

LEC 7 Q –CYTOLOGY

- 1. What is the primary function of the cytoskeleton?**
 - A) Energy production
 - B) Structural support and organization
 - C) DNA replication
 - D) Protein synthesis
- 2. Which of the following is NOT a type of cytoskeletal structure?**
 - A) Actin Microfilaments
 - B) Microtubules
 - C) Intermediate Filaments
 - D) Lipid Bilayers
- 3. What technique is commonly used to visualize actin filaments?**
 - A) Electron microscopy
 - B) Fluorescence staining
 - C) Western blotting
 - D) PCR
- 4. Which of the following proteins is essential for the nucleation and initiation of actin filaments?**
 - A) Profilin
 - B) Formin
 - C) Cofilin
 - D) Tropomyosin
- 5. What role does ATP play in the dynamics of actin filaments?**
 - A) It stabilizes ADP-bound actin.
 - B) It is required for nucleation only.
 - C) It promotes polymerization and stabilizes binding between monomers.
 - D) It prevents depolymerization.
- 6. Which actin-binding protein is responsible for controlling branching in actin networks?**
 - A) Formin
 - B) Cofilin
 - C) ARP 2/3
 - D) Profilin

7. **Treadmilling in actin filaments refers to:**
- A) Continuous assembly and disassembly maintaining a constant length.
 - B) The growth of filaments only at the plus end.
 - C) The process of actin monomers binding to ATP.
 - D) The stabilization of actin filaments by tropomyosin.
8. **In muscle cells, what is the function of dystrophin?**
- A) It promotes actin polymerization.
 - B) It links actin filaments to transmembrane proteins.
 - C) It stabilizes actin filament ends.
 - D) It facilitates actin disassembly.
9. **Which of the following protrusions is specifically involved in phagocytosis?**
- A) Microvilli
 - B) Lamellipodia
 - C) Filopodia
 - D) Pseudopodia
10. **Rho family proteins regulate which of the following processes?**
- A) DNA replication
 - B) Cell surface protrusions in response to stimuli
 - C) Protein degradation
 - D) Lipid synthesis

Answers:

- 1. B
- 2. D
- 3. B
- 4. B
- 5. C
- 6. C
- 7. A
- 8. B
- 9. D
- 10. B

1. **What is the significance of the 90% amino acid sequence similarity of actin proteins between yeast and human cells?**
- A) It indicates a common evolutionary origin.
 - B) It suggests redundancy in muscle function.

- C) It implies functional diversity among different species.
D) It highlights the role of actin in non-muscle cells only.
2. **In the actin polymerization process, which step is considered the rate-limiting step?**
- A) Formation of F-actin
B) Nucleation
C) Dynamic restructuring
D) Monomer addition to the plus end
3. **Which of the following statements about actin filament polarity is true?**
- A) The plus end is more stable than the minus end under all conditions.
B) ATP hydrolysis occurs more rapidly at the plus end.
C) Actin monomers added to the minus end are always ATP-bound.
D) Both ends of the filament exhibit equal polymerization rates.
4. **What mechanism explains why ADP-actin dissociates more readily than ATP-actin?**
- A) The stability of the ATP-bound state is higher than the ADP-bound state.
B) ATP binding increases the affinity of actin for neighboring monomers.
C) Hydrolysis of ATP changes the conformation of actin, reducing its stability.
D) ADP-bound actin has a higher energy state than ATP-bound actin.
5. **Which of the following actin-binding proteins is primarily involved in the stabilization of filament ends by binding to capping proteins?**
- A) Cofilin
B) Tropomyosin
C) Profilin
D) Formin
6. **What effect does the presence of stress fibers and focal adhesions have on cell motility?**
- A) They impede movement by creating a rigid structure.
B) They enhance motility by stabilizing the leading edge.
C) They are irrelevant to the cell's movement dynamics.
D) They allow for rapid retraction of the cell body.
7. **Which type of actin protrusion is specifically characterized by its role in sensory functions?**

- A) Lamellipodia
 - B) Microvilli
 - C) Pseudopodia
 - D) Filopodia
8. **In the context of cancer, how do epithelial cells change their characteristics?**
- A) They increase cadherin expression to enhance adhesion.
 - B) They lose cadherins and adopt fibroblast-like properties.
 - C) They enhance the formation of adherens junctions.
 - D) They downregulate actin-binding proteins to reduce movement.
9. **How does the phenomenon of treadmilling benefit cellular functions?**
- A) It ensures a static length of actin filaments for stability.
 - B) It allows rapid responses to changes in cellular environments.
 - C) It prevents the degradation of actin networks.
 - D) It facilitates the assembly of larger protein complexes.
10. **What is the role of the Rho family proteins in relation to actin dynamics?**
- A) They directly promote actin depolymerization.
 - B) They coordinate the interaction between actin and microtubules.
 - C) They regulate the formation of specific actin structures in response to extracellular signals.
 - D) They facilitate the synthesis of actin monomers.

