Board Exam Desk

General Biology Reviewer

General Biology | BIO | 120 original questions

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Review cell biology, genetics, evolution, plant and animal biology and ecology. There is no PRC board exam for biology, so this is a general review.

Practice questions

Cell Biology

1. In a eukaryotic cell, most ATP made by oxidative phosphorylation is produced in which organelle?

A. Golgi apparatus
B. Lysosome
C. Mitochondrion
D. Smooth endoplasmic reticulum

2. Which structure is present in both prokaryotic and eukaryotic cells?

A. A membrane-bound nucleus
B. Ribosomes
C. Mitochondria
D. Endoplasmic reticulum

3. According to the fluid mosaic model, which molecules form the basic bilayer of the plasma membrane?

A. Triglycerides
B. Phospholipids
C. Glycogen chains
D. Nucleic acids

4. A red blood cell is placed in a strongly hypertonic salt solution. What happens to the cell?

A. It gains water and bursts
B. It stays exactly the same size
C. It divides by mitosis
D. It loses water and shrinks

5. For each ATP hydrolyzed, the sodium-potassium pump moves which ions?

A. 2 Na+ out of the cell and 3 K+ into the cell
B. 3 Na+ into the cell and 2 K+ out of the cell
C. 3 Na+ out of the cell and 2 K+ into the cell
D. 1 Na+ out of the cell and 1 K+ into the cell

6. Which organelle modifies, sorts and packages proteins received from the endoplasmic reticulum for delivery to their destinations?

A. Golgi apparatus
B. Nucleolus
C. Peroxisome
D. Central vacuole

7. A protein that will be secreted by a pancreatic cell begins its synthesis on ribosomes and is threaded into which compartment?

A. Smooth endoplasmic reticulum
B. Mitochondrial matrix
C. Rough endoplasmic reticulum
D. Lysosome

8. Lysosomal hydrolytic enzymes work best under which condition inside the lysosome?

A. A strongly basic pH of about 10
B. An acidic pH of about 4.5 to 5
C. A neutral pH of exactly 7.0
D. A pH that matches the cytosol

9. Which observation best supports the endosymbiotic origin of mitochondria?

A. Mitochondria are built from Golgi vesicles
B. Mitochondria have their own circular DNA and bacteria-like ribosomes
C. Mitochondria have no membranes at all
D. Mitochondria are found only in plant cells

10. During mitosis, sister chromatids separate and move toward opposite poles in which phase?

A. Prophase
B. Metaphase
C. Telophase
D. Anaphase

11. Homologous chromosomes are separated from each other in which stage?

A. Anaphase II of meiosis
B. Anaphase I of meiosis
C. Anaphase of mitosis
D. Prophase II of meiosis

12. Crossing over between non-sister chromatids of homologous chromosomes takes place during which stage?

A. Metaphase II
B. Prophase I
C. Telophase I
D. Interphase G1

13. A human somatic cell has 46 chromosomes. How many chromosomes does each normal gamete produced by meiosis contain?

A. 46
B. 92
C. 12
D. 23

14. In which phase of the cell cycle is nuclear DNA replicated?

A. S phase
B. G1 phase
C. G2 phase
D. M phase

15. Which cytoskeletal elements are hollow tubes made of tubulin dimers and make up the mitotic spindle?

A. Microfilaments
B. Intermediate filaments
C. Collagen fibers
D. Microtubules

16. Which structures are channels through plant cell walls that connect the cytoplasm of neighboring plant cells?

A. Desmosomes
B. Tight junctions
C. Plasmodesmata
D. Gap junctions

17. Glucose enters a red blood cell through a carrier protein, moving down its concentration gradient without using ATP. What is this process called?

A. Primary active transport
B. Facilitated diffusion
C. Receptor-mediated endocytosis
D. Simple diffusion through the lipid bilayer

18. The cell walls of most fungi are made mainly of which polysaccharide?

A. Cellulose
B. Peptidoglycan
C. Lignin
D. Chitin

19. Gram-positive bacteria keep the crystal violet stain during Gram staining mainly because they have which feature?

A. An outer membrane containing lipopolysaccharide
B. A thick peptidoglycan layer in the cell wall
C. No cell wall at all
D. A membrane-bound nucleus

20. What is the main function of the nucleolus?

A. Storing calcium for muscle contraction
B. Making ribosomal RNA and assembling ribosomal subunits
C. Breaking down worn-out organelles
D. Producing ATP by glycolysis

Biochemistry of Life

21. Which covalent bond joins two amino acids in a polypeptide, forming by dehydration synthesis?

A. Peptide bond
B. Glycosidic bond
C. Phosphodiester bond
D. Hydrogen bond

22. Which polysaccharide is the main glucose storage molecule in animal liver and muscle?

A. Starch
B. Glycogen
C. Cellulose
D. Chitin

23. Compared with an unsaturated fatty acid, a saturated fatty acid has which property?

A. Many double bonds that put kinks in the chain
B. A phosphate group attached to every carbon
C. No carbon-carbon double bonds, so it packs tightly and is usually solid at room temperature
D. A ring structure like cholesterol

24. Which pair of features distinguishes RNA from DNA?

A. Deoxyribose sugar and the base thymine
B. Ribose sugar and the base thymine
C. Deoxyribose sugar and the base uracil
D. Ribose sugar and the base uracil

25. How does an enzyme speed up a chemical reaction?

A. It lowers the activation energy of the reaction
B. It makes the overall free energy change more negative
C. It shifts the equilibrium toward the products
D. It is used up as the reaction proceeds

