Animal Physiology 5th edition Hill Test Bank

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Test Bank

to accompany

Animal Physiology, Fifth Edition

Hill • Cavanaugh • Anderson

Chapter 2
Molecules and Cells in Animal Physiology

Multiple Choice

1. How does venom permit a slow-moving predator to feed on prey capable of high-speed escape?
a. Venom disrupts sensory systems such that the prey can no longer detect the predator.
b. Venom disrupts the ability of the prey to digest food and thus have the energy to escape.
c. Venom shuts down the ability of the prey to move very far.
d. Venom confuses the prey such that it may run back in the direction of the predator.
Answer: c
Textbook Reference: Introduction
Learning Objective: 2.0.1 Explain by example how a venom can permit a slow-moving predator to feed on prey capable of high-speed escape.
Bloom's Level: 2. Understanding

2. Why have many venomous animals evolved venoms that break down phospholipids?
a. Phospholipids are an important component of venom.
b. Phospholipids are important in sensing predators.
c. Phospholipids are the key to muscular contraction.
d. Phospholipids are the fundamental structure of all cell membranes and intracellular membranes.
Answer: d
Textbook Reference: 2.1 Cell Membranes and Intracellular Membranes
Learning Objective: 2.1.1 Explain why venomous animals have often evolved venoms that break down phospholipids.
Bloom's Level: 2. Understanding

3. Which molecule is part of a cell membrane?
a. Cholesterol
b. Ubiquitin
c. Cyclic AMP
d. Calmodulin
Answer: a
Textbook Reference: 2.1 Cell Membranes and Intracellular Membranes

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Learning Objective: 2.1.3 Define cell-membrane fluidity and explain how it is affected by the specific phospholipids in a membrane.
Bloom's Level: 4. Analyzing

4. A molecule that consists of a polar portion and a nonpolar portion is said to be
a. hydrophilic.
b. hydrophobic.
c. an integral protein.
d. amphipathic.
Answer: d
Textbook Reference: 2.1 Cell Membranes and Intracellular Membranes
Learning Objective: 2.1.3 Define cell-membrane fluidity and explain how it is affected by the specific phospholipids in a membrane.
Bloom's Level: 1. Remembering

5. A saturated hydrocarbon tends to
a. be more liquid at colder temperatures compared to an unsaturated hydrocarbon.
b. be more solid at colder temperatures compared to an unsaturated hydrocarbon.
c. contain many double bonds.
d. contain fewer carbon–carbon bonds compared to an unsaturated hydrocarbon.
Answer: b
Textbook Reference: 2.1 Cell Membranes and Intracellular Membranes
Learning Objective: 2.1.3 Define cell-membrane fluidity and explain how it is affected by the specific phospholipids in a membrane.
Bloom's Level: 2. Understanding

6. Compared to fish found in lower temperature habitats, fish that inhabit higher temperatures tend to have more
a. saturated phospholipids in their brain synaptic membranes.
b. saturated phospholipids in their brain proteins.
c. unsaturated phospholipids in their brain synaptic membranes.
d. unsaturated phospholipids in their brain proteins.
Answer: a
Textbook Reference: 2.1 Cell Membranes and Intracellular Membranes
Learning Objective: 2.1.3 Define cell-membrane fluidity and explain how it is affected by the specific phospholipids in a membrane.
Bloom's Level: 3. Applying

7. Which membrane protein is responsible for the passive movement of K^+ across the typical animal cell membrane?
a. Channel
b. Enzyme
c. Transporter
d. Receptor
Answer: a
Textbook Reference: 2.1 Cell Membranes and Intracellular Membranes

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Learning Objective: 2.1.2 Distinguish a channel protein from a transporter protein in a cell membrane.
Bloom's Level: 2. Understanding

8. Which molecule is a functional membrane protein?
a. Acetylcholine
b. Cholesterol
c. The Na^+–K^+ pump
d. Calmodulin
Answer: c
Textbook Reference: 2.1 Cell Membranes and Intracellular Membranes
Learning Objective: 2.1.2 Distinguish a channel protein from a transporter protein in a cell membrane.
Bloom's Level: 5. Evaluating

9. Choose a feature that is *not* common to all simple epithelia.
a. microvilli
b. basement membrane
c. nucleus in each cell
e. apical surface
Answer: a
Textbook Reference: 2.2 Epithelia
Learning Objective: 2.2.1 Sketch a cross-section of a tubule, such as a blood capillary or nephron, that is composed of a simple epithelium.
Bloom's Level: 5. Evaluating

10. A ring of _____ demarcates the apical surface of the cell from its lateral and basal surfaces.
a. tight junctions
b. septate junctions
c. gap junctions
e. microvilli
Answer: a
Textbook Reference: 2.2 Epithelia
Learning Objective: 2.2.3 Explain why the distinction between the apical and basolateral regions of an epithelial cell is important.
Bloom's Level: 2. Understanding

11. Which of the following is considered a communicating junction?
a. Gap junction
b. Tight junction
c. Septate junction
d. Desmosome
Answer: a
Textbook Reference: 2.2 Epithelia
Learning Objective: 2.2.2 Compare and contrast a tight junction and a gap junction.

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Bloom's Level: 1. Remembering

12. When a protein is denatured, which of the following structures is disrupted first?
a. Primary
b. Secondary
c. Tertiary
d. Quarternary
Answer: c
Textbook Reference: 2.3 Proteins
Learning Objective: 2.3.4 Distinguish the effects of denaturation on the tertiary and primary structures of a protein.
Bloom's Level: 1. Remembering

13. If a protein *in situ* becomes partially denatured because of high temperature, the denaturation can be reversed by a
a. molecular chaperone.
b. proteasome.
c. ubiquitin.
d. peptidase.
Answer: a
Textbook Reference: 2.3 Proteins
Learning Objective: Not aligned
Bloom's Level: 2. Understanding

14. Which of the following tags proteins for destruction?
a. Proteasome
b. Ubiquitin
c. Molecular chaperone
d. Heat-shock protein
Answer: b
Textbook Reference: 2.3 Proteins
Learning Objective: Not aligned
Bloom's Level: 1. Remembering