Answers:

- 1. A
- 2. B
- 3. B
- 4. C
- 5. B
- 6. B
- 7. D
- 8. B
- 9. B
- 10. C

1. **What structural feature of actin filaments allows them to undergo rapid assembly and disassembly?**
 - A) Their hydrophobic nature
 - B) Their dynamic polymerization state
 - C) Their rigid, stable configuration
 - D) Their non-polar interactions
2. **Which actin-binding protein plays a crucial role in the branching of actin networks?**
 - A) Profilin
 - B) Formin
 - C) Cofilin
 - D) ARP 2/3
3. **The term "treadmilling" in actin dynamics primarily refers to:**
 - A) The uniform addition of actin monomers at both ends of the filament.
 - B) A state where actin filaments maintain a constant length despite ongoing polymerization and depolymerization.
 - C) The preferential addition of ADP-actin at the minus end.
 - D) The simultaneous growth and shrinkage of actin filaments.
4. **What is the role of dystrophin in muscle cells?**
 - A) It initiates actin polymerization during contraction.
 - B) It connects actin filaments to the cytoskeleton.
 - C) It links actin filaments to transmembrane proteins for structural integrity.
 - D) It prevents the disassembly of actin filaments.
5. **In the context of cell migration, which of the following is true regarding lamellipodia and filopodia?**
 - A) Lamellipodia are responsible for sensory functions, while filopodia facilitate movement.
 - B) Both structures are static and serve to anchor the cell in place.
 - C) Lamellipodia are broad, sheet-like extensions, while filopodia are thin, finger-like projections.
 - D) Lamellipodia are more stable than filopodia and resist retraction.
6. **How do cancer cells exploit focal adhesions to enhance motility?**
 - A) By increasing the number of integrins in the cell membrane.
 - B) By transforming into epithelial-like cells that adhere more strongly to

- substrates.
- C) By losing their cadherin expression to become more mesenchymal-like.
- D) By enhancing their actin cortex structure to prevent movement.
7. **Which statement accurately describes the role of ATP in actin filament dynamics?**
- A) ATP is necessary for the initial binding of actin monomers only.
- B) ATP hydrolysis is required for the polymerization of actin at the plus end.
- C) ATP-bound actin is less stable than ADP-bound actin.
- D) ATP facilitates the disassembly of actin filaments.
8. **What is the primary function of the cell cortex in relation to the cytoskeleton?**
- A) It promotes nuclear envelope stability.
- B) It provides a dynamic structure beneath the plasma membrane, influencing cell shape and movement.
- C) It anchors microtubules to organelles.
- D) It serves as a storage site for actin monomers.
9. **What distinguishes pseudopodia from other types of cell protrusions?**
- A) They are rigid structures formed solely from microtubules.
- B) They are primarily involved in absorption rather than movement.
- C) They are formed by crosslinked actin filaments for phagocytosis.
- D) They lack any connection to the cytoskeleton.
10. **In cell signaling related to actin dynamics, which Rho family protein is specifically associated with the formation of stress fibers?**
- A) Rac
- B) Cdc42
- C) Rho
- D) ARP 2/3

Answers:

