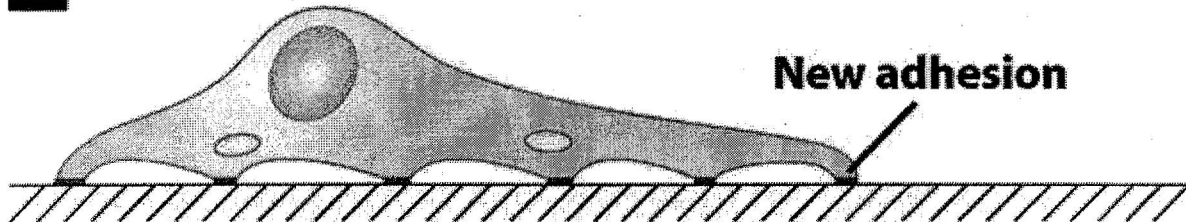


1. Cell-cell adhesion complexes are associated with specific cytoskeleton systems. Which of these adhesive complexes are linked to intermediate filaments?
  - A) focal adhesions
  - B) adherence junctions
  - C) desmosomes
  - D) gap junctions
  - E) tight junctions
2. Separation of spindle poles during anaphase B utilizes which of the following?
  - A) (+) end-directed microtubule motors at the cell membrane
  - B) (+) end-directed microtubule motors at the kinetochore
  - C) (–) end-directed microtubule motors on overlapping polar microtubules
  - D) (+) end-directed microtubule motors on overlapping polar microtubules
  - E) both A and C.
3. Which protein is expressed in a cell-specific manner and binds to the tripeptide sequence Arg-Gly-Asp?
  - A) integrin
  - B) collagen
  - C) laminin
  - D) fibronectin
  - E) both C and D
4. During mitosis
  - A) all chromosomes must be captured.
  - B) the microtubule network becomes more stable.
  - C) treadmilling is not utilized.
  - D) the plasma membrane is degraded.
  - E) no energy is required.
5. If actin within a sarcomere is decorated with S1 myosin the "arrow heads" will point to
  - A) the Z disk.
  - B) tropomodulin.
  - C) capZ.
  - D) A and C.
  - E) None of the above.
6. A migrating cell expressing  $\alpha 5 \beta 1$  integrin stops migrating when it reaches a new substrate. Migration stopped because
  - A) no more collagen substrate was available.
  - B) no more fibronectin substrate was available.
  - C) no more laminin substrate was available.
  - D) no more lamin substrate was available.
  - E) no more carbohydrate substrate was available.

7. Microtubules within a dendrite are composed of \_\_\_\_\_ protofilaments.

- A) 10
- B) 13
- C) 23
- D) 33
- E) two of the above

8. What two proteins are found at the indicated “New adhesion” spot on this migrating cell?



- A) Cadherin and actin.
- B) Integrin and actin.
- C) Integrin and lamin.
- D) Cadherin and vimentin.
- E) Integrin and keratin.

9. A  $\gamma$ -tubulin antibody is added into a plant cell where it labels hundreds of individual spots within that cell. This labelling pattern indicates that

- A) plant tubulin dimers are composed of  $\alpha$  and  $\gamma$  subunits.
- B) plants have many basal bodies.
- C) plants have hundreds of centrioles.
- D) plants have many MTOCs.
- E) plant cell walls are supported by microtubules.

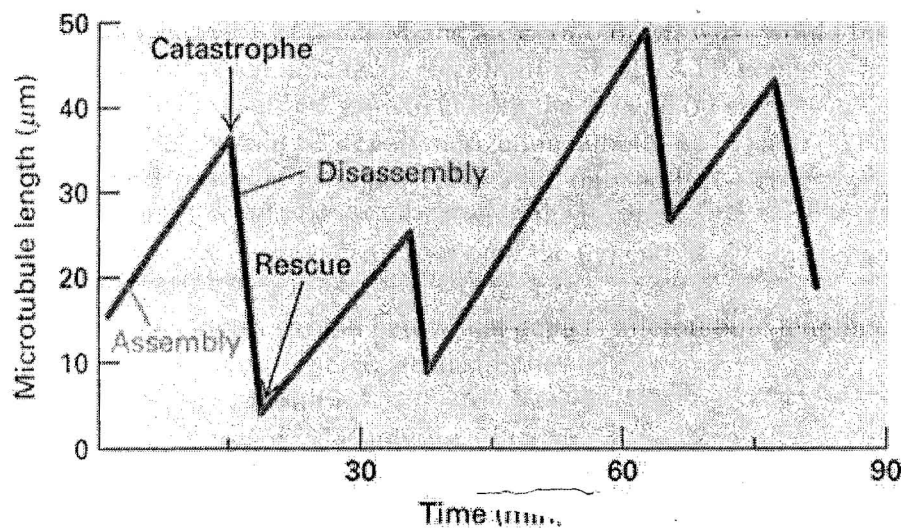
10. During treadmilling, actin subunits add

- A) predominantly to filament (+) ends.
- B) predominantly to filament (–) ends.
- C) equally to both filament ends.
- D) along the entire length of a filament.
- E) in the GTP form.

11. Microtubule assembly can occur

- A) if microtubule-associated proteins are hydrolyzed.
- B) if cells are incubated at 4°C.
- C) when ATP is hydrolyzed.
- D) when CAMs are utilized.
- E) when the tubulin subunit concentration is in excess of the Cc.

