LEC 9 Q – CYROLOGY:

1. **What is the primary function of intermediate filaments in cells?**
   A) Energy production
   B) Mechanical strength and stability
   C) Cellular communication
   D) Protein synthesis
2. **Which of the following types of intermediate filaments is specifically found in muscle cells?**
   A) Vimentin
   B) Neurofilaments
   C) Desmin
   D) Keratin
3. **Intermediate filaments are less dynamic compared to which two other cytoskeletal components?**
   A) Microtubules and glycoproteins
   B) Actin filaments and microtubules
   C) Actin filaments and collagen
   D) Myosin and microtubules
4. **Which type of intermediate filament is found in the axons of neurons?**
   A) Type I keratin
   B) Type IV neurofilaments
   C) Type V nuclear lamins
   D) Type II keratin
5. **How are intermediate filaments primarily regulated?**
   A) By GTP binding
   B) By phosphorylation
   C) By calcium ions
   D) By ATP hydrolysis
6. **Which disease is associated with mutations in keratin genes, leading to fragile skin?**
   A) Amyotrophic Lateral Sclerosis (ALS)
   B) Epidermolysis Bullosa Simplex
   C) Duchenne Muscular Dystrophy
   D) Multiple Sclerosis

Answers

1 B

2 C

3 B

4 B

5 B

6 B

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7. **What is the structure of intermediate filaments primarily composed of?**
   A) Lipid bilayers
   B) RNA molecules
   C) Helical polypeptide chains
   D) Sugars

8. **Which component of the cytoskeleton do intermediate filaments connect to?**
   A) Nucleus
   B) Microtubules and actin filaments
   C) Ribosomes
   D) Mitochondria
9. **What type of keratin is classified as acidic?**
   A) Type I
   B) Type II
   C) Type III
   D) Type IV
10. **In what way do intermediate filaments contribute to muscle contraction?**
   A) By storing calcium
   B) By connecting actin filaments to each other and the plasma membrane
   C) By generating ATP
   D) By facilitating nerve impulses
11. **Which of the following is NOT a function of intermediate filaments?**
   A) Providing mechanical strength
   B) Acting as a scaffold
   C) Synthesizing proteins
   D) Organizing the internal structure of the cell
12. **What happens to nuclear lamins and vimentins when they are phosphorylated?**
   A) They become more stable
   B) They undergo disassembly
   C) They promote cell division
   D) They enhance structural integrity
13. **Which disease is characterized by the accumulation and abnormal assembly of neurofilaments?**
   A) Alzheimer's Disease
   B) Amyotrophic Lateral Sclerosis (ALS)
   C) Huntington's Disease
   D) Parkinson's Disease
14. **What role do intermediate filaments play in epithelial cells?**
   A) Energy storage
   B) Mechanical stability at junctions
   C) Nutrient absorption
   D) Hormone secretion
15. **What type of junctions do intermediate filaments support in epithelial cells?**
   A) Tight junctions
   B) Focal adhesions
   C) Desmosomes and hemidesmosomes
   D) Gap junctions

Answers

1 B
2 C
3 B
4 B
5 B
6 B
7 C
8 B
9 A
10 B
11 C
12 B
13 B
14 B
15 C

1. **Which of the following statements best describes the stability of intermediate filaments compared to actin filaments and microtubules?**
   A) Intermediate filaments are less stable and more dynamic.
   B) Intermediate filaments are more stable and less dynamic.
   C) Intermediate filaments are equally dynamic as microtubules.
   D) Intermediate filaments have no structural role.
2. **What structural feature is unique to intermediate filaments that distinguishes them from actin filaments and microtubules?**
   A) They consist of tubulin dimers.
   B) They are composed of a central α-helical rod domain.
   C) They are involved in intracellular transport.
   D) They are highly dynamic and readily polymerize.
3. **Which type of intermediate filament protein is most likely to be involved in connecting the cytoskeleton to the extracellular matrix in epithelial cells?**
   A) Desmin
   B) Vimentin
   C) Keratin
   D) Neurofilaments
4. **What mechanism is primarily responsible for the disassembly of intermediate filaments during mitosis?**
   A) Dephosphorylation
   B) Hydrolysis of ATP