15. How can amino acids in a protein be any closer to one another than their spaced positions in the linear string?
a. Many amino acids break their covalent bonds in the linear arrangement and form closer ionic bonding arrangements.
b. Amino acids in their linear primary structure are constantly breaking and reforming their covalent bonds. When they are not in a bonding arrangement, they can be closer to adjacent amino acids temporarily.
c. As amino acid chains fold into their tertiary structure, this commonly brings some amino acids closer together than their linear spaced positions.
d. Amino acids only form covalent bonds with one another and do not associate with one another at a distance closer than the covalent bond.
Answer: c

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Textbook Reference: 2.3 Proteins
Learning Objective: 2.3.1 Explain how amino acids that are at widely spaced positions in the linear string of amino acids in a protein can be close together—and function together—in the natural protein.
Bloom's Level: 2. Understanding

16. What drives the ATP protein machine?
a. Na^+
b. The gradient of H^+ across the membrane
c. ATP
d. The movement of electrons
Answer: b
Textbook Reference: 2.3 Proteins
Learning Objective: 2.3.2 Sketch the ATP synthase protein and describe how it functions as a tiny machine.
Bloom's Level: 2. Understanding

17. Why have many venomous animals evolved venoms that disrupt the gating mechanism of the voltage-gated sodium channel?
a. Disrupting the voltage-gated sodium channel would slow the prey's metabolism.
b. Disrupting the voltage-gated sodium channel would slow the prey's ability to manufacture ATP.
c. Disrupting the voltage-gated sodium channel would block oxygen transport.
d. Disrupting the voltage-gated sodium channel would disrupt the nervous system.
Answer: d
Textbook Reference: 2.3 Proteins
Learning Objective: 2.3.3 Explain why venomous animals have often evolved venoms that disrupt the gating mechanism of the voltage-gated sodium channel.
Bloom's Level: 2. Understanding

18. _____ is(are) the specific set of processes by which complex chemical compounds are broken down to release energy, create smaller chemical building blocks, or prepare chemical constituents for elimination.
a. Metabolism
b. Catabolism
c. Anabolism
d. Biochemical reactions
Answer: b
Textbook Reference: 2.4 Elements of Metabolism
Learning Objective: 2.4.1 Distinguish between anabolism and catabolism.
Bloom's Level: 1. Remembering

19. Per gram, the leopard frog can jump farther per jump compared to the western toad because the leopard frog
a. is insensitive to lactic acid.
b. tends to live in warmer climates.

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c. has a higher aerobic capacity.
d. creates more lactic acid per unit time.
Answer: d
Textbook Reference: 2.5 Enzyme Fundamentals
Learning Objective: 2.5.1 Explain how differences in running speed between related species may be explained by differences in the mechanisms the species use to synthesize ATP.
Bloom's Level: 2. Understanding

20. Which statement regarding enzymes is *false*?
a. All enzymes are catalysts.
b. Enzymes have substrates and products.
c. Enzymes speed chemical reactions.
d. All catalysts are enzymes.
Answer: d
Textbook Reference: 2.5 Enzyme Fundamentals
Learning Objective: Not aligned
Bloom's Level: 5. Evaluating

21. Which reaction is catalyzed by LDH?
a. Pyruvic acid + $NADH_2$ → lactic acid + NAD
b. Pyruvic acid + NAD → pyruvic acid + $NADH_2$
c. Pyruvic acid + NAD → lactic acid + $NADH_2$
d. Lactic acid + $NADH_2$ → pyruvic acid + NAD
Answer: a
Textbook Reference: 2.5 Enzyme Fundamentals
Learning Objective: 2.5.1 Explain how differences in running speed between related species may be explained by differences in the mechanisms the species use to synthesize ATP.
Bloom's Level: 3. Applying

22. The amount of substrate converted to product per unit of time is called the
a. turnover number.
b. saturated speed.
c. V_{max}.
d. reaction velocity.
Answer: d
Textbook Reference: 2.5 Enzyme Fundamentals
Learning Objective: 2.5.2 Sketch a graph of reaction velocity as a function of substrate concentration for an enzyme-catalyzed reaction with hyperbolic kinetics.
Bloom's Level: 1. Remembering

23. Turnover number (k_{cat}) describes what property of an enzymatic reaction?
a. Activation energy
b. Catalytic effectiveness
c. Enzyme–substrate affinity
d. The transition state
Answer: b

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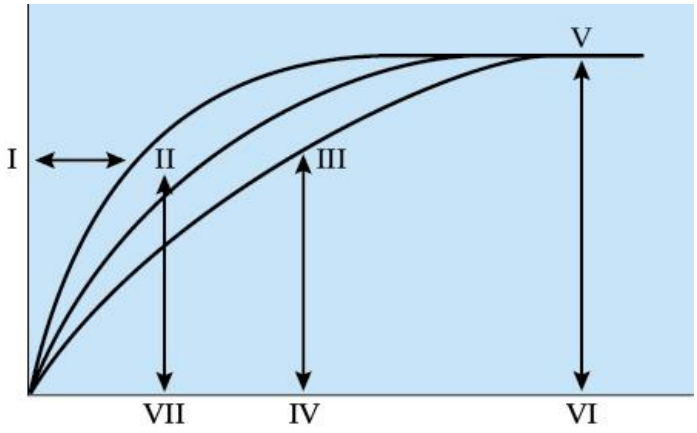
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Textbook Reference: 2.5 Enzyme Fundamentals
Learning Objective: 2.5.2 Sketch a graph of reaction velocity as a function of substrate concentration for an enzyme-catalyzed reaction with hyperbolic kinetics.
Bloom's Level: 1. Remembering

24. The likelihood that an enzyme will form a complex with the substrate during a collision is called the
a. catalytic effectiveness.
b. activation energy.
c. enzyme–substrate affinity.
d. transition state.
Answer: c
Textbook Reference: 2.5 Enzyme Fundamentals
Learning Objective: 2.5.2 Sketch a graph of reaction velocity as a function of substrate concentration for an enzyme-catalyzed reaction with hyperbolic kinetics.
Bloom's Level: 1. Remembering

25. An enzymatic reaction is proceeding at subsaturation. Which of the following is *not* a means by which the enzymatic reaction can be increased?
a. Adding more substrate
b. Adding more enzyme
c. Increasing the catalytic effectiveness
d. Increasing the temperature
Answer: b
Textbook Reference: 2.5 Enzyme Fundamentals
Learning Objective: 2.5.2 Sketch a graph of reaction velocity as a function of substrate concentration for an enzyme-catalyzed reaction with hyperbolic kinetics.
Bloom's Level: 3. Applying

