

## 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 7 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 9:30 am on Monday Nov. 17. **EXAMS ARE DUE BY 9:30 AM ON MONDAY NOVEMBER 17.** If you turn in your exam late, you will lose a letter grade 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 sentence 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:

**10 pts.**

While you were conducting your research in lab, I was conducting some of my own. Unfortunately, a small meteor landed on my head and I lost the ability to interpret quantitative data. Please help me finish my research and answer these questions. My hypothesis was that the berries would be more toxic than the leaves. Use this web site to analyze the data:

<http://www.quantitativeskills.com/sisa/statistics/fisher.htm>

1) bring shrimp data generated the same way you generate data

Treatment	# Alive	# Dead
Water control	38	2
Methanol control	36	4
Plant A leaves	20	20
Plant A berries	32	8

- What was my null hypothesis? (maximum of 20 words)
- Was the methanol toxic? Support your answer with data. (maximum of 20 words)
- Was either treatment more toxic than methanol alone? Support your answer with data. (maximum of 20 words)
- Was one tissue more toxic than the other? Support your answer with data. (maximum of 20 words)
- Propose an evolutionary explanation for your answer to part d. (maximum of 30 words)

Lecture Questions:

**12 pts.**

2) Several questions about cells.

- Which proteins move faster, large cytoplasmic proteins or integral membrane proteins? Support your answer with data. (maximum of 40 words)
- What are the two main arguments why there are no giant cells. Support your answer with data. (maximum of 30 words for each argument)
  - 
  -
- Name one exception to the rule of only small cells and how this species evolved a mechanism to overcome complications of being too big. Support your answer with data. (maximum of 40 words)

**14 pts.**

3) some questions about neurons

- What is the change in cytoplasmic charge when one sodium pump completes one full cycle and consumes one ATP? Support your answer with a figure. (maximum of 40 words)

b) Compare and contrast ligand-gated sodium channels and the calcium channels at the terminus of a neuron. You must list 3 major similarities and 3 major differences. Support your answer with data when possible. (maximum of 30 words for each one)

3 similarities

- 1.
- 2.
- 3.

3 differences

- 1.
- 2.
- 3.

c) Describe what a neuron must do before it can send a second action potential. (maximum of 30 words)

**11 pts.**

4) some questions about muscles

a) In this movie (<http://www.bio.davidson.edu/misc/movies/musclcp.mov>), what molecules are in the white band that gets smaller and what molecules are in the dark band that stays about the same? Explain why. Support your answer with visual information. (maximum of 40 words)

b) Muscle cells are giant cells. Describe two adaptations of muscle cells to overcome the limitations of large cell volume. Support your answer with data. (maximum of 30 words for each one)

- 1.
- 2.

c) What role does each ion play in muscle contraction? (maximum of 30 words for each one)

K<sup>+</sup> :

Na<sup>+</sup> :

Ca<sup>2+</sup> :

**8 pts.**

5) some questions about memory formation

a) What is the smallest unit of memory? Support your answer with data. (maximum of 40 words)

b) What separates a long term memory from a short term memory? Support your answer with visual information. (maximum of 40 words)

**10 pts.**

6) some questions about cellular respiration

a) Give three examples of homeostasis of cellular respiration. Support each answer with data. (maximum of 30 words)

- 1.

2.

3.

b) Name three metabolic molecules that are major repositories of energy prior ATP synthesis. Support your answer with visual information in a figure. (maximum of 30 words)

**12 pts.**

7) more questions about cellular respiration

a) What evidence did Krebs use to deduce the cyclic nature of the citric acid cycle? Cite specific examples. Support your answer with data. (maximum of 30 words)

b) Why do we need to breath in oxygen? Support your answer with a figure. (maximum of 30 words)

c) Which one molecule is the most important one for negative feedback of cellular respiration? Support your answer citing specific examples. (maximum of 20 words)