1. B
2. D
3. B
4. C
5. C
6. C

- 7. B
- 8. B
- 9. C
- 10. C

1. **Which property of actin microfilaments contributes to their ability to generate mechanical force during cellular processes?**
 - A) Their rigid structure
 - B) Their dynamic instability
 - C) Their affinity for nucleotide binding
 - D) Their ability to form stable polymers
2. **During the actin polymerization process, what is the significance of the transition from G-actin to F-actin?**
 - A) G-actin is more stable than F-actin.
 - B) F-actin forms a network that provides structural support.
 - C) G-actin is the only form involved in cellular motility.
 - D) F-actin has a lower energy state than G-actin.
3. **What mechanism allows cells to rapidly alter their shape and movement in response to environmental cues?**
 - A) Stabilization of actin filaments
 - B) Regulation of actin-binding proteins
 - C) Maintenance of static focal adhesions
 - D) Prevention of actin polymerization
4. **Which of the following best explains the impact of ATP hydrolysis on actin filament dynamics?**
 - A) ATP hydrolysis increases the stability of actin filaments.
 - B) ATP hydrolysis promotes the disassembly of actin filaments.
 - C) ATP hydrolysis changes the binding affinity of actin for neighboring monomers.
 - D) ATP hydrolysis has no effect on actin dynamics.
5. **The formation of adherens junctions primarily involves which type of protein?**
 - A) Cadherins
 - B) Integrins

- C) Spectrins
D) Catenins
6. **Which actin-binding protein primarily regulates the exchange of ADP for ATP on actin monomers?**
- A) Cofilin
B) Profilin
C) Tropomyosin
D) Formin
7. **What role does the cell cortex play in the context of actin dynamics?**
- A) It acts as a barrier to prevent actin polymerization.
B) It stabilizes microtubules during cell division.
C) It organizes actin filaments beneath the plasma membrane to influence cell shape.
D) It serves as a reservoir for actin monomers.
8. **In which type of cells is dystrophin particularly crucial, and what is its primary role?**
- A) Neurons; to facilitate neurotransmitter release
B) Muscle cells; to connect actin filaments to the cell membrane
C) Epithelial cells; to maintain cell-cell junctions
D) Fibroblasts; to promote extracellular matrix synthesis
9. **What is a characteristic feature of cancer cells regarding their actin cytoskeleton?**
- A) They exhibit reduced actin polymerization.
B) They maintain stable adherens junctions.
C) They often lose cadherin expression and become more motile.
D) They rely solely on microtubules for movement.
10. **Which of the following best describes the relationship between Rho family proteins and actin dynamics during cell migration?**
- A) Rho proteins promote the assembly of actin filaments into bundles only.
B) Rac proteins enhance actin disassembly to facilitate movement.
C) Cdc42 is involved in filopodia formation, while Rho regulates stress fiber formation.
D) All Rho family proteins have the same effect on actin dynamics.

Answers:

1. B
2. B
3. B
4. C
5. A
6. B
7. C
8. B
9. C
10. C

1. **What distinguishes the plus end of an actin filament from the minus end in terms of dynamics?**

- A) The plus end is less stable due to higher ATP binding.
- B) Polymerization occurs predominantly at the minus end.
- C) The plus end has a higher rate of nucleotide exchange.
- D) The minus end serves as the primary site for actin branching.

2. **In the context of actin filament regulation, what is the primary role of cofilin?**

- A) To promote actin polymerization by stabilizing filaments
- B) To sever and depolymerize actin filaments, facilitating turnover
- C) To bind to ATP-bound actin and prevent polymerization
- D) To form networks of actin by cross-linking filaments

3. **How do focal adhesions contribute to the process of cell migration?**

- A) By preventing cell detachment during movement
- B) By providing sites for actin disassembly
- C) By anchoring the cell to the extracellular matrix and transmitting signals
- D) By stabilizing microtubule networks in the leading edge

4. **Which mechanism primarily drives the process of pseudopodia formation during phagocytosis?**

- A) Passive diffusion of actin monomers
- B) Localized actin polymerization at the membrane
- C) Hydrolysis of ATP at the trailing edge
- D) Stabilization of existing actin filaments

5. **What is the significance of the high conservation of actin proteins across different species?**

- A) It indicates the redundancy of actin function in cellular processes.
 - B) It suggests that actin is essential for fundamental cellular processes throughout evolution.
 - C) It implies that actin functions are limited to muscle cells.
 - D) It highlights the structural diversity of actin in multicellular organisms.
6. **Which of the following describes a characteristic change in epithelial cells as they become more invasive in cancer?**
- A) Enhanced expression of cadherins to promote adhesion
 - B) Increased actin polymerization to maintain structural integrity
 - C) Decreased stability of adherens junctions leading to greater motility
 - D) Reduction in focal adhesion formation to anchor cells
7. **What role does profilin play in actin dynamics?**
- A) It inhibits actin polymerization by capping filament ends.
 - B) It promotes the exchange of ADP for ATP on actin monomers.
 - C) It stabilizes existing actin filaments against depolymerization.
 - D) It facilitates branching of actin networks.
8. **How does the process of actin filament treadmilling contribute to cellular adaptability?**
- A) It allows for the maintenance of a fixed filament length during migration.
 - B) It enables rapid remodeling of actin structures in response to environmental changes.
 - C) It prevents the incorporation of new actin monomers into the filament.
 - D) It ensures the disassembly of actin filaments at a constant rate.
9. **Which actin-binding protein is most closely associated with maintaining the structural integrity of red blood cells?**
- A) Tropomyosin
 - B) Spectrin
 - C) Cofilin
 - D) Formin
10. **What is the primary action of the Rho family of small GTP-binding proteins during cell migration?**
- A) To enhance the stability of microtubules
 - B) To regulate the interaction of actin with myosin
 - C) To coordinate the formation of actin structures like lamellipodia and