26. Refer to the figure shown.



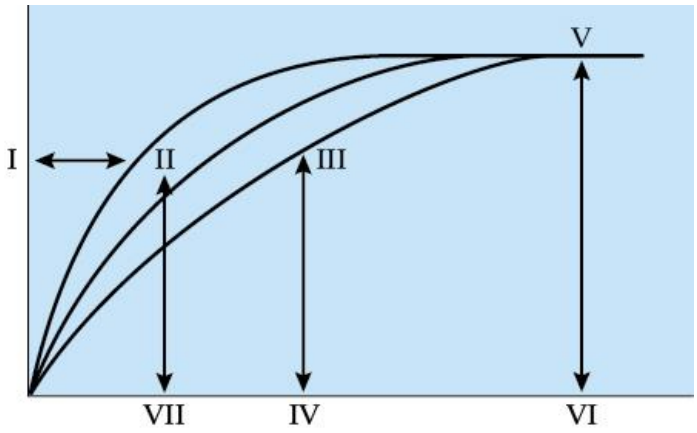
Which of the following represent the best labels for the *x* axis and the *y* axis in the figure?
a. *x* = Substrate concentration; *y* = Reaction velocity
b. *x* = Enzyme concentration; *y* = Reaction velocity

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c. *x* = Time; *y* = Substrate concentration
d. *x* = Time; *y* = Enzyme–substrate conversion rate
Answer: a
Textbook Reference: 2.5 Enzyme Fundamentals
Learning Objective: 2.5.2 Sketch a graph of reaction velocity as a function of substrate concentration for an enzyme-catalyzed reaction with hyperbolic kinetics.
Bloom's Level: 3. Applying

27. Refer to the figure shown.

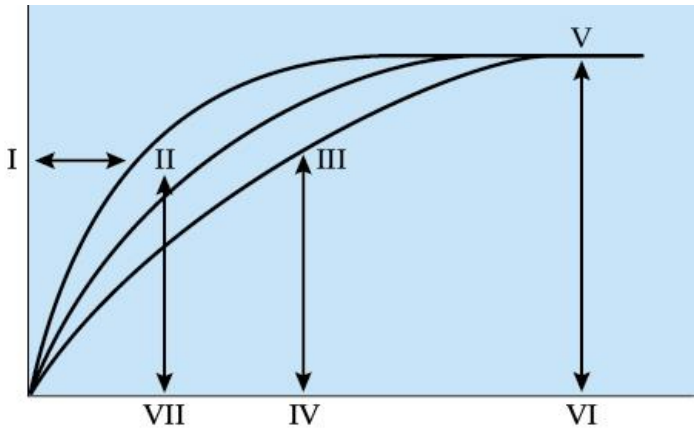


Which letter in the figure represents high affinity?
a. I
b. II
c. III
d. V
Answer: b
Textbook Reference: 2.5 Enzyme Fundamentals
Learning Objective: 2.5.2 Sketch a graph of reaction velocity as a function of substrate concentration for an enzyme-catalyzed reaction with hyperbolic kinetics.
Bloom's Level: 3. Applying

28. Refer to the figure shown.

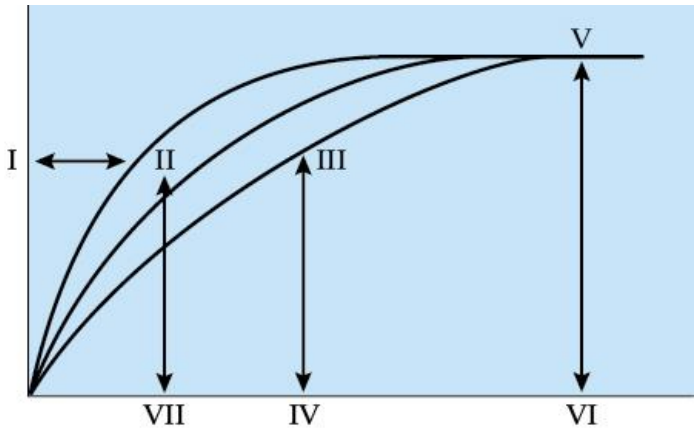
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Which letter in the figure best represents the V_{max}?
a. VI
b. I
c. III
d. V
Answer: d
Textbook Reference: 2.5 Enzyme Fundamentals
Learning Objective: 2.5.2 Sketch a graph of reaction velocity as a function of substrate concentration for an enzyme-catalyzed reaction with hyperbolic kinetics.
Bloom's Level: 3. Applying

29. Refer to the figure shown.

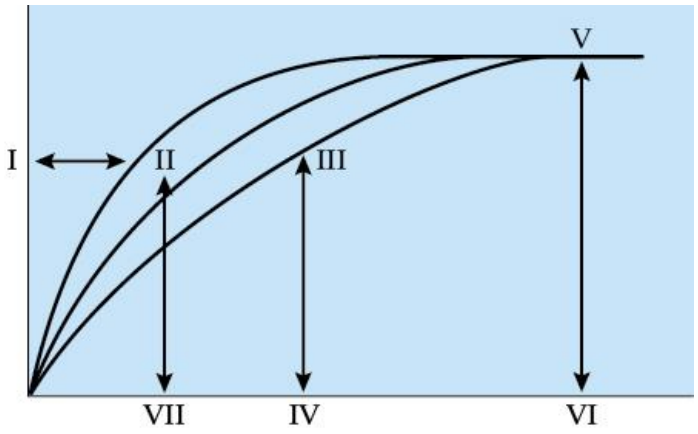


In the figure, which region best represents the K_m of the highest affinity enzyme?
a. I
b. II
c. VII
d. IV
Answer: c
Textbook Reference: 2.5 Enzyme Fundamentals

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Learning Objective: 2.5.2 Sketch a graph of reaction velocity as a function of substrate concentration for an enzyme-catalyzed reaction with hyperbolic kinetics.
Bloom's Level: 3. Applying

30. Refer to the figure shown.



If more substrate is added to the reaction system of line C in the figure, what would be the most likely outcome?
a. The curve of line C would shift toward line B.
b. The V_{max} will increase.
c. K_m will decrease.
d. The curve will remain the same.
Answer: d
Textbook Reference: 2.5 Enzyme Fundamentals
Learning Objective: 2.5.2 Sketch a graph of reaction velocity as a function of substrate concentration for an enzyme-catalyzed reaction with hyperbolic kinetics.
Bloom's Level: 3. Applying