C) Phosphorylation of specific sites
D) Cleavage by proteolytic enzymes

5. **In which scenario would you expect to see a direct impact on gene expression due to mutations in intermediate filament proteins?**
   A) During muscle contraction
   B) When changes occur in the nuclear lamina
   C) During synaptic transmission
   D) In the formation of tight junctions
6. **How do the structural properties of intermediate filaments contribute to their role as a "real skeleton" of the cell?**
   A) They provide a dynamic framework that changes shape with cell movement.
   B) They form rigid connections that anchor organelles and maintain cell shape.
   C) They facilitate the transport of materials within the cytoplasm.
   D) They interact with signaling pathways to modulate cell function.
7. **Which type of keratin is involved in the formation of hard structures such as nails and hair, and is characterized by extensive disulfide bonding?**
   A) Type I keratin
   B) Type II keratin
   C) Type III keratin
   D) Type IV keratin
8. **What critical role do vimentin and keratin filaments play in maintaining nuclear integrity?**
   A) They facilitate chromatin organization.
   B) They anchor the nuclear envelope to the cytoskeleton.
   C) They regulate gene transcription.
   D) They promote cell division.
9. **In the context of neurofilaments, which of the following best describes their arrangement within the axon?**
   A) They are randomly distributed throughout the axon.
   B) They are arranged parallel to microtubules, providing flexibility.
   C) They interconnect actin filaments and microtubules for stability.
   D) They form a continuous network around the nucleus.
10. **What is the significance of the staggered arrangement of protofilaments in intermediate filament assembly?**
    A) It allows for rapid depolymerization in response to stress.
    B) It increases the overall tensile strength of the filament.
    C) It facilitates interactions with motor proteins.
    D) It ensures uniform diameter along the filament.

Answers

1 B

2 B

3 C
4 C
5 B
6 B
7 A
8 B
9 C
10 B

11. **Which intermediate filament type is crucial for the structural integrity of the nuclear envelope and is often implicated in laminopathies?**
    A) Type I keratin
    B) Type V nuclear lamins
    C) Type III vimentin
    D) Type IV neurofilaments
12. **In which way does the phosphorylation of intermediate filament proteins primarily affect cellular function?**
    A) It stabilizes the filament structure.
    B) It promotes interaction with actin and microtubules.
    C) It triggers disassembly and reorganization of the filaments.
    D) It enhances the binding of growth factors.
13. **How do mutations in keratin genes lead to the symptoms observed in Epidermolysis Bullosa Simplex?**
    A) By increasing cellular adhesion
    B) By disrupting filament assembly and leading to mechanical fragility
    C) By promoting excessive cell proliferation
    D) By altering gene transcription factors
14. **What role do intermediate filaments play in the context of desmosomes within epithelial tissues?**
    A) They provide a pathway for signaling molecules.
    B) They connect cadherins to the cytoskeleton, providing tensile strength.
    C) They facilitate nutrient exchange between cells.
    D) They regulate cell cycle progression.
15. **Which type of protein interactions primarily contribute to the formation of intermediate filament dimers?**
    A) Ionic interactions
    B) Hydrophobic interactions
    C) Hydrogen bonds
    D) Covalent bonds
16. **What specific structural feature of intermediate filaments contributes to their resistance to mechanical stress?**

A) Their dynamic polymerization
B) The coiled-coil structure of dimers
C) The presence of globular domains
D) The uniform diameter across the filament

17. **In neurofilament pathology, what might a malfunction in the transport of neurofilaments indicate about neuronal health?**
    A) Enhanced neuronal plasticity
    B) Impaired synaptic function
    C) Increased neurogenesis
    D) Potential for neurodegeneration
18. **How do hemidesmosomes utilize intermediate filaments to connect to the extracellular matrix?**
    A) By anchoring microtubules to the matrix
    B) Through integrin receptors that bind to filament-associated proteins
    C) By forming tight junctions with neighboring cells
    D) Through direct interactions with glycoproteins
19. **What aspect of intermediate filament assembly differentiates it from the assembly mechanisms of actin filaments and microtubules?**
    A) Intermediate filaments do not require ATP.
    B) They form structures in a dynamic fashion like actin.
    C) They rely solely on calcium ions for stability.
    D) Their assembly is influenced by the presence of GTP.
20. **What is the potential impact of mutations in nuclear lamins on cellular processes?**
    A) They only affect cytoskeletal integrity.
    B) They can disrupt gene expression and lead to laminopathies.
    C) They enhance cellular migration.
    D) They have no significant impact on cell function.