26. A competitive inhibitor is added to an enzyme reaction. How are the kinetic constants affected?

A. Apparent Km increases while Vmax stays the same
B. Vmax decreases while Km stays the same
C. Both Km and Vmax decrease by the same factor
D. Km decreases while Vmax increases

27. What is the net ATP yield of glycolysis for each glucose molecule?

A. 4 ATP
B. 36 ATP
C. 0 ATP
D. 2 ATP

28. In eukaryotic cells, where does the citric acid (Krebs) cycle take place?

A. Cytosol
B. Inner surface of the plasma membrane
C. Mitochondrial matrix
D. Thylakoid lumen

29. What is the final electron acceptor of the electron transport chain in aerobic respiration?

A. NAD+
B. Pyruvate
C. Oxygen
D. Carbon dioxide

30. When oxygen is scarce, muscle cells convert pyruvate to lactate. What is the main benefit to the cell?

A. Lactate produces more ATP than the Krebs cycle
B. Carbon dioxide is fixed into sugar
C. Oxygen is produced for the mitochondria
D. NAD+ is regenerated so glycolysis can continue making ATP

31. In photosynthesis, the oxygen gas released by plants comes from which molecule?

A. Water
B. Carbon dioxide
C. Glucose
D. Ribulose bisphosphate

32. Which enzyme fixes carbon dioxide onto ribulose bisphosphate in the Calvin cycle?

A. Rubisco
B. ATP synthase
C. PEP carboxylase
D. DNA polymerase

33. In C4 plants such as corn and sugarcane, what is the first stable product of carbon dioxide fixation in mesophyll cells?

A. A three-carbon acid (3-phosphoglycerate)
B. Ribulose bisphosphate
C. Glucose
D. A four-carbon acid (oxaloacetate)

34. Pineapple is a CAM plant. How does it reduce water loss while still fixing carbon dioxide?

A. It keeps its stomata open only at midday
B. It fixes CO_2 without any enzyme
C. It opens its stomata at night and stores CO_2 as organic acids for use during the day
D. It takes in CO_2 through its roots instead of its leaves

35. Alpha helices and beta pleated sheets belong to which level of protein structure?

A. Primary structure
B. Secondary structure
C. Tertiary structure
D. Quaternary structure

Genetics and Molecular Biology

36. Two plants heterozygous for a trait with complete dominance (Aa x Aa) are crossed. What phenotypic ratio is expected in the offspring?

A. 1 dominant : 1 recessive
B. 1 : 2 : 1
C. All dominant
D. 3 dominant : 1 recessive

37. A purple-flowered pea plant of unknown genotype is crossed with a white-flowered (recessive) plant. What is this cross called and why is it done?

A. A reciprocal cross, to test for sex linkage
B. A backcross, to produce polyploid plants
C. A test cross, to find out whether the purple parent is homozygous or heterozygous
D. A dihybrid cross, to measure linkage between two genes

38. In a dihybrid cross AaBb x AaBb with independent assortment and complete dominance, what fraction of offspring show both recessive phenotypes?

A. 3/16
B. 1/16
C. 9/16
D. 1/4

39. A plant with genotype AaBb is crossed with an aabb plant. If the genes assort independently, what phenotypic ratio is expected?

A. 1 : 1 : 1 : 1
B. 9 : 3 : 3 : 1
C. 3 : 1
D. 1 : 2 : 1

40. In snapdragons, red (RR) crossed with white (WW) gives pink offspring through incomplete dominance. What phenotypic ratio results from crossing two pink plants?

A. 1 red : 2 pink : 1 white
B. 3 red : 1 white
C. 3 pink : 1 white
D. All pink

41. A mother with blood type A (genotype IAi) and a father with blood type B (genotype IBi) have a child. What is the probability that the child has type O blood?

A. 1/2
B. 1/4
C. 0
D. 3/4

42. A woman who carries an X-linked recessive allele for hemophilia has a son with a man who does not have hemophilia. What is the probability that the son has hemophilia?

A. 1/4
B. 1/2
C. 0
D. 1

43. Two genes on the same chromosome show a recombination frequency of 8 percent. What is the map distance between them?

A. 8 map units (centimorgans)
B. 92 map units
C. 4 map units
D. 16 map units

44. In Labrador retrievers, B (black) is dominant to b (brown), and a separate gene E is needed for pigment to be deposited; ee dogs are yellow whatever their B genotype. What ratio is expected from BbEe x BbEe?

A. 9 black : 3 brown : 3 yellow : 1 white
B. 12 black : 3 brown : 1 yellow
C. 3 black : 1 yellow
D. 9 black : 3 brown : 4 yellow

45. After DNA replication, each daughter double helix contains one original strand and one newly made strand. What is this mode of replication called?

A. Semiconservative replication
B. Conservative replication
C. Dispersive replication
D. Rolling-circle replication

46. Which enzyme makes the short RNA primers that DNA polymerase needs to start replication?

A. Helicase
B. DNA ligase
C. Topoisomerase
D. Primase

47. Which enzyme seals the gaps between Okazaki fragments on the lagging strand?

A. Primase
B. RNA polymerase
C. Reverse transcriptase
D. DNA ligase

48. In which direction does DNA polymerase synthesize a new DNA strand?

A. 3-prime to 5-prime, adding nucleotides to the 5-prime phosphate end
B. 5-prime to 3-prime, adding nucleotides to the 3-prime hydroxyl end
C. In either direction, depending on the strand
D. From the middle of the strand outward toward both ends at once