31. Human LDH-B_4 and rat LDH-B_4 are examples of
a. isozymes.
b. analogous enzymes.
c. isoenzymes.
d. interspecific enzyme homologs.
Answer: d
Textbook Reference: 2.5 Enzyme Fundamentals
Learning Objective: 2.5.3 Compose a 20-minute talk for a middle-school class on the significance of the fact that enzymes occur in multiple molecular forms.
Bloom's Level: 2. Understanding

32. An enzyme-encoding gene is considered to be _____ within a cell if the gene results in the synthesis of the encoded enzyme within that same cell.
a. promoted
b. induced
c. expressed

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d. enhanced
Answer: c
Textbook Reference: 2.6 Regulation of Cell Function by Enzymes
Learning Objective: 2.6.1 Explain the ways that inducible enzymes can help an animal cope with a changing environment.
Bloom's Level: 2. Understanding

33. _____ enzymes are present in a tissue in relatively high and steady amounts regardless of conditions, whereas _____ enzymes are present at low levels (or not at all) in a tissue unless their synthesis is activated.
a. Inducible; constitutive
b. Promotable; constitutive
c. Constitutive; inducible
d. Expressed; promotable
Answer: c
Textbook Reference: 2.6 Regulation of Cell Function by Enzymes
Learning Objective: 2.6.1 Explain the ways that inducible enzymes can help an animal cope with a changing environment.
Bloom's Level: 2. Understanding

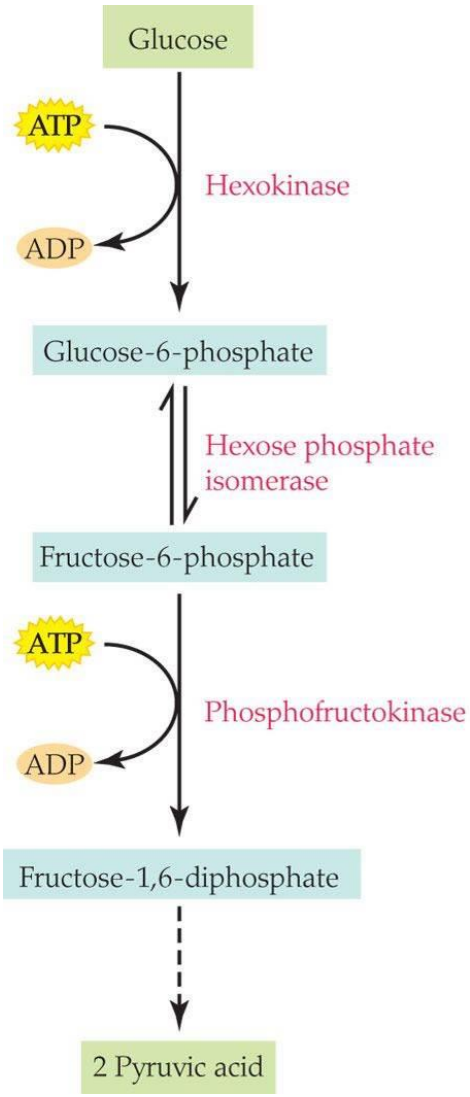
34. Which statement regarding allosteric modulation is true?
a. The binding of an allosteric modulator follows the law of mass action.
b. The binding of an allosteric modulator is irreversible.
c. An allosteric modulator, when present, will always bind to the enzyme it modulates.
d. The binding of an allosteric modulator always increases the catalytic activity of the enzyme.
Answer: a
Textbook Reference: 2.6 Regulation of Cell Function by Enzymes
Learning Objective: 2.6.2 Compare and contrast modulation of enzyme function by allosteric modulators and by phosphorylation.
Bloom's Level: 5. Evaluating

35. Which of the following is directly involved in covalent modulation?
a. The Na^+–K^+ pump
b. Protein kinases
c. van der Waals interactions
d. Calcium
Answer: b
Textbook Reference: 2.6 Regulation of Cell Function by Enzymes
Learning Objective: 2.6.2 Compare and contrast modulation of enzyme function by allosteric modulators and by phosphorylation.
Bloom's Level: 5. Evaluating

36. Refer to the figure shown.

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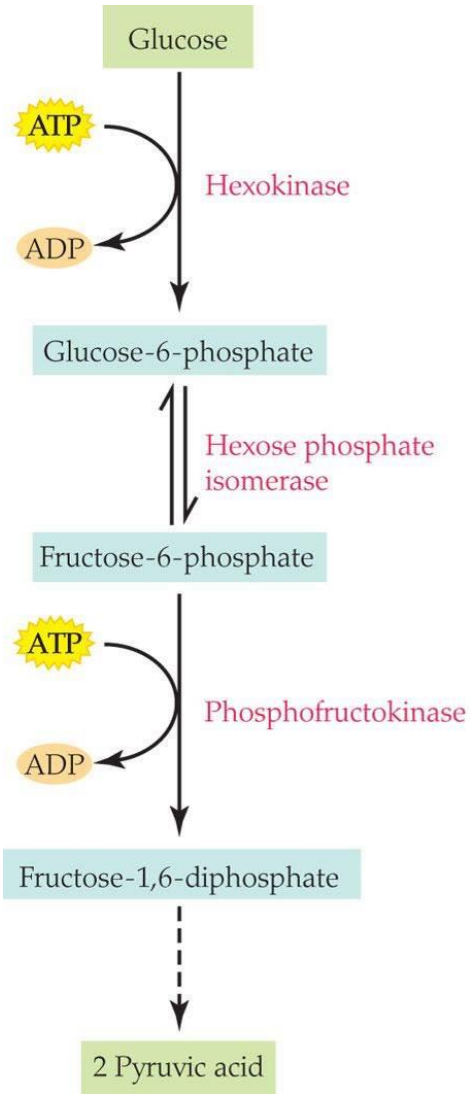
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How many different enzymes are catalyzing reactions?
a. Two
b. Three
c. Four
d. Five
Answer: b
Textbook Reference: 2.6 Regulation of Cell Function by Enzymes
Learning Objective: 2.6.2 Compare and contrast modulation of enzyme function by allosteric modulators and by phosphorylation.
Bloom's Level: 3. Applying

