

Biol 319, Cell Biology  
Fall 2001  
Sample questions for the final exam

Name:

**Part 1.** Multiple choice questions. Check *all* that apply (there *may be* more than one correct item in a given question). 4 points each, for a total of 48.

1. Cyclin-dependent kinase (Cdk) activity increases steadily during G<sub>2</sub> as a result of
  - phosphorylation of mitotic cyclins by Cdks
  - activation of mitotic Cdk-cyclins through the activity of a phosphatase
  - phosphorylation of Cdks at a point not located inside the catalytic site of the cdk-cyclin complex
  - transient increase in the cytosolic [GTP] concentration
  
2. Entry into M is not allowed if
  - the cell is not big enough
  - mitotic cyclin is overexpressed
  - sufficient nutrients are not available
  - if DNA replication is not complete
  
3. Which of these steps in the G-protein linked signaling system represents a divergence, or diversification, of the signaling pathway to affect multiple targets?
  - activated G-protein dissociates to produce an  $\alpha$  and a  $\beta\gamma$  subunit
  - the  $\beta\gamma$  subunit binds to, and activates, a potassium channel
  - phospholipase C activation produces DAG and IP<sub>3</sub>
  - DAG activates C-kinase
  
4. Which of these are properties typically displayed by cancer cells?
  - dependence on growth factors for continued cell division
  - secretion of proteases that degrade the extracellular matrix
  - growth inhibition upon contact with neighboring cells
  - high nucleo-cytoplasmic ratio
  
5. Which of the following are a component in the signaling pathway stimulated by receptor tyrosine kinases?
  - adenylate cyclase
  - adaptor proteins
  - autophosphorylating receptor
  - ras activating protein

**Part II.** Short answers/ brief essays. Variable points.

1. Below you'll find two lists. List 1 contains names of substances that participate in signal transduction; List 2 contains various mechanisms that may or may not promote the inactivation ('turning off') of one or more of these signaling agents. For each second messenger, find one or more inactivating mechanisms from list 2, then write-in the appropriate letter.

List 1. Second messengers

List 2. Inactivating mechanisms

(don't have to use all items in this list)

cAMP

A. Activity of phosphatases

Ca<sup>2+</sup>

B. Activity of ER-calcium pumps

protein kinases

C. Presence of bound GDP

GTPases

D. Activity of phosphodiesterases

E. Activity of ER calcium channels

F. Activity of phospholipase C

2. Compare and contrast protooncogenes and tumor suppressor genes using the table below. Make check marks (or write yes/no) in the two columns on the right if the feature listed on the left applies.

Protooncogenes                      Tumor suppressor genes

Overexpression produces potential for carcinogenesis?

Normally acts to inhibit cell division?

genes encoding protein kinases that participate in MAP kinase cascade are an example of this?

CKI (cyclin kinase inhibitors) are an example of this?

3. Check or circle **one** from the choices given to complete the statements below.

A. Calmodulin activates protein kinases in response to a transient increase in

- cAMP
- calcium ions
- DAG

B. The signaling system that operates over the shortest range is

- contact-dependent cell signaling, as in the inhibition of neighbors by differentiating nerve cells
- paracrine secretion, as in the secretion of histamines by mast cells
- neural signaling, as in the transmission of a nerve impulse

4. Short answers. Answer the following questions in one to three sentences. 2 points for each question.

A. Mitotic cdks are present at steady-state levels throughout interphase, and mitotic cyclins levels increase steadily through interphase. Why, then, is the MPF not activated during G<sub>1</sub> and S? State at least two different mechanisms that keep the MPF from being activated.

B. What is the critical difference between cells in G<sub>0</sub> versus cells in G<sub>1</sub> arrest? Why is the G<sub>0</sub> state often described as a 'safe haven' for a differentiated cell?

C. How can signaling systems involving the three different signal transduction pathways be integrated? Illustrate with a specific example.

5. Write an essay on ‘ Cellular Aspects of Cancer’ in which you consider the following issues: cancer is described as a disease of old age; why is cancer more common in our later years? Are most human cancers hereditary? Explain. What is the role of environmental factors in cancer causation? The establishment of an aggressive, metastatic tumor involves a ‘Darwinian struggle’ among clonal populations; how does clonal selection serve to promote cancer progression? 6 points, of which one point is reserved for clarity and organization in your essay. 6 points.