

## Biology 113 Closed Book Take-Home Exam #3 – Chapters 8 - 11

There is no time limit on this test, though I have tried to design one that you should be able to complete within 3 hours. There are 8 pages in this test, including this cover sheet. You are not allowed to look at someone else's test, nor use your notes, old tests, the internet, any books, nor are you allowed to discuss the test with anyone until all exams are turned in by 10:30 am on Monday Nov. 16. **EXAMS ARE DUE BY 10:30 AM ON MONDAY NOVEMBER 16.** If you turn in your exam late, you will lose a letter grade which accumulates for each day you are late. **The answers to the questions must be typed within this test** unless you want to draw on a separate page. If you do not write your answers in the appropriate location, I may not find them. Tell me where to look if you put your answer at the back of your test.

I have provided you with a “Data Gallery” in the form of figures and tables. To choose a figure in support of your answer, simply state Figure #x. You do NOT need to move the figure on your test. Do not assume how many of the data images you will use, or not use. **Simply choosing the data is not sufficient support for your answer. You must explain the significance of the data and how they support your answer.** I have given you word limits so be concise.

**-3 pts if you do not follow this direction.**

**Please do not write or type your name on any page other than this cover page.**

Staple all your pages together when finished with the exam. Do not print test pages without answers. I only want to see your answers. You can type your answers right under each question.

Name (please print):

Read the pledge and sign if you can do so with honor:

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On my honor I have neither given nor received unauthorized information regarding this work, I have followed and will continue to observe all regulations regarding it, and I am unaware of any violation of the Honor Code by others.

How long did this exam take you to complete?

Lab Questions:

**8 pts.**

1) Last weekend, I went camping in a cave. While there, I lost most of my gear. All I could find was a plant and some flint for making sparks. Luckily, there was some spare lab equipment and blind cave shrimp in the cave too. While I waited for the rescue drones to find me, I performed a toxicity test on the plant to determine if I could eat the plant tissue. Use this web site to analyze the data I recorded on my cell phone: <http://www.quantitativeskills.com/sisa/statistics/fisher.htm>

bring shrimp data generated the same way you generated data

Treatment	# Alive	# Dead
Water control	77	3
Methanol control	73	7
Plant A roots	39	41
Plant A leaves	66	14

- a) What was my null hypothesis? (**maximum of 20 words**)
- b) What was the purpose of the water and methanol controls? (**maximum of 30 words**)
- c) Did the controls work as expected? Support your answer with data. (**maximum of 30 words**)
- d) Is either part of this plant toxic as defined by the brine shrimp assay? Support your answer with data. (**maximum of 30 words**)

**4 pts.**

2) In the space provided below, draw a picture of the final results you expect to see next week if your bacterial population has evolved antibiotic resistance. Include in your drawing the appropriate controls.

Draw here:

Lecture Questions:

**8 pts.**

3) Two questions about cells.

- a) Using all the available data, what are nanobacteria? Support your answer with data from *two figures*. (**maximum of 35 words**)

b) Organize the information related to energy needs, time, number and volume that support the statement that all cells must be small. Support your answer with information from *two figures*. (maximum of 40 words)

**12 pts.**

4) some questions about neurons

a) How is the chemical signal of a neurotransmitter converted into an electrical signal that is sufficient to travel the length of a neuron. Focus on the conversion, not the travel part. Support your answer with information from *two figures*. (maximum of 40 words)

b) What molecular event constraints an action potential so that it only moves in one direction down the axon? Support your answer with data showing the one direction movement. (maximum of 40 words)

c) On a separate piece of paper, draw a picture of exocytosis in a neuron where short term memory is present. Be sure to label all the key components and players in the exocytosis process.