37. Refer to the figure shown.

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According to the figure, a high number of products from the Kreb's cycle could act as _____ and result in _____ of the overall reaction.
a. covalent modulators; inhibition
b. covalent modulators; acceleration
c. allosteric modulators; inhibition
d. allosteric modulators; acceleration
Answer: c
Textbook Reference: 2.6 Regulation of Cell Function by Enzymes
Learning Objective: 2.6.2 Compare and contrast modulation of enzyme function by allosteric modulators and by phosphorylation.
Bloom's Level: 3. Applying

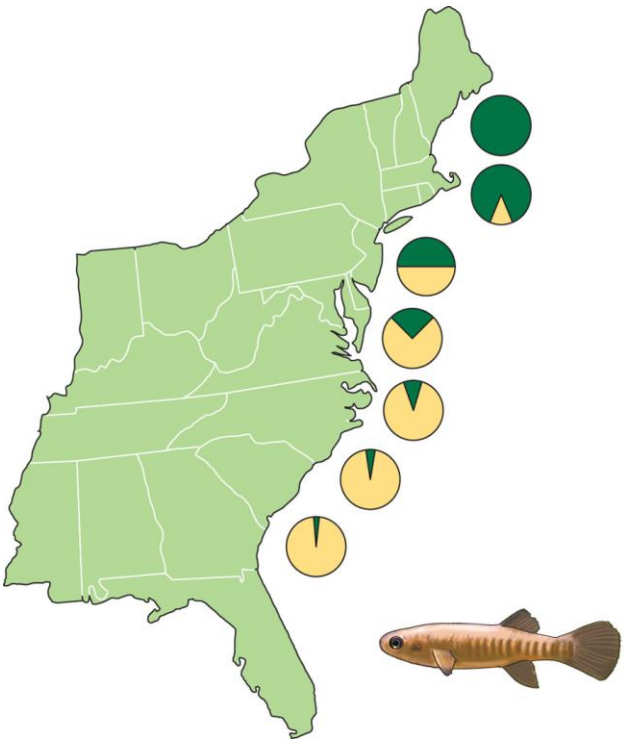
38. A protein kinase catalyzes the phosphorylation of another protein kinase, which in turn catalyzes the phosphorylation of a third protein kinase. This series of multiple enzyme sequences is an excellent example of
a. amplification.

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b. a rate-limiting reaction.
c. inducing enzymes.
d. allosteric regulation.
Answer: a
Textbook Reference: 2.6 Regulation of Cell Function by Enzymes
Learning Objective: 2.6.2 Compare and contrast modulation of enzyme function by allosteric modulators and by phosphorylation.
Bloom's Level: 2. Understanding

39. The _____ is(are) directly responsible for the amplifying effects during a second messenger cascade.
a. receptors
b. substrates
c. enzymes
d. cell membrane
Answer: c
Textbook Reference: 2.6 Regulation of Cell Function by Enzymes
Learning Objective: 2.6.2 Compare and contrast modulation of enzyme function by allosteric modulators and by phosphorylation.
Bloom's Level: 2. Understanding

40. Refer to the figure shown.

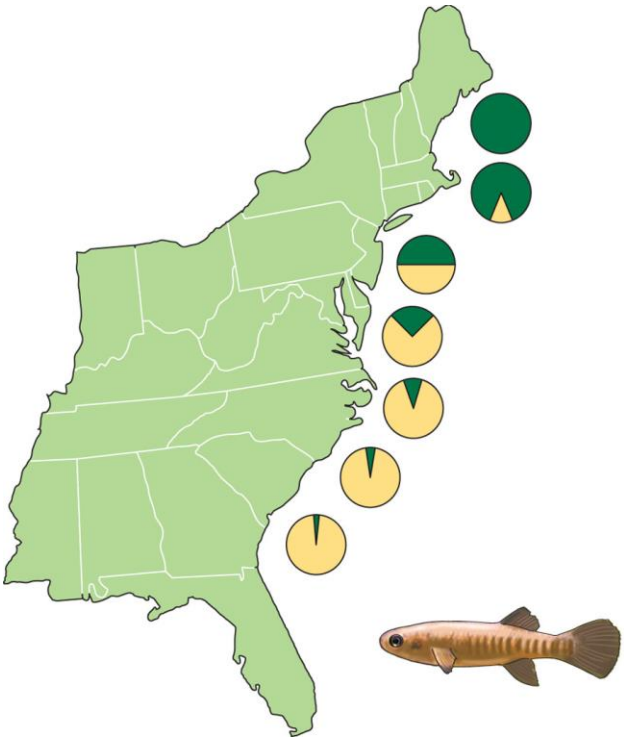


Which abiotic factor most likely explains the data in the figure?
a. LDH expression
b. Allele frequencies

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c. Temperature
d. Predation
Answer: c
Textbook Reference: 2.7 Evolution of Enzymes
Learning Objective: 2.7.2 Explain to a friend why steep gradients of gene frequencies in killifish populations are argued to reflect “evolution in action.”
Bloom’s Level: 3. Applying