filopodia

D) To promote the disassembly of actin networks for cell detachment

Answers:

1. C
2. B
3. C
4. B
5. B
6. C
7. B
8. B
9. B
10. C

1. **Which of the following accurately describes the relationship between actin filament dynamics and cellular motility?**

- A) Actin dynamics are only crucial during cell division.
- B) Increased polymerization at the leading edge facilitates forward movement.
- C) Actin filaments must remain static to provide structural support.
- D) All motility is driven by microtubule dynamics, rendering actin secondary.

2. **How does the structural organization of intermediate filaments differ from that of actin microfilaments?**

- A) Intermediate filaments are highly dynamic, while actin filaments are stable.
- B) Intermediate filaments provide more tensile strength and are less flexible than actin filaments.
- C) Actin filaments are exclusively involved in cell movement, while intermediate filaments are not.
- D) Intermediate filaments are only found in muscle cells, while actin is ubiquitous.

3. **In the context of actin filament polymerization, what does the term "nucleation" specifically refer to?**

- A) The rapid addition of actin monomers to an existing filament.
- B) The formation of a stable filament from monomers.
- C) The initial formation of a trimer that serves as a seed for filament growth.
- D) The breakdown of filaments into individual monomers.

4. **Which statement regarding the role of integrins in focal adhesions is true?**
- A) Integrins directly bind to actin filaments without any additional proteins.
 - B) Integrins act as transmembrane receptors that connect the extracellular matrix to the cytoskeleton.
 - C) Integrins solely promote the disassembly of actin networks.
 - D) Integrins inhibit cell migration by stabilizing actin filaments.
5. **What is the functional consequence of actin filament treadmilling for a migrating cell?**
- A) It prevents the cell from adapting to new environments.
 - B) It maintains a constant filament length, allowing for a stable leading edge.
 - C) It facilitates rapid remodeling of actin structures, enabling swift directional changes.
 - D) It ensures that all actin monomers remain bound to ATP.
6. **What distinguishes the behavior of ADP-bound actin from ATP-bound actin during polymerization?**
- A) ADP-bound actin promotes filament growth more effectively.
 - B) ADP-bound actin is more likely to associate with the plus end of a filament.
 - C) ADP-bound actin is less stable and more prone to dissociation.
 - D) ATP-bound actin does not participate in polymerization.
7. **Which cellular structure is primarily responsible for the rapid and dynamic formation of lamellipodia?**
- A) Intermediate filaments
 - B) Microtubules
 - C) Actin filaments
 - D) Golgi apparatus
8. **How does the loss of cadherins affect epithelial cells in the context of cancer progression?**
- A) It enhances their ability to form tight junctions.
 - B) It promotes increased adhesion to the extracellular matrix.
 - C) It facilitates their transition to a more motile, mesenchymal-like state.
 - D) It reduces their proliferation rate.
9. **Which actin-binding protein is known for its role in promoting the nucleation of new actin filaments?**

- A) Tropomyosin
- B) Formin
- C) Cofilin
- D) ARP 2/3

10. **What characteristic of actin microfilaments allows for the formation of diverse structures such as filopodia and lamellipodia?**

- A) Their ability to bind to microtubules
- B) Their dynamic assembly and disassembly regulated by binding proteins
- C) Their static nature once formed
- D) Their uniform size and shape across different cell types

Answers:

- 1. B
- 2. B
- 3. C
- 4. B
- 5. C
- 6. C
- 7. C
- 8. C
- 9. B
- 10. B

1. A researcher is studying a type of cell that exhibits rapid changes in shape and movement, particularly during wound healing. Upon investigation, it is found that the cells rely heavily on actin dynamics at their leading edges.