**12 pts.**

8) some questions about photosynthesis

a) Photosynthesis has traditionally been divided into two parts, light reactions and dark reactions. Biochemically, how many distinct parts exist within photosynthesis? Name the parts. Support your answer with data. Please use a numbered list for the parts. (maximum of 20 words for each part)

b) What two molecules are produced as a consequence of cyclic and non-cyclic electron flow? (maximum of 10 words)

c) When photosynthesis generates the two molecules you listed in part b above, do the molecules have a positive or negative  $\Delta G$ ? Explain your answer. (maximum of 30 words)

**11 pts.**

9) some questions about carbon fixation

a) What is required to produce a new ~~PGA~~ G3P which contains three “new” carbons? Support your answer by citing a figure. (maximum of 40 words)

b) Give three examples of photosynthetic homeostatic regulation. (maximum of 20 words for each example)

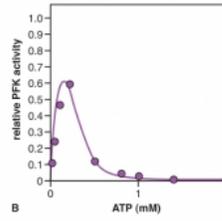
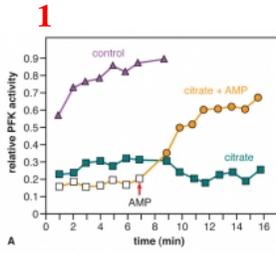
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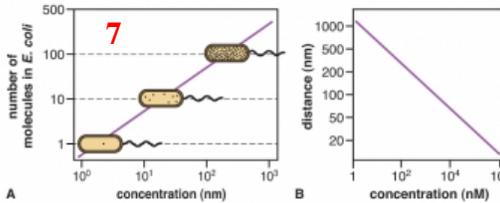
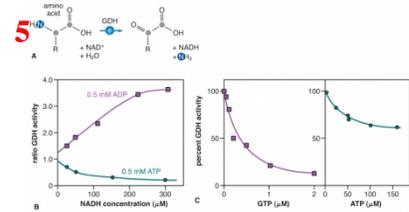
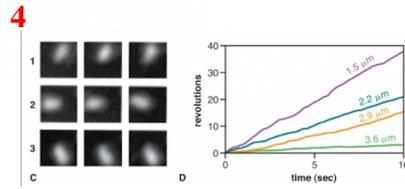
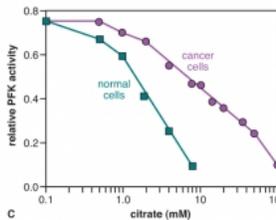
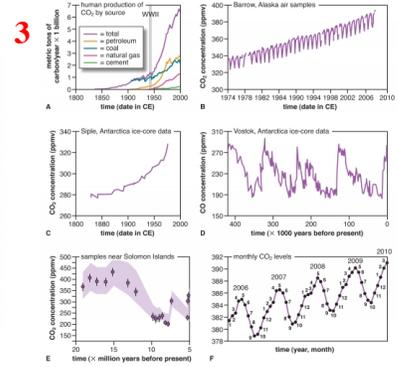
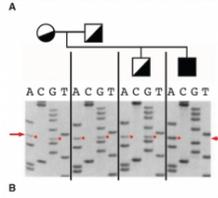
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c) How is photosynthesis connected to global climate change? Support your answer with data. (maximum of 30 words)

Data Gallery

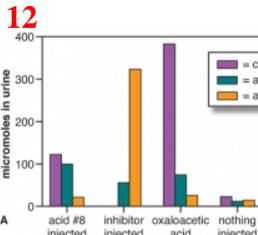
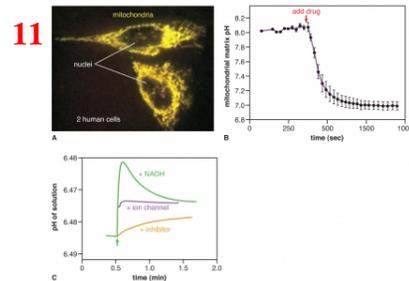
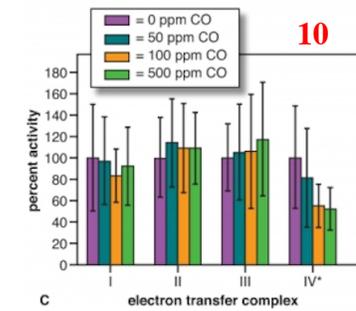
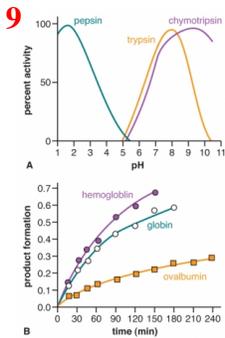