49. A double-stranded DNA sample contains 30 percent adenine. What percentage of its bases is cytosine?

A. 20 percent
B. 30 percent
C. 40 percent
D. 70 percent

50. What is the DNA sequence called where RNA polymerase binds to begin transcription of a gene?

A. Terminator
B. Promoter
C. Intron
D. Start codon

51. In eukaryotes, which complex removes introns from pre-mRNA and joins the exons together?

A. The ribosome
B. The spliceosome
C. DNA ligase
D. The proteasome

52. An mRNA codon reads 5-prime GCA 3-prime. Written 5-prime to 3-prime, what is the matching tRNA anticodon?

A. 5-prime UGC 3-prime
B. 5-prime CGU 3-prime
C. 5-prime TGC 3-prime
D. 5-prime GCA 3-prime

53. Which of these mRNA codons is a stop codon?

A. AUG
B. UGA
C. UGG
D. GAU

54. A base substitution changes a codon from GAA to GAG, and both code for glutamic acid. What kind of mutation is this?

A. Missense mutation
B. Nonsense mutation
C. Silent mutation
D. Frameshift mutation

55. What is the usual effect of inserting a single extra nucleotide near the start of a protein-coding sequence?

A. It changes only one amino acid and leaves the rest of the protein unaffected
B. It shifts the reading frame, changing the codons downstream of the insertion
C. It has no effect, because ribosomes skip extra bases
D. It always converts the start codon into a stop codon

56. Sickle cell disease results from a single base substitution that replaces glutamic acid with valine in beta-globin. What type of mutation is this?

A. Silent mutation
B. Nonsense mutation
C. Missense mutation
D. Frameshift mutation

57. In the lac operon of E. coli, what happens when lactose is present?

A. Lactose binds directly to RNA polymerase and blocks it
B. The repressor binds the operator more tightly and shuts the genes off
C. The lacZ gene is deleted from the chromosome
D. Allolactose binds the repressor, so the repressor releases the operator and the genes can be transcribed

58. Why is Taq polymerase used in the polymerase chain reaction (PCR)?

A. It stays active through the repeated high-temperature denaturation steps
B. It cuts DNA at specific palindromic sequences
C. It copies RNA into DNA
D. It joins DNA fragments into plasmids

59. In gel electrophoresis, why do DNA fragments move toward the positive electrode?

A. Their bases carry a strong positive charge
B. Gravity pulls them through the gel
C. Their phosphate backbone carries a negative charge
D. The gel actively pumps them in one direction

60. What do restriction enzymes do in recombinant DNA work?

A. They cut DNA at specific recognition sequences
B. They join Okazaki fragments together
C. They add poly-A tails to mRNA
D. They unwind the double helix during replication

Evolution and Biodiversity

61. Which condition is required for evolution by natural selection to occur?

A. Inheritance of traits acquired during an individual's lifetime
B. Heritable variation in traits that affect survival or reproduction
C. A population size that never changes
D. Equal reproductive success for every individual

62. In a population in Hardy-Weinberg equilibrium, 16 percent of individuals show a recessive phenotype. What is the expected frequency of heterozygotes?

A. 0.48
B. 0.16
C. 0.24
D. 0.36

63. The forelimbs of humans, bats and whales share the same basic bone arrangement but are used for different functions. What are these structures called?

A. Analogous structures
B. Vestigial structures
C. Convergent structures
D. Homologous structures

64. Which process changes allele frequencies at random and has its strongest effect in small populations?

A. Genetic drift
B. Natural selection
C. Gene flow from a large population
D. Directional selection

65. Which of these is a prezygotic reproductive isolating mechanism?

A. A mule, the offspring of a horse and a donkey, is sterile
B. Hybrid embryos die early in development
C. Hybrid offspring are fertile, but their own offspring are weak
D. Two related frog species breed in different months of the year

66. A mountain range rises and splits a population of beetles into two groups that later become separate species. What type of speciation is this?

A. Sympatric speciation
B. Polyploid speciation within one population
C. Allopatric speciation
D. Artificial selection

67. In the Linnaean hierarchy, which rank comes directly above genus?

A. Order
B. Species
C. Family
D. Class

68. The Philippine eagle has the scientific name Pithecophaga jefferyi. In binomial nomenclature, what does the second word, jefferyi, represent?

A. The genus
B. The family
C. The order
D. The specific epithet

69. Which feature distinguishes members of domain Archaea from members of domain Bacteria?

A. Archaea have a membrane-bound nucleus
B. Archaea lack peptidoglycan in their cell walls and have ether-linked membrane lipids
C. Archaea contain chloroplasts
D. Archaea are all multicellular

70. How do fungi obtain their nutrients?

A. They secrete digestive enzymes into their surroundings and absorb the products
B. They make sugar by photosynthesis in chloroplasts
C. They engulf food particles into a mouth-like opening
D. They fix nitrogen gas into sugars

71. Which of these is one of the four features that all chordates have at some stage of life?

A. A notochord
B. A vertebral column
C. A chitinous exoskeleton
D. Radial symmetry

72. The amniotic egg allowed which group of vertebrates to reproduce fully on land?

A. Amphibians
B. Amniotes: reptiles, birds and mammals
C. Bony fishes
D. Cartilaginous fishes

73. Which pair of features characterizes the phylum Arthropoda?

A. Jointed appendages and a chitinous exoskeleton
B. A water vascular system and tube feet
C. Stinging cells and radial symmetry
D. A shell, a muscular foot and a mantle

74. The Philippine tarsier, a small nocturnal mammal with very large eyes, belongs to which order?

A. Rodentia
B. Primates
C. Chiroptera
D. Carnivora

75. Stinging cells called cnidocytes are a defining feature of which group?

A. Cnidaria, such as jellyfish, corals and sea anemones
B. Porifera, such as sponges
C. Annelida, such as earthworms
D. Echinodermata, such as sea stars