Answers

11 B
12 C
13 B
14 B
15 B
16 B
17 D
18 B
19 A
20 B

21. **What is the primary role of desmin in muscle cells?**
    A) Facilitating energy production
    B) Connecting actin filaments and linking them to the plasma membrane
    C) Acting as a signaling molecule for muscle contraction
    D) Regulating calcium ion concentrations
22. **In what way do intermediate filaments differ in their assembly from actin filaments and microtubules?**
    A) Intermediate filaments do not polymerize dynamically like the others.
    B) They are assembled from nucleotide triphosphates.
    C) Their assembly is reversible and requires ATP.
    D) They form rigid structures with no capability for remodeling.
23. **Which of the following statements accurately reflects the interaction of intermediate filaments with other cytoskeletal components?**
    A) Intermediate filaments only interact with actin filaments.
    B) They create a network that integrates microtubules, actin filaments, and cell membranes.
    C) Intermediate filaments are completely independent of microtubule dynamics.
    D) They enhance the dynamic instability of microtubules.
24. **What pathological feature is often observed in cells affected by amyotrophic lateral sclerosis (ALS) related to neurofilaments?**
    A) Increased filament stability
    B) Aggregation and abnormal phosphorylation of neurofilaments
    C) Enhanced transport of neurofilaments along axons
    D) Disruption of nuclear lamins
25. **How do keratins contribute to the mechanical properties of epithelial tissues?**
    A) By forming tight junctions between cells
    B) Through their ability to polymerize into rigid filaments, providing tensile strength
    C) By regulating ion channels in the plasma membrane
    D) By mediating signal transduction pathways
26. **Which structural characteristic of intermediate filaments allows them to maintain cell shape during mechanical stress?**
    A) High turnover rate
    B) Their coiled-coil dimer formation
    C) Presence of accessory proteins
    D) Rapid polymerization and depolymerization
27. **What type of mutations in lamin A are associated with specific laminopathies, impacting cellular integrity?**
    A) Missense mutations leading to structural abnormalities
    B) Silent mutations with no functional consequences

C) Nonsense mutations leading to truncated proteins
D) Frameshift mutations that alter the reading frame

28. **What is the consequence of phosphorylating vimentin during cell division?**
    A) Stabilization of the filament structure
    B) Disassembly and rearrangement of vimentin filaments
    C) Activation of signaling pathways for proliferation
    D) Enhanced binding to actin filaments
29. **Which intermediate filament type is characterized by its role in neuronal structure and is involved in maintaining axonal diameter?**
    A) Type I keratin
    B) Vimentin
    C) Neurofilaments
    D) Type V nuclear lamins
30. **In what way do hemidesmosomes contribute to the integrity of epithelial tissues?**
    A) They facilitate cell-cell communication.
    B) They anchor intermediate filaments to the extracellular matrix via integrins.
    C) They regulate nutrient transport across the epithelial layer.
    D) They form barriers against pathogens.

Answers

21 B
22 A
23 B
24 B
25 B
26 B
27 A
28 B
29 C
30 B

31. **What molecular feature of intermediate filaments contributes to their role in providing mechanical strength to tissues?**
    A) Their ability to bind to ATP
    B) The presence of a central α-helical rod domain that allows for coiled-coil

interactions
C) Their uniform diameter along the length of the filament
D) The interaction with signaling proteins

32. **Which type of intermediate filament protein is most closely associated with the pathology of Charcot-Marie-Tooth disease?**
A) Desmin
B) Vimentin
C) Neurofilaments
D) Keratin

33. **In the context of intermediate filament assembly, what is the significance of the staggered, antiparallel arrangement of tetramers?**
A) It increases the likelihood of filament disassembly.
B) It enhances the tensile strength and reduces mechanical stress points.
C) It allows for dynamic polymerization similar to microtubules.
D) It ensures that all protofilaments are identical in orientation.

34. **What type of interactions primarily stabilize the coiled-coil structure of intermediate filament dimers?**
A) Van der Waals forces
B) Ionic interactions
C) Hydrophobic interactions
D) Covalent bonds

35. **Which of the following best describes the involvement of intermediate filaments in the cellular response to mechanical stress?**
A) They serve solely as passive structural components.
B) They actively reorganize in response to tensile forces to maintain integrity.
C) They destabilize to allow for cellular movement.
D) They initiate signaling pathways to promote cell growth.

36. **How do mutations in neurofilament proteins contribute to neurodegenerative diseases?**
A) By enhancing their polymerization rates, leading to aggregation
B) By disrupting their interaction with microtubules, impairing axonal transport
C) By causing excessive phosphorylation, leading to filament stabilization
D) By promoting cell proliferation in neuronal tissues

37. **In muscle cells, how does desmin specifically interact with actin filaments during contraction?**
A) By directly binding to myosin filaments
B) By linking adjacent Z-disks, providing structural support
C) By facilitating the release of calcium ions
D) By altering the contractile force generated

38. **What is the relationship between intermediate filaments and gene expression within the nucleus?**
A) Intermediate filaments have no impact on gene expression.
B) They stabilize chromatin structure, facilitating transcription.

C) They inhibit transcription factors from entering the nucleus.
D) They directly regulate RNA polymerase activity.

39. **Which of the following intermediate filament types is most critical for the formation of a resilient epidermal barrier?**
A) Vimentin
B) Type I keratin
C) Type IV neurofilaments
D) Type V nuclear lamins

40. **How do the unique properties of soft keratins differ from hard keratins in terms of cellular function?**
A) Soft keratins provide structural support in external tissues, while hard keratins are intracellular.
B) Soft keratins are found in hair and nails, while hard keratins are cytoplasmic.
C) Soft keratins are more flexible and involved in cellular processes, while hard keratins provide rigidity.
D) Soft keratins are only expressed in the cytoplasm of muscle cells.