Which of the following mechanisms is most likely responsible for the cells' ability to extend their leading edges and migrate effectively?

- A) Increased actin polymerization at the plus end of filaments
- B) Stabilization of actin filaments by tropomyosin
- C) Hydrolysis of ATP at the minus end of filaments
- D) Formation of stable focal adhesions to prevent movement

2. A patient diagnosed with Duchenne Muscular Dystrophy (DMD) presents with muscle weakness due to a mutation affecting dystrophin. This protein is crucial for linking the actin cytoskeleton to the cell membrane.

What is the primary consequence of dystrophin deficiency in muscle cells?

- A) Increased stability of actin filaments
- B) Impaired connection between actin filaments and the plasma membrane
- C) Enhanced polymerization of actin filaments
- D) Overproduction of actin-binding proteins

3. During an experiment, a type of immune cell is observed extending thin, finger-like projections to capture a pathogen. The extensions are highly dynamic and form through the assembly of actin filaments.

Which actin structure is primarily involved in the formation of these projections?

- A) Lamellipodia
- B) Filopodia
- C) Pseudopodia
- D) Microvilli

4. A researcher is examining a population of cancer cells that have undergone epithelial-mesenchymal transition (EMT). These cells show reduced expression of cadherins and increased motility.

What is the primary effect of reduced cadherin expression on these cancer cells?

- A) Enhanced adhesion to neighboring cells
- B) Increased ability to migrate and invade surrounding tissues
- C) Stabilization of adherens junctions
- D) Inhibition of actin polymerization

5. A study investigates the role of Rho family proteins in cell migration. The results show that specific Rho proteins regulate the formation of various actin structures.

Question: Which Rho protein is specifically associated with the promotion of lamellipodia formation?

- A) Rho
- B) Rac
- C) Cdc42
- D) Cofilin

Answers:

- 1. A
- 2. B
- 3. B
- 4. B
- 5. B

1. A scientist is studying a mutant cell line that exhibits significantly reduced rates of actin polymerization. As a result, the cells show an inability to maintain their shape and experience difficulties in cellular motility.

Which of the following is most likely a contributing factor to the observed cellular defects?

- A) Increased binding of ATP to actin monomers
- B) Impaired nucleation leading to decreased formation of F-actin
- C) Excessive capping of actin filaments by tropomyosin
- D) Enhanced activity of actin-binding proteins that stabilize filaments

2. **An experiment is conducted to observe the dynamics of F-actin in a cell undergoing rapid movement. Researchers introduce a drug that inhibits ATP hydrolysis.**

What effect would this drug most likely have on F-actin dynamics?

- A) Stabilization of actin filaments and prevention of treadmilling
- B) Increased rate of actin polymerization at both ends
- C) Promotion of filament disassembly at the minus end
- D) Enhanced branching of actin filaments

3. **A patient with Becker Muscular Dystrophy (BMD) displays milder symptoms compared to those with DMD, attributed to some functional dystrophin produced.**

What aspect of muscle cell function is most likely preserved in patients with BMD due to the presence of dystrophin?

- A) Complete stabilization of the actin cytoskeleton
- B) The ability to maintain connections between the cytoskeleton and plasma membrane
- C) Enhanced contractile function of muscle fibers
- D) Increased resistance to mechanical stress

4. **A researcher is exploring how cancer cells utilize focal adhesions to enhance their migratory capabilities. They find that the signaling pathways activated at focal adhesions facilitate changes in the actin cytoskeleton.**

What is the primary role of integrins at focal adhesions in this context?

- A) To directly sever actin filaments and promote disassembly
- B) To transmit mechanical signals from the extracellular matrix to the cytoskeleton
- C) To stabilize cadherin-mediated cell-cell junctions
- D) To inhibit the formation of stress fibers

5. **A genetic study reveals a mutation in the gene encoding for profilin, leading to altered actin dynamics in a specific cell type. This change affects the cell's ability to respond to extracellular signals.**

What is the most likely consequence of profilin dysfunction on actin filament dynamics?

- A) Decreased polymerization rates of actin filaments
- B) Increased stability of actin filaments
- C) Enhanced branching of actin networks
- D) Inhibition of nucleotide exchange on actin monomers

Answers:

- 1. B
- 2. A
- 3. B
- 4. B
- 5. A

Done By: Khaled Ghanayem