Course Materials for Week 6: Cytoskeleton Motor Proteins

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Assignment Questions

1. Microtubules (choose all that apply):

    a. Are the tracks on which the myosin protein moves
    b. Are the tracks on which the dynein protein moves
    c. Has a ‘minus’ end that binds to the centrosome
    d. Allows dynein to transport cargo from the center to the periphery of the cell, and back
    e. None of the above

2. There are different approaches to studying mechanisms of cell motility. Provide two examples cited by Dr. Vale in his talk.

3. One important difference in the roles of muscle myosin and kinesin is the fact that (choose all that apply):

    a. Muscle myosin works outside the cell to contract myocytes in the muscle tissue, whereas kinesin works inside the cell to transport a cargo
    b. They both work inside the cell, but myosin can produce muscle contraction without any energy release, whereas kinesin cannot
    c. A kinesin protein needs to continuously bind to its track for many ATPase cycles, whereas muscle myosin only needs to bind to its track for one ATPase cycle to produce motion
    d. The motion of one myosin cannot produce muscle contraction, whereas one kinesin can carry a cargo from one end of a cell to the other
    e. None of the above

4. The cyclic binding-stroke-release events that lead to muscle contraction require: (choose all that apply)

    a. The release of energy through ADP hydrolysis
    b. The binding of a phosphate to myosin
    c. Rotation of the kinesin protein

d. Binding of ATP to the molecular motor
e. None of the above

5. A cytoskeletal motor protein is a protein that: (choose all that apply)

    a. Uses chemical energy from ATP to produce movement
    b. Is 50% more efficient at producing movement than a car engine
    c. Can move in any direction along a cytoskeletal track
    d. Moves 108 times faster than a car, proportional to its size
    e. None of the above

6. In his talk, Dr. Vale provides several examples of diseases caused by mutations in motor proteins or proteins that are associated with motor proteins. Provide two of these examples.

7. Kinesin: (choose all that apply)

    a. Belongs to a family of proteins coded by one gene
    b. Is involved in the formation of the mitotic spindle
    c. Is a molecular motor
    d. None of the above

8. In the list below, identify examples of intracellular motility: (choose all that are correct)

    a. The transport of organelles
    b. The movement of lipids within a membrane
    c. The movement of a nucleus inside a cell
    d. The movement of melanosomes to cause changes in pigmentation
    e. None of the above

9. What are the common features of kinesin, dynein and myosin: (choose all that are appropriate)

    a. All 3 have homologous primary sequences
    b. The crystal structures of these 3 proteins display similarities
    c. They all have the ability to produce force by hydrolyzing nucleotides
    d. They all change conformation after hydrolyzing nucleotides
    e. None of the above

10. To study the microtubule-binding properties of a mutated kinesin protein, which of the following methods could one use: (check all that are correct)

    a. Kinesins bound to a glass surface, with added soluble microtubules
    b. X-Ray crystallography of the mutant kinesin
    c. A motility assay with purified microtubules, kinesin, beads and GTP
    d. An optical trap experiment using fluorescently labeled kinesin
    e. None of the above

Assignment Answers

1. b and c
    a. Label motor proteins with green fluorescent protein and use light microscopy.
    b. In vitro – purify proteins and do single molecule analysis using plastic beads attached to motor protein and see how it moves along filament.
    c. In vitro – purify dye-tagged motor protein and using light microscopy analyze the movement along filament.
    d. Attach motor proteins to a glass and label filaments. Observe the movement of filaments along the attached motor proteins.
2. c and d
3. d
4. a
5. Examples include:
    - Familial Hypertrophic cardiomyopathy
    - Deafness
    - Cilia Dyskinesias
    - Neurodegenerative Diseases
6. b and c
7. a, c, and d
8. b, c, and d
9. a, c, and d