**12 pts.**

5) some questions about muscles

a) Analyze the data that explain how muscles grow bigger when you exercise a lot. Support your answer with data. (maximum of 40 words)

b) After a muscle cell is depolarized, describe the chemical signal that allows the cell to contract and from where the signal comes? Support your answer with a figure. (maximum of 40 words)

c) For a muscle that is contracting, explain why one category of fibers within a sarcomere moves and the other remains stationary. Support your answer with *two figures*. (maximum of 40 words)

**12 pts.**

6) some questions about memory formation

a) How did Kandel know that *Aplysia* could learn and store a long term memory? Support your answer with *two data figures*. (maximum of 35 words)

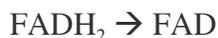
b) Describe the feedback loop that plays a central role in long-term memory formation. Support your answer with a figure. (maximum of 40 words)

c) On a separate piece of paper, draw a picture of exocytosis in a neuron where long term memory is present. Be sure to label all the key components and players in the exocytosis process.

**12 pts.**

7) some questions about cellular respiration

a) What is the sign (positive or negative) of the  $\Delta G$  for this redox reaction? Explain your answer. (maximum of 20 words)



b) Animals consume many forms of carbon for food. In what chemical forms are the carbons after the first portions of cellular respiration but prior to the citric acid cycle? For this question,

just focus on the carbons, not the energy harvested so far. Support your answer with *two figures*. (maximum of 40 words)

c) Citric acid is composed of six carbons. What happens to each of the six carbons after one round of the citric acid cycle? Support your answer with *two figures*. (maximum of 30 words)

d) What chemicals temporarily store the energy harvested during the citric acid cycle? List them in order from the most amount of stored energy per molecule (#1) to the least stored energy per molecule (last number).

1.

**12 pts.**

8) more questions about cellular respiration

a) How does carbon monoxide kill you? Support your answer using at least two figures. (maximum of 40 words)

b) Soon we will study how hemoglobin carries oxygen. Explain all the functions of oxygen in your body. Support your answer with a figure. (maximum of 30 words)

c) Of the three types of food (lipids, proteins and carbohydrates), which one is regulated to be digested last through homeostatic mechanisms? Support your answer with data from the *one most compelling data figure*. (maximum of 40 words)

**10 pts.**

9) some questions about photosynthesis

a) What is the main function of water consumption for plants when they photosynthesize? Support your answer with a figure. (maximum of 30 words)

b) Describe the abiotic factor that determines the homeostasis of cyclic vs. non-cyclic electron flow when plants harvest light energy? Support your answer with a figure. (maximum of 40 words)

c) On a separate sheet of paper, draw a picture of a chloroplast and illustrate these components using the numbers here: 1 = location of new ATP production; 2 = ATP synthase; 3 = photosystem I; 4 = photosystem II; 5 = water splitting; 6 = oxygen production; 7 = carbon fixation. Also label the approximate pH in the stroma, cytoplasm and thylakoid space.

**10 pts.**

10) You may have read recent stories how oil companies Exxon Mobil, Shell Oil, BP *etc.* were paying climate change deniers despite Shell's own scientists agreeing that climate change is real and caused by humans (*NY Times*, Nov. 6, 2015).

a) Sketch one image that shows the change in CO<sub>2</sub> levels over time that deniers used to argue that the change was just a part of the natural cycle of CO<sub>2</sub> when in fact, the upward trend is clear. Support your answer with a figure.