lipids tested	16 carbons	14 carbons	8 carbons	4 carbons
family 1	high activity	high activity	low activity	high activity
family 2	low activity	high activity	high activity	high activity
family 3	high activity	high activity	high activity	low activity
family 4	high activity	low activity	high activity	high activity



**8**

source of protein	protein added	substrate added	oxygen consumed	substrate consumed	product formed
mitochondria	2.7 mg	no	6.1 μmoles	n.d.	0.9 μmoles
mitochondria	2.7 mg	yes	23.2 μmoles	8.0 μmoles	8.5 μmoles
nucleus	3.5 mg	no	1.5 μmoles	n.d.	0.3 μmoles
nucleus	3.5 mg	yes	2.3 μmoles	0.9 μmoles	1.1 μmoles
cytoplasm	4.5 mg	no	1.3 μmoles	n.d.	0.2 μmoles
cytoplasm	4.5 mg	yes	1.0 μmoles	n.d.	0.2 μmoles

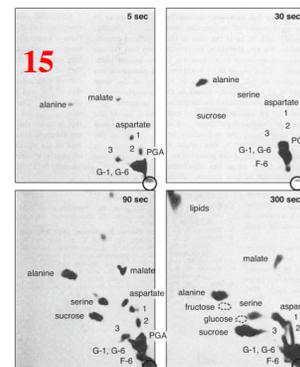
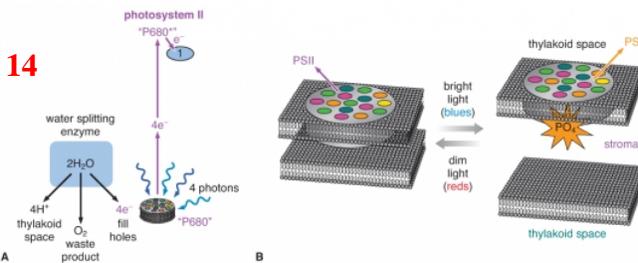


**12**

acid #8 added	oxygen uptake (calculated)	oxygen uptake (measured)
1 μmole	6 μmoles	47.2 μmoles
2 μmoles	12 μmoles	69.4 μmoles

**13**

gene name	average copy number	copy number range
<i>ftsZ</i>	80,600	35,800–198,800
<i>dnaA</i>	48,700	29,800–153,000
	120,000	60,300–205,000
16S rRNA	368,000	241,000–737,000

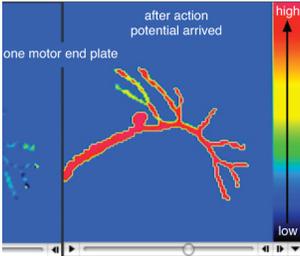




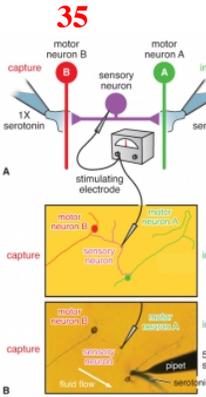
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ion	intracellular concentration	extracellular concentration
K <sup>+</sup>	155 mM	4 mM
Na <sup>+</sup>	12 mM	145 mM
Ca <sup>2+</sup>	0.0001 mM	1.5 mM
Cl <sup>-</sup>	4 mM	120 mM