Plant Biology

76. Which vascular tissue carries sugars from leaves to roots, fruits and other sink tissues?

A. Xylem
B. Epidermis
C. Phloem
D. Cork

77. What mainly drives the movement of water up the xylem of a tall tree?

A. Active pumping of water by ATP in each xylem vessel
B. Gravity pulling water upward
C. Contraction of muscle-like cells in the stem
D. Transpiration pull from the leaves, together with the cohesion of water molecules

78. What causes the stomata of a leaf to open?

A. Guard cells take up potassium ions, water follows, and the guard cells swell
B. Guard cells lose water and become limp
C. Root pressure pushes the stomata open
D. Ethylene dissolves the guard cell walls

79. What is the function of the Casparian strip in the root endodermis?

A. It produces new root hairs
B. It blocks water and minerals from passing between cells, forcing them through endodermal cell membranes
C. It stores starch for the seedling
D. It carries out photosynthesis in the root

80. Which plant hormone is mainly responsible for phototropism and apical dominance?

A. Abscisic acid
B. Ethylene
C. Cytokinin
D. Auxin

81. In germinating cereal seeds such as rice, which hormone from the embryo signals the aleurone layer to make amylase?

A. Abscisic acid
B. Ethylene
C. Gibberellin
D. Auxin

82. During drought, which hormone builds up in leaves and causes the stomata to close?

A. Gibberellin
B. Auxin
C. Cytokinin
D. Abscisic acid

83. A ripe banana placed in a closed bag with unripe mangoes speeds up their ripening. Which gaseous hormone is responsible?

A. Gibberellin
B. Cytokinin
C. Ethylene
D. Abscisic acid

84. In mosses, which generation is the dominant, longer-lived and photosynthetic stage of the life cycle?

A. The diploid sporophyte
B. The haploid gametophyte
C. The triploid endosperm
D. The diploid seed

85. Ferns differ from mosses in having which feature?

A. Vascular tissue (xylem and phloem)
B. Seeds
C. Flowers
D. A dominant gametophyte generation

86. In flowering plants, double fertilization produces a zygote and an endosperm. What is the usual ploidy of the endosperm?

A. Haploid (n)
B. Triploid (3n)
C. Diploid (2n)
D. Tetraploid (4n)

87. Which trait is typical of monocots such as rice and corn?

A. Two cotyledons in the seed
B. Net-like leaf venation
C. Floral parts usually in multiples of four or five
D. Vascular bundles scattered throughout the stem

88. What defines a gymnosperm such as a pine?

A. It reproduces only by spores
B. It has no vascular tissue
C. Its seeds are not enclosed in an ovary
D. It produces flowers and fruits

89. Which tissue is responsible for secondary growth, the increase in stem thickness of woody plants?

A. Apical meristem
B. Epidermis
C. Palisade mesophyll
D. Vascular cambium

90. What actually controls flowering in a short-day plant?

A. A day longer than a critical length
B. Any period of darkness, however short
C. An uninterrupted night longer than a critical length
D. Soil temperature alone

Animal Anatomy and Physiology

91. Which heart chamber pumps deoxygenated blood to the lungs through the pulmonary artery?

A. Left ventricle
B. Right atrium
C. Right ventricle
D. Left atrium

92. In what form is most carbon dioxide carried in human blood?

A. Bound to the iron of hemoglobin
B. As carbon monoxide
C. As gas bubbles in the red blood cells
D. Bicarbonate ions dissolved in the plasma

93. Which hormone increases water reabsorption in the collecting ducts of the kidney, producing more concentrated urine?

A. Insulin
B. Glucagon
C. Antidiuretic hormone (ADH)
D. Thyroxine

94. What causes the rapid rising (depolarization) phase of a neuron action potential?

A. Potassium ions leave the cell through voltage-gated channels
B. Voltage-gated sodium channels open and Na+ rushes into the cell
C. The sodium-potassium pump stops working
D. Chloride ions flow out of the cell

95. When an action potential reaches the axon terminal, which ion entering the terminal triggers the release of neurotransmitter?

A. Chloride (Cl-)
B. Magnesium (Mg2+)
C. Calcium (Ca2+)
D. Bicarbonate (HCO3-)

96. In skeletal muscle, what happens when calcium binds to troponin?

A. Myosin heads detach permanently from actin
B. ATP is made from creatine
C. The sarcomere lengthens
D. Tropomyosin moves, exposing myosin-binding sites on actin

97. Insulin is secreted by which cells and has what effect?

A. Alpha cells of the pancreatic islets; it raises blood glucose
B. The adrenal medulla; it raises heart rate
C. The thyroid gland; it raises metabolic rate
D. Beta cells of the pancreatic islets; it lowers blood glucose

98. Where in the human digestive tract are most nutrients absorbed?

A. Stomach
B. Large intestine
C. Small intestine
D. Esophagus

99. Which enzyme starts protein digestion in the stomach?

A. Salivary amylase
B. Pepsin
C. Pancreatic lipase
D. Trypsin

100. Which cells produce and secrete antibodies?

A. Plasma cells derived from B lymphocytes
B. Helper T cells
C. Red blood cells
D. Platelets

101. Which of these is an example of negative feedback?

A. Oxytocin release increasing the strength of labor contractions
B. Activated clotting factors activating even more clotting factors
C. Sweating when body temperature rises, which brings the temperature back down
D. Sodium entry during an action potential opening even more sodium channels

102. The brain and spinal cord develop from which embryonic germ layer?

A. Ectoderm
B. Endoderm
C. Mesoderm
D. Trophoblast

103. In actively working tissues, a lower blood pH makes hemoglobin release more oxygen. What is this called?

A. The Doppler effect
B. The Frank-Starling law
C. The Bohr effect
D. The all-or-none law

104. Which gland secretes thyroid-stimulating hormone (TSH)?

A. Anterior pituitary
B. Thyroid gland
C. Adrenal cortex
D. Pineal gland

105. Where are sperm cells produced in the human male?

A. Epididymis
B. Seminiferous tubules of the testes
C. Prostate gland
D. Vas deferens

Ecology

106. A grassland ecosystem has producers that capture 10,000 kcal of energy. Using the 10 percent rule, about how much energy reaches the secondary consumers?