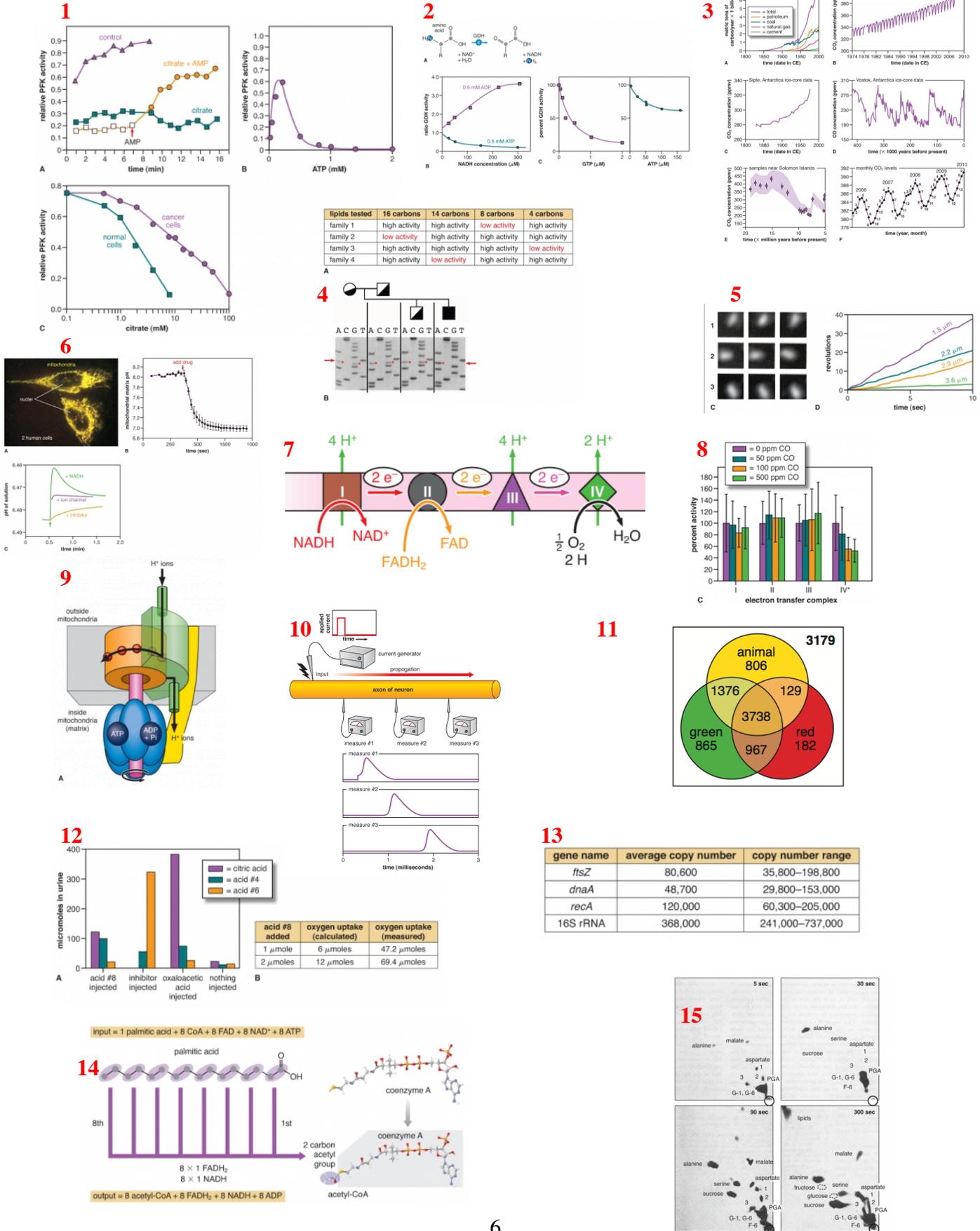
b) What two homeostatic mechanisms regulate the rate of carbon fixation? Support your answer with data. (maximum of 30 words for each one)

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- 1.
  - 2.
- c) What high-energy molecules are consumed to provide energy for carbon fixation? Support your answer with a figure. (maximum of 30 words for each one)

- 1.

Data Gallery

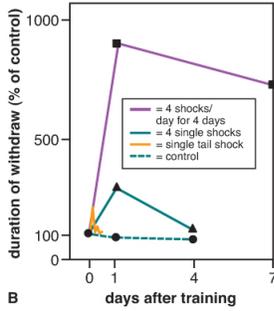




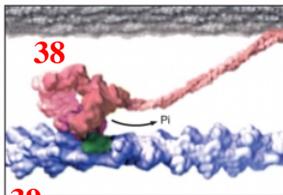
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description	green alga	bacterium	diatom	yeast, fungus	red alga	flowering weed
species	<i>O. tauri</i>	<i>E. coli</i>	<i>T. pseudonana</i>	<i>S. cerevisiae</i>	<i>C. merote</i>	<i>A. thaliana</i>
cell length	1 μm	2 μm	5 μm	5 μm	2 μm	multicellular
genome size	12.5 Mbp	4.6 Mbp	34 Mbp	12 Mbp	16.5 Mbp	140 Mbp
number of chromosomes	20	1	24	16	20	5
number of genes (rounded)	8,200	4,300	11,200	6,600	5,300	27,200