12. The sarcoplasmic reticulum must have membrane proteins that can
- A) bind to tropomyosin and troponin.
  - B) depolymerize.
  - C) release and pump  $\text{Ca}^{2+}$ .
  - D) contract.
  - E) promote cell adhesion.
13. Microtubules can be destabilized at the (+) end by \_\_\_\_\_ and \_\_\_\_\_, the latter of which requires \_\_\_\_\_.
- A) stathmin, katanin, MTOC
  - B) stathmin, kinesin, ATP
  - C) stathmin, kinesin, MTOC
  - D) katanin, stathmin, GTP
  - E) katanin, kinesin, ATP
14. If actin has a  $Cc^{+}$  of  $0.12\mu\text{M}$  and a  $Cc^{-}$  of  $0.6\mu\text{M}$ , what would result if excess amounts of CapZ were present and the concentration of free ATP bound G-actin is  $0.9\mu\text{M}$ ?
- A) There would be growth at both the (+) and (-) ends.
  - B) There would be depolymerization at both the (+) and (-) ends.
  - C) There would be depolymerization only at the (-) end.
  - D) There would be growth at only the (-) end.
  - E) There would be growth at only the (+) end.
15. With respect to the graph below that depicts microtubule length with respect to time, what event could have triggered a catastrophe?
- A) Excess  $\gamma$ -tubulin.
  - B) Depletion of GTP-tubulin.
  - C) Increasing temperature to  $37^{\circ}\text{C}$ .
  - D) Inadequate IFAPs.
  - E) Excess dynein.



16. During mitosis in animal cells
- A) nuclear membrane breakdown occurs after metaphase.
  - B) the centrioles replicate after metaphase.
  - C) the nuclear DNA is replicated after metaphase.
  - D) anaphase occurs after metaphase.
  - E) All of the above.
17. With respect to actin polymerization where there is ample G-Actin in the ATP form, the presence of nuclei (short F-actin polymers) will
- A) decrease the time needed to reach steady state.
  - B) increase the time needed to reach steady state.
  - C) decrease the critical concentration of the plus end.
  - D) increase the critical concentration of the plus end.
  - E) inhibit polymerization.
18. Which of the following properties is not shared by all myosins?
- A) The ability to bind ATP.
  - B) They move to the (+) end of actin.
  - C) The ability to form dimers.
  - D) The ability to bind actin.
  - E) The presence of a head domain.
19. Which of the following proteins is involved in the formation of actin bundles in microvilli?
- A)  $\alpha$ -actinin
  - B) cofilin
  - C) fimbrin
  - D) profiling
  - E) tau
20. Membrane extension during cell locomotion is driven by
- A) myosin II.
  - B) focal adhesions.
  - C) sarcomeres.
  - D) actin polymerization.
  - E) adherens junctions.
21. All of the following are actin based structures, except
- A) flagella
  - B) filopodia
  - C) microvilli
  - D) stress fibers
  - E) adherens junctions

22. The force for axoneme bending is derived from the
- A) sliding movement of the central singlet microtubules.
  - B) contraction of central singlet microtubules.
  - C) sliding movement of outer doublet microtubules.
  - D) contraction of outer doublet microtubules.
  - E) bi-polar motor driven microtubule movements.
23. A cell is treated with taxol and subsequent analysis revealed that it could not migrate, but that it had its keratin filaments intact. From this description we can deduce that
- A) the actin cytoskeleton was depolymerized.
  - B) the actin cytoskeleton was stabilized.
  - C) the cell's myosin was inactive.
  - D) the cell was epithelial.
  - E) the cell was dead.
24. With respect to cell migration, which is the correct sequence of events?
- A) Rac activation at the front of a cell allows Rho activation of Arp2/3 and subsequent WASp activation and myosin activation.
  - B) Cdc42 activation at the front of a cell allows Rac activation of Arp2/3 and subsequent Rho activation and myosin activation.
  - C) Cdc42 activation at the back of a cell allows Rac activation of Arp2/3 and subsequent Rho activation and actin activation.
  - D) Cdc42 activation at the front of a cell allows WASp activation of Rho and subsequent myosin activation.
  - E) Rac activation at the front of a cell allows WASp activation of Arp2/3 and subsequent Rho activation and actin activation.
25. You are given a culture dish in which cells are adhering to each other. You then add EDTA to the culture. EDTA binds to and removes all calcium from the culture solution. After the EDTA treatment all of the cells remain bound to each other as they did before. From this observation you can conclude that:
- A) the cells are all expressing cadherin molecules.
  - B) the cells are all expressing Ig superfamily CAMs.
  - C) half the cells are expressing N-Cad, while the other half are expressing complementary N-CAM molecules on their surface.
  - D) the cells are adhering to each other using integrins.
  - E) the cells are adhering to each other using hemidesmosomes.
26. The plasma membrane of eukaryotic cells is supported by
- A) actin filaments.
  - B) microtubules.
  - C) lamins.
  - D) clathrin.
  - E) myosin II.

27. Which of the following occurs during anaphase A?
- A) The spindle elongates.
  - B) The aster elongates.
  - C) Kinetochores remain attached to shortening kinetochore microtubules.
  - D) Chromosomes move to the spindle equator.
  - E) The spindle poles move closer together.
28. Vertebrate gap junctions are composed of
- A) adherins.
  - B) collagens.
  - C) cadherins.
  - D) integrins.
  - E) none of the above.
29. A mutation arises which renders kinesin-5 non-functional. As a result
- A) trafficking of vesicles from the ER to the Golgi will cease.
  - B) anterograde trafficking of vesicles will cease.
  - C) anaphase B will be interfered with.
  - D) cytokinesis will be interfered with.
  - E) Retrograde trafficking of vesicles will cease.
30. The kinetochore
- A) is made of DNA.
  - B) contains two asters.
  - C) is an actin attachment site.
  - D) is associated with the centromere.
  - E) contains centrioles.