A. 100 kcal
B. 1,000 kcal
C. 10 kcal
D. 5,000 kcal

107. Mycorrhizal fungi help plant roots absorb phosphorus and water, and the plants supply the fungi with sugars. What kind of relationship is this?

A. Mutualism
B. Commensalism
C. Parasitism
D. Competition

108. An orchid grows on a tree branch to reach sunlight but takes no nutrients from the tree and does not harm it. What kind of relationship is this?

A. Mutualism
B. Parasitism
C. Commensalism
D. Predation

109. In the logistic growth model, at what population size is the growth rate (individuals added per unit time) greatest?

A. When the population is very close to zero
B. Exactly at the carrying capacity (K)
C. At half the carrying capacity (K/2)
D. When the population exceeds the carrying capacity

110. Which set of traits describes an r-selected species?

A. Few large offspring and extended parental care
B. Long lifespan and late maturity
C. A population that stays steadily near carrying capacity
D. Many small offspring, early reproduction and little parental care

111. Rhizobium bacteria in the root nodules of legumes such as mungbean carry out which process?

A. Nitrogen fixation, converting N2 gas into ammonia
B. Denitrification, converting nitrate into N2 gas
C. Nitrification, converting ammonia into nitrate
D. Decomposition of cellulose

112. Which is an example of primary succession?

A. Grasses and shrubs regrowing on an abandoned rice field
B. A forest regrowing after logging
C. A grassland recovering after a fire
D. Lichens and mosses colonizing a newly cooled lava flow

113. What is a keystone species?

A. The species with the greatest total biomass in a community
B. Any species that was introduced by humans
C. A species whose effect on community structure is much larger than its abundance would suggest
D. The first species to colonize bare rock

114. Some mangrove trees, such as Avicennia, produce pencil-like roots called pneumatophores that stick up out of the mud. What is their main function?

A. Absorbing salt to make the leaves salty
B. Catching insects for nitrogen
C. Storing seeds until the tide goes out
D. Supplying oxygen to roots growing in waterlogged, oxygen-poor mud

115. Coral bleaching happens when stressed corals expel which symbiotic partners?

A. Parasitic worms living in their skeletons
B. Nitrogen-fixing bacteria in their mouths
C. Small reef fishes sheltering among their branches
D. Photosynthetic dinoflagellates (zooxanthellae) living in their tissues

116. Which process removes carbon dioxide from the atmosphere and builds it into organic molecules?

A. Cellular respiration
B. Combustion of fossil fuels
C. Photosynthesis
D. Decomposition

117. A persistent pesticide reaches higher concentrations in fish-eating birds than in the plankton at the base of the same food chain. What is this called?

A. Eutrophication
B. Ecological succession
C. Nitrogen fixation
D. Biomagnification

118. What does the competitive exclusion principle state?

A. Two species competing for exactly the same limiting resources cannot coexist indefinitely in the same place
B. Predators always drive their prey to extinction
C. Every species occupies more than one niche
D. Species with similar niches always form mutualisms

119. Humans in countries with good health care show high survival until old age, followed by a steep drop. Which survivorship curve fits this pattern?

A. Type II
B. Type I
C. Type III
D. Exponential growth curve

120. The Philippine eagle is described as endemic to the Philippines. What does endemic mean here?

A. It was introduced to the Philippines by humans
B. It migrates to the Philippines only during certain seasons
C. It occurs naturally only in the Philippines and nowhere else
D. It is found throughout tropical Asia

Answer key

General Biology

1. C. Mitochondrion

Oxidative phosphorylation runs on the electron transport chain and ATP synthase in the inner mitochondrial membrane.

2. B. Ribosomes

All cells make proteins on ribosomes. Prokaryotes lack a nucleus and membrane-bound organelles.

3. B. Phospholipids

Phospholipids are amphipathic, so they arrange into a bilayer with hydrophobic tails inside. Proteins sit in or on this bilayer.

4. D. It loses water and shrinks

Water moves by osmosis toward the higher solute concentration outside, so the cell shrinks (crenates).

5. C. 3 Na+ out of the cell and 2 K+ into the cell

The Na+/K+-ATPase exports three sodium ions and imports two potassium ions per cycle, which helps create the membrane potential.

6. A. Golgi apparatus

Proteins move from the ER to the Golgi, where they are modified (for example, glycosylated), sorted and packed into vesicles.

7. C. Rough endoplasmic reticulum

Secretory and membrane proteins are made on ribosomes bound to the rough ER and enter its lumen as they are synthesized.

8. B. An acidic pH of about 4.5 to 5

Proton pumps keep the lysosome interior acidic, and its hydrolases are most active at that low pH.

9. B. Mitochondria have their own circular DNA and bacteria-like ribosomes

Like bacteria, mitochondria have circular genomes, 70S-type ribosomes and divide by fission. This points to an ancestral bacterial symbiont.

10. D. Anaphase

In anaphase, cohesin is cleaved and spindle microtubules pull the separated chromatids to opposite poles.