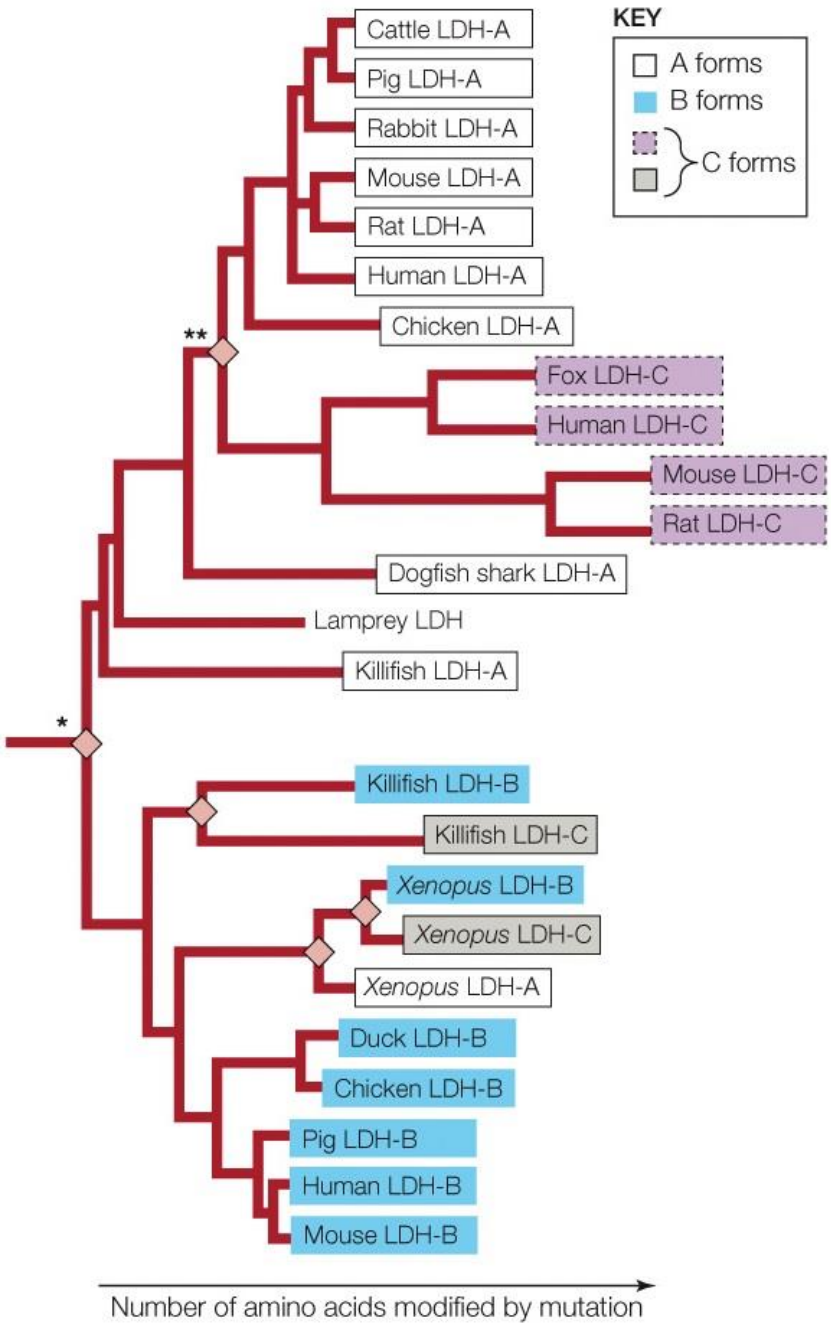
41. Refer to the figure shown.



The figure shows the
a. frequency distribution of two predators on killifish.
b. frequency distribution of two different alleles of the gene for LDH.
c. frequency distribution of two main diets of killifish.
d. temperature tolerance of two subtypes of killifish.
Answer: b
Textbook Reference: 2.7 Evolution of Enzymes
Learning Objective: 2.7.2 Explain to a friend why steep gradients of gene frequencies in killifish populations are argued to reflect “evolution in action.”
Bloom’s Level: 1. Remembering

42. Refer to the figure shown.

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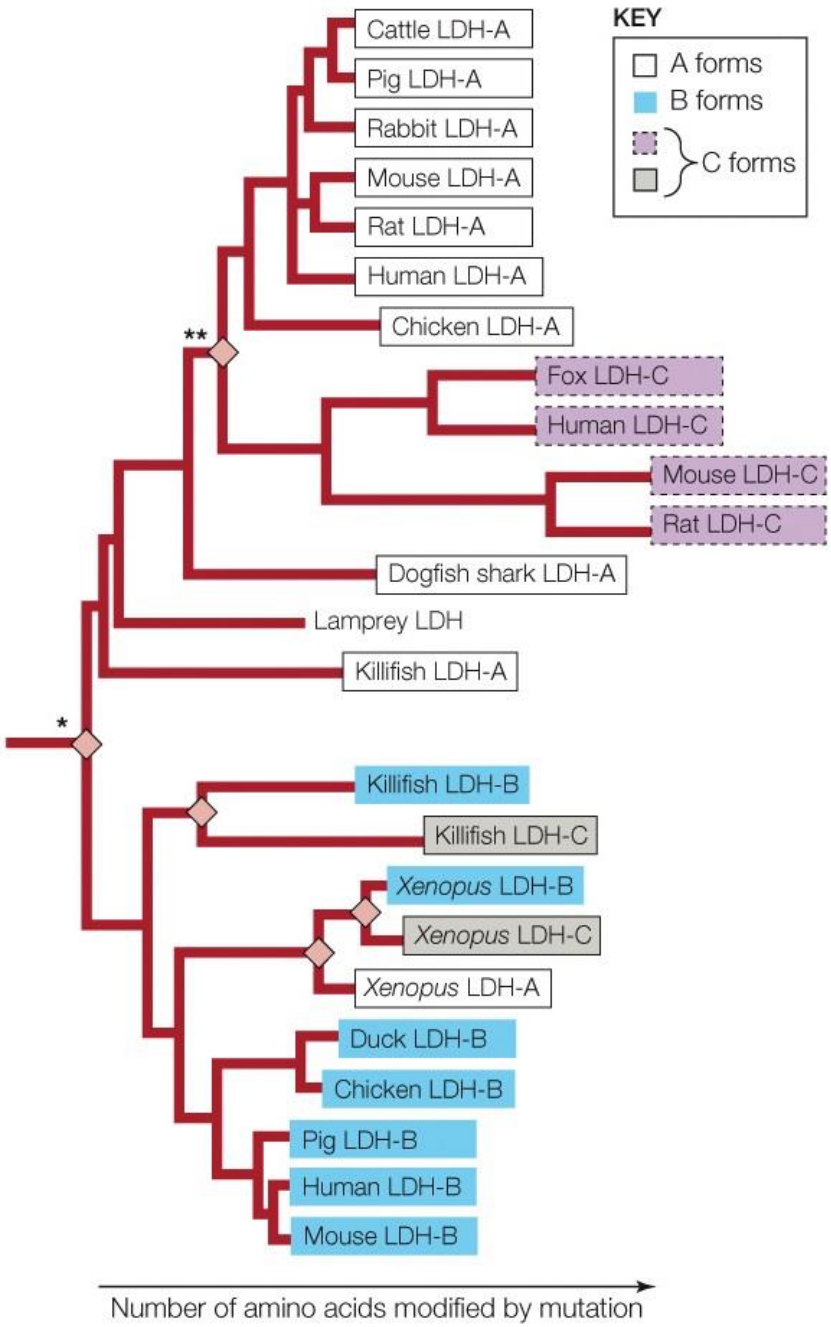


What is the best explanation for why mammalian and fish LDH-C enzymes are shown to be so distantly related?
a. Many separate gene duplication events created the C version of LDH.
b. The tree is based on LDH-A relationships, so it does not accurately show how closely related the LHD-C versions are to one another.
c. The enzymes were named before the actual evolutionary relationships were known.
d. The tree is separated based on animal phyla, not LDH.
Answer: c
Textbook Reference: 2.7 Evolution of Enzymes

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Learning Objective: 2.7.1 Outline the rationale for arraying enzyme forms into a family tree based on their amino acid sequences.
Bloom's Level: 4. Analyzing

43. Refer to the figure shown.



The diamonds refer to
a. genetic divergence.
b. gene duplication.

