

## Cell Biology: Bio308 Review 2 2006

The review must be turned in to my office **before 3:00pm** on **Sunday November 12th**. **To promote earlier preparation:** *If you turn in the review before 5pm on Friday November 10<sup>th</sup> you will earn one bonus point.*

- This is a closed-book, closed-note review.
- The review was designed to be able to be completed in 2 hours. You have from now until 2:59pm Sunday to complete it. I suggest trying to complete it within 2 hours. I also strongly suggest beginning it before noon on Sunday so that you will have time to complete it, print it, and turn it in.
- All answers must be typed and must be in the form of complete sentences unless the question specifically states otherwise.
- You may use a calculator if calculations are required. However, the steps behind any calculation must be shown to receive full credit (calculations can be hand-written).
- Any figures or graphs (required, or used to clarify a point) may be hand-drawn.
- This page must be the first page of your answer packet. Fill out the information at the bottom and attach this page to the ones containing your answers. The questions are yours to keep.
- The top of each additional page in the packet must contain only your initials and the page number.

Your review period begins when you read any part of the scenario or questions within this packet. There are a total of 100pts on the review (additional bonus points are possible)

*REMEMBER: According to the honor code you may not discuss the review, its contents or your impression of it until after all have taken it. You may be done but others may not have started or be taking a break in the middle. My preference is that you do not discuss it until after you get it back (Tues or Wed of next week).*

Any questions about the review should be directed to me at [kabernd@davidson.edu](mailto:kabernd@davidson.edu), 894-2889 (o), or 662-9744 (h). Any calls to my home must occur before 9:00pm. I do not have email at home so emails must be at my office before 5pm on Friday.

Turn in the review at my office (Watson 289). Sign the sheet on the door and place the review either in my hands or under my door. Your card access to Dana will allow you to turn in the review 'after hours' by coming across the second floor bridge.

Name: \_\_\_\_\_  
(print)

Signature: \_\_\_\_\_

My signature indicates that I have completed this review following the Honor Code.

This review was completed in \_\_\_\_\_ hours.

I placed it under your door at \_\_\_\_\_ on \_\_\_\_\_.  
(time) (day)

The scenario that follows is based upon review article that appeared in Current Biology. Previous knowledge of the specifics of this article is not needed as you are given background throughout the test. Read the information given and answer the questions based on that information and the topics covered in Unit 2.

#### NEUROBIOLOGY: ON THE RIBBON SYNAPSES OF SENSORY NEURONS

The following points are made by M. Holt et al (Current Biology 2004 14:173):

*'Ribbon synapses of sensory neurons begin the transfer of both visual information in the retina and auditory information in the cochlea [region of the ear]. At the active zone [region where high levels of exocytosis occur], they contain a structure called the ribbon to which large numbers of vesicles attach by short filaments. The signals that control neurotransmitter release from ribbon synapses are graded with the intensity of the stimulus and maintained according to the duration of the stimulus. These maintained signals stimulate a continuous cycle of exocytosis and endocytosis in retinal photoreceptors, as well as cochlear hair cells [cells of the ear that are stimulated by vibrations]. Ribbons are not found at conventional synapses releasing transmitter at neuromuscular junctions. (Words in parentheses were added to clarify terms that might not be familiar)*

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- 1) What are the names of the three types of cytoskeletal elements? (3pt)
- 2) Explain why it is important that the cytoskeleton is dynamic rather than static. (3pt) (do not explain *how* the dynamic nature is achieved)
- 3) Choose one type of cytoskeletal element that you think may be found as part of the ribbon. Explain why you think that this element might be found in a ribbon. (6pt)
- 4) Consider one of cytoskeletal elements that you did **not** choose in #3 (above)
  - a) What is the name of that cytoskeletal element and what is its monomeric subunit? (2pt)
  - b) Describe one molecular motor that would be associated with that cytoskeletal element. In your description include its name, a description of its structure, its direction of movement and how nucleotide hydrolysis plays a role in its movement. (8pt)

Consider the type of element and molecular motor you just described in #4. In a test tube any of those 'road' chains will easily associate with any molecules of that 'engine'. However in the cell, the 'engine' will only be used to power movement of certain cargo on specific 'roads' found in specific regions of the neuron.