11. B. Anaphase I of meiosis

Meiosis I is the reductional division in which homologs move apart. Sister chromatids separate later, in anaphase II.

12. B. Prophase I

Homologs pair (synapsis) in prophase I, and that is when chromatid segments are exchanged.

13. D. 23

Meiosis halves the chromosome number. Human gametes are haploid with 23 chromosomes.

14. A. S phase

DNA synthesis (replication) defines the S phase of interphase.

15. D. Microtubules

Microtubules are polymers of alpha- and beta-tubulin. They form the spindle, cilia and flagella.

16. C. Plasmodesmata

Plasmodesmata cross the plant cell wall and link adjacent cells. Gap junctions do a similar job in animal cells.

17. B. Facilitated diffusion

Movement down a gradient is passive. Because a carrier protein is needed, it is facilitated diffusion, not simple diffusion.

18. D. Chitin

Fungal walls are built mostly of chitin. Plant walls use cellulose and bacterial walls use peptidoglycan.

19. B. A thick peptidoglycan layer in the cell wall

The thick peptidoglycan wall holds the crystal violet-iodine complex during decolorizing. Gram-negative cells have a thin layer and an outer membrane.

20. B. Making ribosomal RNA and assembling ribosomal subunits

The nucleolus is where rRNA genes are transcribed and where rRNA joins proteins to form ribosomal subunits.

21. A. Peptide bond

A peptide bond forms between the carboxyl group of one amino acid and the amino group of the next, and a water molecule is released.

22. B. Glycogen

Animals store glucose as glycogen, a highly branched polymer. Starch is the storage form in plants.

23. C. No carbon-carbon double bonds, so it packs tightly and is usually solid at room temperature

Saturated chains are straight and pack closely, which raises the melting point. Animal fats such as butter are examples.

24. D. Ribose sugar and the base uracil

RNA nucleotides contain ribose, and RNA uses uracil in place of thymine.

25. A. It lowers the activation energy of the reaction

Enzymes stabilize the transition state, which lowers activation energy. They do not change the free energy change or the equilibrium, and they are not consumed.

26. A. Apparent Km increases while Vmax stays the same

A competitive inhibitor competes with substrate for the active site. Enough extra substrate overcomes it, so Vmax is unchanged but more substrate is needed to reach half Vmax.

27. D. 2 ATP

Glycolysis makes 4 ATP but uses 2 in the early steps, leaving a net gain of 2 ATP (plus 2 NADH and 2 pyruvate).

28. C. Mitochondrial matrix

Citric acid cycle enzymes are found in the mitochondrial matrix. Glycolysis happens in the cytosol.

29. C. Oxygen

At the end of the chain, cytochrome oxidase passes electrons to O2, which combines with H+ to form water.

30. D. NAD+ is regenerated so glycolysis can continue making ATP

Reducing pyruvate to lactate oxidizes NADH back to NAD+, which glycolysis needs in order to keep running.

31. A. Water

Photosystem II splits water, releasing O2, protons and electrons. Isotope-labeling experiments confirmed water as the source.

32. A. Rubisco

Rubisco joins CO2 to RuBP, and the product splits into two molecules of 3-phosphoglycerate.

33. D. A four-carbon acid (oxaloacetate)

PEP carboxylase fixes CO2 into four-carbon oxaloacetate. That is where the name C4 comes from.

34. C. It opens its stomata at night and stores CO2 as organic acids for use during the day

CAM plants take up CO2 in the cool night and store it as malic acid. They close their stomata by day and release the CO2 to the Calvin cycle.

35. B. Secondary structure

Secondary structure consists of local folding patterns held by hydrogen bonds between backbone groups.

36. D. 3 dominant : 1 recessive

The Punnett square gives 1 AA : 2 Aa : 1 aa. AA and Aa share the dominant phenotype, so the ratio is 3:1.

37. C. A test cross, to find out whether the purple parent is homozygous or heterozygous

If any offspring are white, the purple parent must carry the recessive allele (Aa). All purple offspring suggest it is AA.

38. B. 1/16

The chance of aa is 1/4 and of bb is 1/4. Together that is 1/4 x 1/4 = 1/16.

39. A. 1 : 1 : 1 : 1

The AaBb parent makes AB, Ab, aB and ab gametes in equal numbers. The aabb parent adds only recessive alleles, so four phenotypes appear equally.

40. A. 1 red : 2 pink : 1 white

RW x RW gives 1 RR : 2 RW : 1 WW. With incomplete dominance, each genotype has its own phenotype.

41. B. 1/4

Type O requires ii. Each parent passes i with probability 1/2, so 1/2 x 1/2 = 1/4.

42. B. 1/2

A son receives his only X from his mother. She passes the affected X half the time, so the probability is 1/2.

43. A. 8 map units (centimorgans)

One map unit is defined as a 1 percent recombination frequency, so 8 percent means 8 cM.

44. D. 9 black : 3 brown : 4 yellow

This is recessive epistasis. Of the 16 combinations, 9 are B_E_ (black), 3 are bbE_ (brown), and all 4 ee dogs are yellow.

45. A. Semiconservative replication

The Meselson-Stahl experiment showed that each new DNA molecule keeps one parental strand, which is semiconservative replication.

46. D. Primase

DNA polymerase can only extend an existing 3-prime end. Primase lays down the short RNA primer that provides it.

47. D. DNA ligase

DNA ligase forms the final phosphodiester bond that joins adjacent fragments into a continuous strand.

48. B. 5-prime to 3-prime, adding nucleotides to the 3-prime hydroxyl end

DNA polymerases add nucleotides only to a free 3-prime OH, so new strands always grow 5-prime to 3-prime. This is why the lagging strand is made in fragments.