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c. mutations.
d. speciation.
Answer: b
Textbook Reference: 2.7 Evolution of Enzymes
Learning Objective: 2.7.1 Outline the rationale for arraying enzyme forms into a family tree based on their amino acid sequences.
Bloom's Level: 3. Applying

44. In rats, phosphoenolpyruvate carboxykinase activity per gram of liver significantly increases at birth and remains at this higher level for the life of the animal. This is an example of enzymatic change that takes place over a(n) _____ time frame.
a. acute
b. chronic
c. evolutionary
d. developmental
Answer: d
Textbook Reference: 2.8 Enzymes Are Instruments of Change in All Time Frames
Learning Objective: 2.8.1 Illustrate how enzymes play roles in the acute, chronic, and evolutionary time frames of response to the environment—and during internally programmed developmental and clock-controlled processes.
Bloom's Level: 3. Applying

45. The process of absorbing preexisting light and re-emitting it at longer wavelengths is called
a. bioluminescence.
b. reflection.
c. chromatophoration.
d. fluorescence.
Answer: d
Textbook Reference: 2.9 Light and Color
Learning Objective: 2.9.1 Distinguish between bioluminescence and fluorescence.
Bloom's Level: 2. Understanding

46. The ability of animals to change color in seconds or minutes depends on the function of
a. photocytes.
b. chromatophores.
c. photoproteins.
d. luciferin.
Answer: b
Textbook Reference: 2.9 Light and Color
Learning Objective: 2.9.2 Compare and contrast the color-change mechanisms of vertebrates (e.g., fish and frogs) and cephalopod molluscs (e.g., squids and octopuses).
Bloom's Level: 2. Understanding

47. Intracellular modification of activity in response to an external signal is an example of
a. transduction.
b. transformation.

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c. conversion.
d. covalent modulation.
Answer: a
Textbook Reference: 2.10 Reception and Use of Signals by Cells
Learning Objective: Not aligned
Bloom's Level: 2. Understanding

48. Extracellular signaling molecules initiate their actions on a cell by binding with certain protein molecules of the cell called
a. ligands.
b. peripheral proteins.
c. integral proteins.
d. receptors.
Answer: d
Textbook Reference: 2.10 Reception and Use of Signals by Cells
Learning Objective: Not aligned
Bloom's Level: 1. Remembering

49. Which of the following statements regarding the ligand-gated receptor is *false*?
a. The naturally occurring ligand can cause the associated protein channel to open.
b. The naturally occurring ligand should bind irreversibly to the receptor until it breaks down.
c. A similarly shaped foreign ligand can attach to the receptor and block the naturally occurring ligand from binding.
d. A ligand can attach to the receptor and activate an intracellular catalytic site on the same molecule.
Answer: b
Textbook Reference: 2.10 Reception and Use of Signals by Cells
Learning Objective: Not aligned
Bloom's Level: 5. Evaluating

50. Receptor proteins can bring about all of the following cellular actions *except*
a. reinforcing the structure of the membrane.
b. opening a protein channel on the membrane.
c. activating an enzyme on the intracellular surface.
d. combining with a ligand to initiate transcription.
Answer: a
Textbook Reference: 2.10 Reception and Use of Signals by Cells
Learning Objective: Not aligned
Bloom's Level: 5. Evaluating

51. The α-conotoxin injected into fish by the cone snail binds to and therefore blocks receptor sites on the muscle membrane. This prevents a(n)
a. enzyme from being activated.
b. G protein from being activated.
c. channel from opening into the nucleus.
d. channel from opening.

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Answer: d
Textbook Reference: 2.10 Reception and Use of Signals by Cells
Learning Objective: 2.10.1 Explain how a venom can quickly paralyze a prey animal by blocking muscle-cell receptor proteins.
Bloom's Level: 3. Applying

52. Which reaction does *not* directly produce an amplification?
a. Activation of a G protein by an activated receptor
b. Formation of cyclic AMP by catalyzing action of adenylyl cyclase
c. Activation of glycogen phosphorylase kinase by active cAMP-dependent protein kinase
d. Opening of a ligand-gated channel on the membrane
Answer: d
Textbook Reference: 2.10 Reception and Use of Signals by Cells
Learning Objective: 2.10.2 Distinguish first- and second-messenger molecules in a stimulus–response system.
Bloom's Level: 5. Evaluating

53. Which substance is considered a second messenger?
a. IP_3-gated calcium channel
b. Calcium
c. Epinephrine
d. Adenylyl cyclase
Answer: b
Textbook Reference: 2.10 Reception and Use of Signals by Cells
Learning Objective: 2.10.2 Distinguish first- and second-messenger molecules in a stimulus–response system.
Bloom's Level: 5. Evaluating

54. As a second messenger, calcium typically binds to
a. calmodulin, and the complex activates protein kinases.
b. a G protein to activate general second messengers.
c. cyclic AMP to activate cAMP-dependent protein kinases.
d. inositol triphosphate to activate the endoplasmic reticulum.
Answer: a
Textbook Reference: 2.10 Reception and Use of Signals by Cells
Learning Objective: 2.10.2 Distinguish first- and second-messenger molecules in a stimulus–response system.
Bloom's Level: 2. Understanding

55. Steroid hormones bind to _____ and ultimately cause _____.
a. specific intracellular membrane proteins; the opening of ion channels
b. specific intracellular receptor proteins; gene expression
c. specific extracellular receptor proteins; the opening of ion channels
d. specific extracellular membrane proteins; gene expression
Answer: b
Textbook Reference: 2.10 Reception and Use of Signals by Cells

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Learning Objective: 2.10.3 Sketch a diagram that shows how a vertebrate steroid hormone (e.g., estrogen) affects the function of a cell that expresses a steroid receptor protein.
Bloom's Level: 2. Understanding