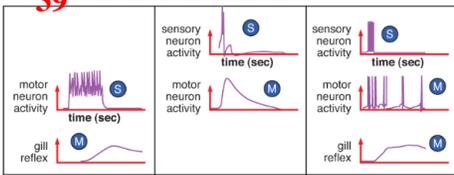
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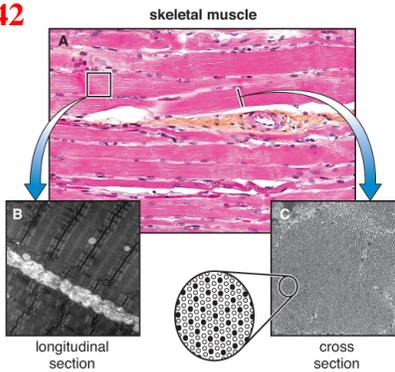
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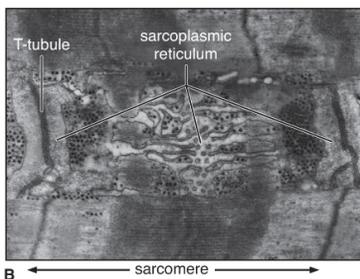
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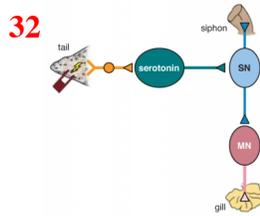
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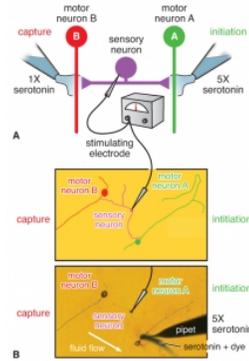
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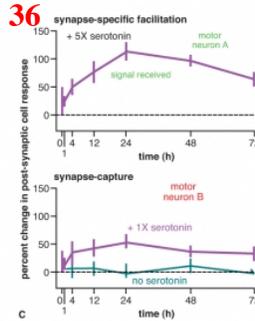
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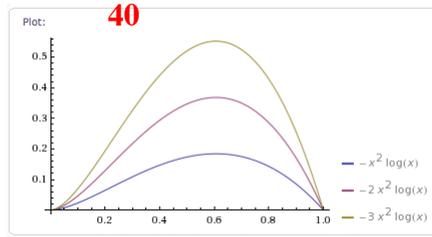
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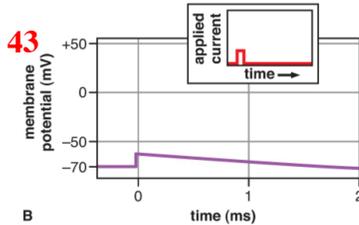
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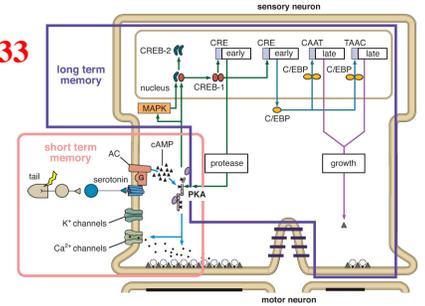
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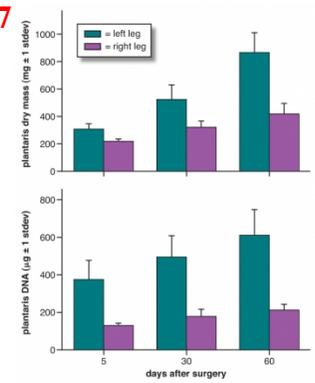
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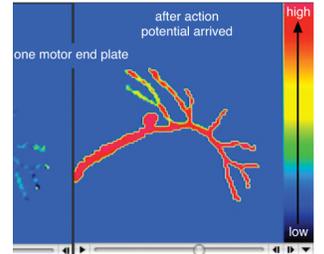
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ion	intracellular concentration	extracellular concentration
K <sup>+</sup>	155 mM	4 mM
Na <sup>+</sup>	12 mM	145 mM
Ca <sup>2+</sup>	0.0001 mM	1.5 mM
Cl <sup>-</sup>	4 mM	120 mM

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