49. A. 20 percent

By base pairing, A = T = 30 percent, leaving 40 percent for G + C. Since G = C, cytosine is 20 percent.

50. B. Promoter

RNA polymerase, often with transcription factors, recognizes and binds the promoter located upstream of the transcribed region.

51. B. The spliceosome

The spliceosome is made of snRNAs and proteins. It cuts out introns and joins exons during mRNA processing in the nucleus.

52. A. 5-prime UGC 3-prime

The anticodon is complementary and antiparallel (3-prime CGU 5-prime). Read 5-prime to 3-prime it is UGC, and tRNA contains U, not T.

53. B. UGA

UAA, UAG and UGA are the stop codons. AUG codes methionine and also serves as the start codon, UGG codes tryptophan, and GAU codes aspartate.

54. C. Silent mutation

The genetic code is redundant, so the new codon still specifies the same amino acid. The protein is unchanged.

55. B. It shifts the reading frame, changing the codons downstream of the insertion

Codons are read in groups of three. One extra base shifts every codon after it and often creates an early stop codon.

56. C. Missense mutation

One amino acid is swapped for another, which is a missense mutation. It changes how the hemoglobin behaves.

57. D. Allolactose binds the repressor, so the repressor releases the operator and the genes can be transcribed

Allolactose, made from lactose, acts as an inducer. It changes the repressor shape so it falls off the operator.

58. A. It stays active through the repeated high-temperature denaturation steps

Taq polymerase comes from the heat-loving bacterium Thermus aquaticus and survives the roughly 95 degree Celsius steps of each cycle.

59. C. Their phosphate backbone carries a negative charge

Phosphate groups make DNA negatively charged. Fragments move toward the anode, and smaller ones travel farther.

60. A. They cut DNA at specific recognition sequences

Restriction endonucleases recognize short, often palindromic sequences and cut there. This lets DNA pieces be cut out and inserted into vectors.

61. B. Heritable variation in traits that affect survival or reproduction

Selection acts on heritable differences that change how many offspring individuals leave. Without heritable variation, selection cannot change the population.

62. A. 0.48

q squared = 0.16, so q = 0.4 and p = 0.6. The heterozygote frequency is 2pq = 2 x 0.6 x 0.4 = 0.48.

63. D. Homologous structures

Homologous structures come from a common ancestor and keep a shared plan even when their functions differ.

64. A. Genetic drift

Drift is random sampling error between generations. Bottlenecks and founder events are examples, and small populations are most affected.

65. D. Two related frog species breed in different months of the year

Different breeding seasons (temporal isolation) stop mating before a zygote forms. The other choices act after fertilization.

66. C. Allopatric speciation

Allopatric speciation happens when a geographic barrier separates populations, so they diverge independently.

67. C. Family

From broadest to narrowest: domain, kingdom, phylum, class, order, family, genus, species.

68. D. The specific epithet

A binomial is genus plus specific epithet. Pithecophaga is the capitalized genus and jefferyi is the lowercase specific epithet.

69. B. Archaea lack peptidoglycan in their cell walls and have ether-linked membrane lipids

Archaea are prokaryotes, but their cell walls lack peptidoglycan and their membrane lipids use ether linkages instead of ester linkages.

70. A. They secrete digestive enzymes into their surroundings and absorb the products

Fungi are absorptive heterotrophs. They digest food outside their bodies and take up the small molecules through their hyphae.

71. A. A notochord

All chordates have a notochord, a dorsal hollow nerve cord, pharyngeal slits and a post-anal tail at some stage. A backbone is found only in vertebrates.

72. B. Amniotes: reptiles, birds and mammals

The amnion and other membranes keep the embryo in a fluid-filled, protected space, so eggs do not need to be laid in water.

73. A. Jointed appendages and a chitinous exoskeleton

Insects, crustaceans, arachnids and their relatives share jointed legs and an exoskeleton made of chitin that is shed as they grow.

74. B. Primates

Tarsiers are primates. They are neither rodents nor bats, even though they are small and active at night.

75. A. Cnidaria, such as jellyfish, corals and sea anemones

Cnidocytes contain nematocysts, which fire to capture prey. The phylum Cnidaria is named after them.

76. C. Phloem

Phloem sieve tubes move sugar solution from sources to sinks. Xylem carries water and minerals upward.

77. D. Transpiration pull from the leaves, together with the cohesion of water molecules

Water evaporating from leaves creates tension. Hydrogen-bonded water molecules then form a continuous column pulled up from the roots.

78. A. Guard cells take up potassium ions, water follows, and the guard cells swell

K+ uptake lowers the water potential of the guard cells. Water enters, and the cells bow apart to open the pore.

79. B. It blocks water and minerals from passing between cells, forcing them through endodermal cell membranes

The waxy suberin band blocks the apoplastic route, so the plant controls which minerals reach the xylem.

80. D. Auxin

Auxin moves to the shaded side of a shoot and makes those cells elongate. Auxin from the shoot tip also suppresses lateral buds.

81. C. Gibberellin

Gibberellin triggers amylase production, and amylase breaks endosperm starch into sugars for the growing seedling.

82. D. Abscisic acid

Abscisic acid (ABA) is a stress hormone. It makes guard cells lose ions and water, which closes the stomata and saves water.

83. C. Ethylene

Ripening fruit releases ethylene gas, which triggers ripening in nearby fruit.

84. B. The haploid gametophyte

The green moss plant is the haploid gametophyte. The sporophyte grows from it and depends on it for nutrition.

