these bacteria make the element available to life. This role places them squarely in the nitrogen cycle.
34. A — Clearing a large tropical rainforest destroys the habitat of countless species, leading to a sharp decrease in biodiversity. Habitat loss is the leading cause of declining species diversity. The other choices—protecting reserves, restoring wetlands, and protecting endangered species—help preserve rather than reduce biodiversity.
35. B — Carbon dioxide is a greenhouse gas, and its increase from burning fossil fuels is linked to a rise in average global temperatures through the greenhouse effect. Trapped heat warms the planet rather than cooling it. This warming, not changes in oxygen or ozone, is the central concern.
36. D — The correct order from least to most complex is cell → tissue → organ → organ system → organism, with each level built from the one below. Cells form tissues, tissues form organs, organs form systems, and systems make the organism. This hierarchy reflects increasing structural and functional complexity.
37. C — In a complex multicellular organism, specialized cells, tissues, and organs each carry out particular life functions, rather than every function happening in one cell. This division of labor allows the organism to perform tasks more efficiently. It contrasts with single-celled organisms, which must do everything within one cell.
38. A — Antibiotics target structures and processes found in bacterial cells, such as cell walls and bacterial protein synthesis, which viruses do not possess. Because viruses lack these features and rely on host cells to reproduce, antibiotics have no effect on them. This is why viral illnesses like influenza require different treatments.
39. D — A vaccine exposes the immune system to a weakened or inactivated pathogen or its parts, stimulating the production of antibodies and memory cells without causing disease. If the real pathogen later appears, the body responds quickly. This prepared immune response, not antibiotics, is how vaccines protect.
40. B — Increased heart and breathing rates during exercise deliver more oxygen to the working muscles and remove the extra carbon dioxide they produce. This supports the higher rate of cellular respiration needed for activity. The body raises, rather than lowers, its oxygen delivery and metabolic activity during exercise.
41. C — The skin serves as a first line of defense by forming a physical barrier that blocks many pathogens from entering the body. This nonspecific protection works before any immune response is needed. Antibody production and memory cells belong to later, specific defenses, not to the skin barrier.

42. A — The independent variable is the factor the scientist deliberately changes, which here is the amount of light given to the plant. It is the variable being tested for its effect. The rate of photosynthesis that results would be the dependent variable.
43. D — The dependent variable is the factor measured as the outcome of the experiment, which here is the number of oxygen bubbles produced per minute. It depends on the independent variable, the light level. Measuring it shows how photosynthesis responds to the changes being tested.
44. B — A trustworthy scientific claim should be supported by repeated experiments that produce consistent, verifiable results. Reproducibility is what gives a finding reliability and allows other scientists to confirm it. The herb's name, availability, or the scientist's popularity are irrelevant to whether the claim is valid.
45. C — A good hypothesis offers a testable explanation consistent with the observation, such as the idea that shaded plants grow larger leaves to capture more of the limited light. It proposes a possible cause that an experiment could test. The other options either ignore the observation or make untestable assumptions.
46. A — When dark beetles are better camouflaged against soot-darkened bark, more of them survive predation and reproduce, so the proportion of dark beetles increases over generations. This is natural selection favoring the better-hidden variant. The population shifts toward dark coloration, not toward the more visible light beetles.
47. B — Removing a keystone species causes major changes throughout the ecosystem because its influence is far greater than its abundance suggests. Other populations may rise or fall sharply once it is gone, as when losing sea otters lets urchins destroy kelp forests. The effect is significant disruption, not no change or instant total extinction.
48. D — Sampling estimates a total population by collecting data from several small representative areas and scaling up the results. It is used when counting every individual is impractical, as with numerous ground beetles in a forest. This makes it the appropriate method described here.
49. C — High biodiversity generally makes an ecosystem more stable and better able to recover from disturbances, because varied species can fill different roles and respond to change. This resilience helps the ecosystem absorb events like fires or disease. Greater diversity supports stability rather than weakening it.
50. A — Sustainability means using resources in a way that meets present needs without compromising the ability of future generations to meet theirs. Practices like recycling, conserving water, and protecting habitats support this long-term balance. It is about responsible use, not exhausting resources or eliminating all human activity.