Answers

31 B
32 C
33 B
34 C
35 B
36 B
37 B
38 B
39 B
40 C

Advanced Case-Based Questions

1. **Case: A genetic study reveals a novel mutation in the keratin genes of a patient with severe blistering skin disease. The mutation affects the coiled-coil domain of the keratin protein.**
Question: How might this mutation specifically compromise the mechanical properties of the skin?

A) By preventing the proper assembly of keratin filaments, leading to reduced tensile strength.
B) By enhancing the interaction between keratin and actin, resulting in increased flexibility.
C) By causing disulfide bond formation that stiffens the keratin structure.
D) By increasing the dynamic instability of keratin filaments, allowing for better adaptation to stress.

2. **Case: A researcher investigates the role of intermediate filaments in neuronal regeneration following injury. They find that phosphorylated neurofilaments accumulate in damaged axons.**
   Question: What are the potential implications of neurofilament phosphorylation in the context of axonal regeneration?
   A) It promotes neurofilament stability, enhancing the structural integrity of the axon.
   B) It signals for disassembly, which may be necessary for the axon to regenerate.
   C) It facilitates the transport of growth factors along the axon, aiding in repair.
   D) It disrupts the interaction between neurofilaments and microtubules, impairing regeneration.
3. **Case: A patient diagnosed with Amyotrophic Lateral Sclerosis (ALS) exhibits a buildup of abnormal neurofilaments in motor neurons. Genetic tests indicate a mutation in the gene coding for a motor protein.**
   Question: How might this motor protein mutation contribute to the pathology observed in ALS?
   A) By enhancing neurofilament assembly, leading to excessive stability and reduced transport.
   B) By reducing the ability of neurofilaments to anchor to the cell membrane, destabilizing the axon.
   C) By increasing the phosphorylation of neurofilaments, causing aggregation and disruption of axonal transport.
   D) By promoting the interaction between neurofilaments and actin filaments, enhancing neuronal stability.
4. **Case: During a pathology examination, a biopsy of a muscle biopsy shows disorganized desmin filaments in a patient with muscular dystrophy.**
   Question: What does this disorganization indicate about the underlying mechanisms of the disease?
   A) It suggests a deficiency in ATP production affecting filament assembly.
   B) It implies that the structural connectivity between contractile elements is compromised, impacting muscle contraction.
   C) It indicates that there is an overexpression of vimentin disrupting desmin organization.
   D) It highlights an inability of the muscle fibers to recover from mechanical stress.

5. **Case: An individual experiences muscle weakness and has reduced expression of vimentin in their fibroblasts.**
   Question: What physiological consequences might arise from this reduced vimentin expression?
   A) Increased mechanical strength of fibroblasts, enhancing tissue integrity.
   B) Impaired organization of the cytoskeleton, leading to reduced cell motility and impaired wound healing.
   C) Enhanced interaction with microtubules, improving intracellular transport.
   D) Increased stability of the nuclear envelope, protecting against mechanical stress.
6. **Case: A child with Charcot-Marie-Tooth disease is found to have mutations in genes encoding neurofilament proteins. Parents express concern about their child's muscle coordination.**
   Question: What underlying mechanism explains the muscle coordination issues related to neurofilament mutations?
   A) Disruption of myelin sheath integrity, leading to impaired signal conduction.
   B) Altered calcium signaling in muscle cells due to disrupted neurofilament anchoring.
   C) Impaired axonal transport affecting the distribution of neurotransmitters.
   D) Increased oxidative stress due to lack of neuroprotective functions.
7. **Case: A lab experiment shows that overexpression of nuclear lamins affects gene expression in cultured cells. The lamins are found to aggregate in the nuclear envelope.**
   Question: What is the likely outcome of this aggregation on cellular functions?
   A) Enhanced nuclear stability, facilitating efficient gene transcription.
   B) Disruption of nuclear architecture, potentially leading to altered gene regulation and expression.
   C) Increased interactions with chromatin, promoting cellular aging.
   D) Improved response to cellular stress, protecting against apoptosis.
8. **Case: A researcher is studying the effects of external mechanical stress on epithelial cells and notes the role of intermediate filaments in maintaining integrity. They apply cyclic stretching to cultured cells.**
   Question: What adaptations might occur in the intermediate filaments as a response to this mechanical stress?
   A) Increased disassembly and repolymerization of filaments to adapt to shape changes.
   B) Enhanced cross-linking with actin filaments to reinforce cell junctions.
   C) Phosphorylation of filament proteins, leading to reduced stability.
   D) Activation of signaling pathways that promote filament synthesis and organization.

Answers

1 A
2 B
3 C
4 B
5 B
6 A
7 B
8 B

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