- 5) What are the four specific regions of a neuron? (2pt)
- 6) How does the cell make sure that the correct cargo travels and is delivered to the right location along all those similar cytoskeletal chains? (4pt)

Ribbon synapses have synaptic vesicles that contain membrane protein and proteinaceous luminal components. Both must be synthesized and packaged into these vesicles.

- 7) Briefly describe the process of creating the nucleotide based message that is involved in the expression of both of these components. (Include the name of the process, 150words max, show word count) 5pt

*BONUS:* Draw two monomeric subunits that are found in an hnRNA.(2pt) Connect them using the correct covalent bond. (1pt, circle it) (The more details, the more points)

8) What is the name of the covalent bond you were asked to draw in the bonus? (2pt)

9) Protein synthesis machinery involves more than one type of RNA. Name them and provide a one sentence description of the role each plays in making a protein. (5pt)

*BONUS:* Draw two monomeric subunits that are found in a protein.(2pt) Connect them using the correct covalent bond. (1pt, circle it) (The more details, the more points)

10) The membrane proteins components of the synaptic vesicle must overcome a significant thermodynamic barrier in order to become part of a membrane. Briefly define the main translocation mechanisms used by eukaryotic cells to cause a protein to become part of a membrane (No more than one sentence for each mechanism—describe the main defining characteristics.) (5pt)

11) Consider the FUS1 fusion protein in yeast. Which translocation mechanism is it likely to use *and* where would its translocation occur? (briefly explain your reasoning) (5pt)

12) The summary states that ribbons are not found at conventional synapses. Using the summary information *contrast* the process of neurotransmitter release (vesicle fusion) at a ribbon synapse with neurotransmitter release at a conventional synapse. (8pt)

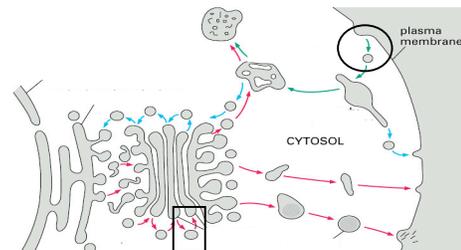
13) Describe bipolar disorder. (4pt)

14) Previous questions have discussed cytoskeletal elements, protein transport, protein translocation and fusion of synaptic vesicles with the plasma membrane. Which of these processes would you choose to study in order to determine the root cause of bipolar disorder. In your explanation provide support for your choice and reasons why it is a more promising than the others in the list. (10pt)

Consider the diagram on the right,

15) What is clathrin? (3pt)

16) Would you expect clathrin to be involved in the process within the circle, the one diagrammed in the square or both? Explain your reasoning (6pt)



17) What is Sar1p? How is it involved in protein targeting and transport? (5pt)

18) McCann et al. (2005) present a new approach for visualizing proteins in live cells. Briefly describe their approach and provide one reason why it is an improvement over previously used techniques (5pt)

19) Suggest a research question about ribbon synapses that could be addressed using this new method. Your answer should be in the form of 'Researchers could ask how/why/what \_????\_ using this method because it would allow them to \_\_\_\_\_', (5pt)

20) My reviews are designed to assess understanding of the broad concepts covered within the unit by requiring the information be applied to new situations. Not every question about every detail is (or can be) asked. Sometimes you get to the end and think 'I studied X so much, she didn't ask about it!'

This is your chance. Write AND answer a question. It must pertain to information covered in the second unit. It cannot re-cover material covered in a question already present in the review. My advice is to keep it simple and don't ask yourself to write a book. (4pt)