Short Answer/Essay

56. Provide a specific example of how a membrane protein can be categorized as more than one functional type.
Answer: There are five functional types of membrane proteins, but a receptor protein, as a prominent example, can be classified into more than one category. Receptor proteins can also function as channels, transporters, and enzymes.
Textbook Reference: 2.1 Cell Membranes and Intracellular Membranes
Learning Objective: 2.1.2 Distinguish a channel protein from a transporter protein in a cell membrane.
Bloom's Level: 3. Applying

57. Describe what it means for a phospholipid to be amphipathic and how this feature is paramount in the formation of the membrane.
Answer: The cell membrane is composed of bilayer phospholipids, which are amphipathic. This means that the molecule consists of a polar part (regional differences in charge) and a nonpolar part (lacking regional differences in charge). Because water is by nature a polar molecule, the polar ends of the phospholipids contact the aqueous solutions, whereas the hydrophobic nonpolar ends of the phospholipids face each other, forming the inner region of the membrane.
Textbook Reference: 2.1 Cell Membranes and Intracellular Membranes
Learning Objective: 2.1.3 Define cell-membrane fluidity and explain how it is affected by the specific phospholipids in a membrane.
Bloom's Level: 2. Understanding

58. Describe how epithelial cells control the transport of substances between the apical and basal sides and thus between different body regions.
Answer: Epithelial cells are able to control and even mediate the transport of substances between the apical and basal areas via occluding junctions between epithelial cells. Substances must pass through the cell to cross the epithelia, and this transcellular path can be highly controlled. Only very small molecules may be able to pass through the occluding junctions and thus take the paracellular path.
Textbook Reference: 2.2 Epithelia
Learning Objective: 2.2.3 Explain why the distinction between the apical and basolateral regions of an epithelial cell is important.
Bloom's Level: 2. Understanding

59. Define the law of mass action and apply it to a real biochemical reaction.
Answer: For a given reaction of $A + B \leftrightarrow C + D$, the law of mass action states that if the compounds are out of equilibrium, the reaction will proceed in the direction of equilibrium as dictated by the ratios of concentrations. For example, within glycolysis, pyruvate typically forms

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lactic acid. However, in the event that lactic acid concentrations rise significantly, the reaction can be reversed, forming pyruvate from lactic acid.
Textbook Reference: 2.5 Enzyme Fundamentals
Learning Objective: Not aligned
Bloom's Level: 3. Applying

60. Compare and contrast the factors affecting the rate of an enzymatic reaction in a substrate that is subsaturated and one that is saturated or at V_{max}.
Answer: Both reaction velocities at V_{max} and in reactions that are subsaturated will be affected by the number of active enzyme molecules present and the catalytic effectiveness of each enzyme molecule. However, reaction velocities in subsaturated reactions will also depend on the affinity of enzyme molecules for the substrate.
Textbook Reference: 2.5 Enzyme Fundamentals
Learning Objective: 2.5.2 Sketch a graph of reaction velocity as a function of substrate concentration for an enzyme-catalyzed reaction with hyperbolic kinetics.
Bloom's Level: 5. Evaluating

61. Describe how amplification works in the cell and why it is important.
Answer: In the cell, if any agent that is activated is itself an enzyme, it is able to catalyze a reaction, forming many products. If these products are also enzymes for other reactions, the amplification process will be exponential. This is important in cell function because one receptor binding one ligand (such as epinephrine) can amplify and bring about a significant result (i.e., the creation of millions of glucose molecules from glycogen).
Textbook Reference: 2.6 Regulation of Cell Function by Enzymes
Learning Objective: Not aligned
Bloom's Level: 2. Understanding

62. How does the killifish demonstrate the present-day operation of evolutionary forces?
Answer: The killifish that live along the entire east coast of the United States show two different alleles of the gene for the B form of lactate dehydrogenase. Since these fish travel extensively along the coast, one would expect the alleles to be evenly distributed. The fact that different allele frequencies persist from place to place indicates that fish with different alleles undergo differential survival and reproduction—an example of the working of present-day evolutionary forces.
Textbook Reference: 2.7 Evolution of Enzymes
Learning Objective: 2.7.2 Explain to a friend why steep gradients of gene frequencies in killifish populations are argued to reflect "evolution in action."
Bloom's Level: 3. Applying

63. Compare and contrast bioluminescence and fluorescence and describe the light production of the hydromedusan jellyfish (*Aequorea victoria*).
Answer: Both bioluminescence and fluorescence can occur within a photocyte, but in bioluminescence, the light is produced *de novo*. In fluorescence, preexisting light is absorbed and re-emitted at longer wavelengths. In the hydromedusan jellyfish, clusters of photocytes produce blue light. However, the light emitted is green because a green fluorescent protein converts the emission wavelengths.

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Textbook Reference: 2.9 Light and Color
Learning Objective: 2.9.1 Distinguish between bioluminescence and fluorescence.
Bloom's Level: 5. Evaluating

64. List and briefly describe the four types of receptor proteins involved in cell signaling.
Answer: (1) Ligand-gated channels bind ligands so that channels can open for ions to pass through the cell membrane. (2) G protein receptors bind ligands and activate a G protein system, which is a complex secondary messenger system that typically amplifies effects in the cell. (3) The enzyme/enzyme-linked receptor binds a ligand on the extracellular surface that activates the receptor protein. The activated receptor protein is itself an enzyme that catalyzes a reaction, typically on the intracellular side. (4) The intracellular receptor is typically housed inside the nucleus, and the ligand usually passes through the cell membrane and the nuclear membrane via diffusion. Once the ligand attaches to the intracellular receptor, the complex initiates transcription by interacting with the DNA.
Textbook Reference: 2.10 Reception and Use of Signals by Cells
Learning Objective: Not aligned
Bloom's Level: 2. Understanding

65. Describe how a simple ion such as calcium is used as a second messenger.
Answer: Calcium ions sometimes act as second messengers. Inositol triphosphate activates a gated channel on the endoplasmic reticulum, which releases calcium into the cytoplasm. Calcium then binds to the protein calmodulin, which can then activate protein kinases or other enzymes.
Textbook Reference: 2.10 Reception and Use of Signals by Cells
Learning Objective: 2.10.2 Distinguish first- and second-messenger molecules in a stimulus–response system.
Bloom's Level: 2. Understanding

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