85. A. Vascular tissue (xylem and phloem)

Ferns are seedless vascular plants. Mosses are nonvascular. Neither group produces seeds or flowers.

86. B. Triploid (3n)

One sperm fertilizes the egg (2n zygote). The other fuses with the two polar nuclei, forming 3n endosperm.

87. D. Vascular bundles scattered throughout the stem

Monocots have one cotyledon, parallel veins, scattered vascular bundles and floral parts in threes. The other choices describe eudicots.

88. C. Its seeds are not enclosed in an ovary

Gymnosperm means naked seed. The seeds sit exposed on cone scales instead of developing inside an ovary.

89. D. Vascular cambium

The vascular cambium is a lateral meristem. It adds secondary xylem (wood) and secondary phloem, which thickens the stem.

90. C. An uninterrupted night longer than a critical length

Short-day plants measure night length. A brief flash of light in the middle of a long night can stop them from flowering.

91. C. Right ventricle

The right ventricle sends blood into the pulmonary circuit. The left ventricle pumps oxygenated blood into the aorta.

92. D. Bicarbonate ions dissolved in the plasma

Carbonic anhydrase in red blood cells converts CO2 into carbonic acid, which separates into H+ and bicarbonate. Bicarbonate carries most of the CO2.

93. C. Antidiuretic hormone (ADH)

ADH adds aquaporin channels to the collecting duct, so more water returns to the blood.

94. B. Voltage-gated sodium channels open and Na+ rushes into the cell

Once threshold is reached, Na+ channels open and Na+ floods inward. K+ outflow later brings the membrane back down (repolarization).

95. C. Calcium (Ca2+)

Voltage-gated Ca2+ channels open. The incoming calcium causes synaptic vesicles to fuse with the membrane and release their contents.

96. D. Tropomyosin moves, exposing myosin-binding sites on actin

Calcium binding shifts the troponin-tropomyosin complex, so myosin heads can attach to actin and form cross-bridges.

97. D. Beta cells of the pancreatic islets; it lowers blood glucose

Insulin from beta cells promotes glucose uptake and glycogen storage. Glucagon from alpha cells has the opposite effect.

98. C. Small intestine

Villi and microvilli give the small intestine a huge surface area for absorbing digested nutrients.

99. B. Pepsin

Pepsin is activated by stomach acid and begins breaking proteins into peptides. Trypsin works later, in the small intestine.

100. A. Plasma cells derived from B lymphocytes

Activated B cells become plasma cells, which release large amounts of antibodies.

101. C. Sweating when body temperature rises, which brings the temperature back down

Negative feedback reverses a change and returns a variable to its set point. The other choices amplify the change, which is positive feedback.

102. A. Ectoderm

The neural tube forms from ectoderm, which also gives rise to the epidermis.

103. C. The Bohr effect

Higher CO2 and H+ lower hemoglobin's affinity for oxygen. The dissociation curve shifts right and more O2 is unloaded.

104. A. Anterior pituitary

The anterior pituitary releases TSH, which signals the thyroid to produce thyroid hormones.

105. B. Seminiferous tubules of the testes

Spermatogenesis happens in the seminiferous tubules. Sperm then mature and are stored in the epididymis.

106. A. 100 kcal

About 10 percent passes to each level: 10,000 to 1,000 for primary consumers, then 100 for secondary consumers.

107. A. Mutualism

Both partners benefit, which defines mutualism.

108. C. Commensalism

The epiphytic orchid benefits while the tree is largely unaffected, which is commensalism.

109. C. At half the carrying capacity (K/2)

Growth is rN(1 - N/K), which peaks at N = K/2. Near zero there are few breeders, and near K growth slows to nothing.

110. D. Many small offspring, early reproduction and little parental care

r-selected species do well in unstable environments by producing many offspring quickly. K-selected species invest heavily in fewer offspring.

111. A. Nitrogen fixation, converting N2 gas into ammonia

Rhizobium uses the enzyme nitrogenase to reduce atmospheric N2 to ammonia that the plant can use. In return, the plant gives the bacteria sugars.

112. D. Lichens and mosses colonizing a newly cooled lava flow

Primary succession starts where there is no soil, such as bare rock or new lava. The other choices start with existing soil, which is secondary succession.

113. C. A species whose effect on community structure is much larger than its abundance would suggest

Removing a keystone species, such as a key predator, can greatly change the community even though the species may be uncommon.

114. D. Supplying oxygen to roots growing in waterlogged, oxygen-poor mud

Pneumatophores have pores (lenticels) and air spaces that let the roots exchange gases with the air.

115. D. Photosynthetic dinoflagellates (zooxanthellae) living in their tissues

Corals rely on zooxanthellae for color and much of their food. Heat stress causes them to expel the algae and turn white.

116. C. Photosynthesis

Photosynthesis fixes atmospheric CO2 into sugars. Respiration, combustion and decomposition release CO2.

117. D. Biomagnification

Fat-soluble, slow-to-break-down chemicals build up at each step of a food chain, so top predators carry the highest concentrations.

118. A. Two species competing for exactly the same limiting resources cannot coexist indefinitely in the same place

If two species have identical niches, the better competitor eventually eliminates the other unless their niches diverge.

119. B. Type I

A Type I curve shows low mortality early and in mid-life, with most deaths in old age.

120. C. It occurs naturally only in the Philippines and nowhere else

An endemic species is native to and found only within a particular geographic area.

Topics to review

- Cell biology and biochemistry
- Genetics and molecular biology
- Evolution, biodiversity, plant and animal biology
- Ecology

Online question banks and study resources

Biology 2e - OpenStax (Open textbook)

Independent study material prepared by Board Exam Desk.