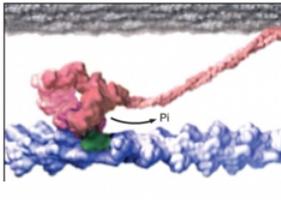
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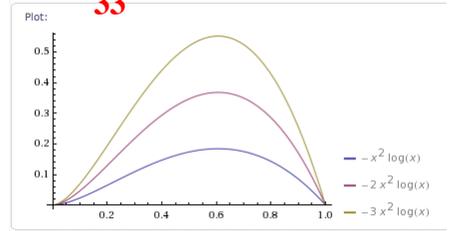
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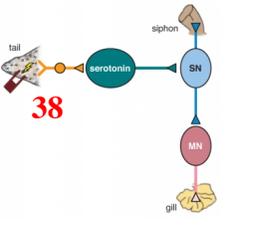
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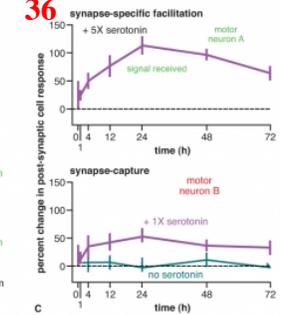
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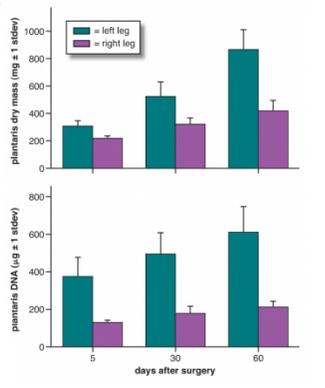
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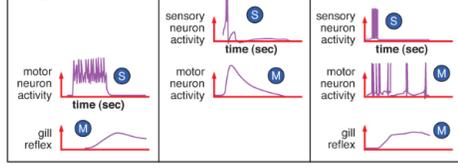
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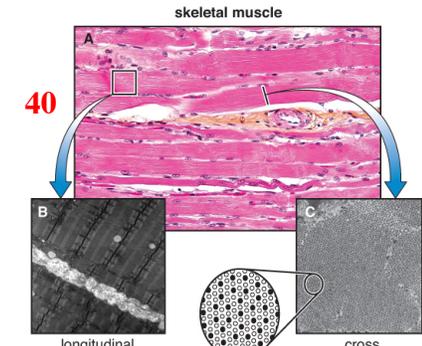
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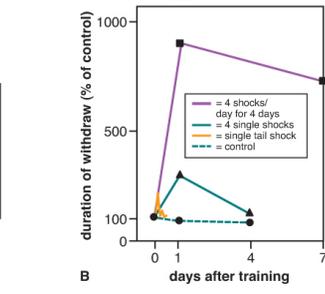
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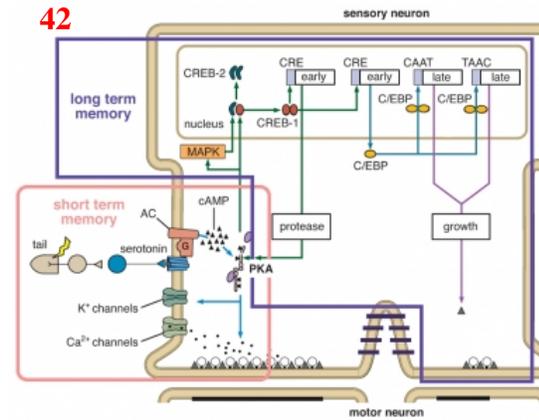
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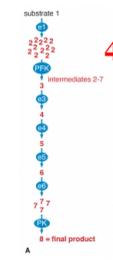
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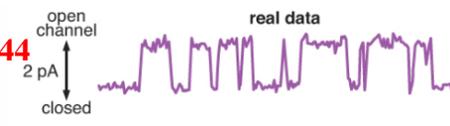
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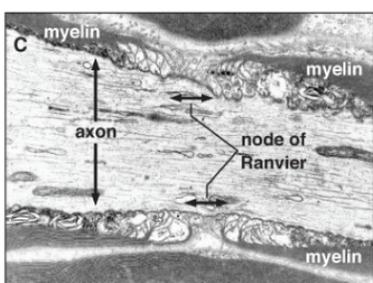


enzyme identification	enzyme (µM)	substrate (µM)
e1	n.a	s1 near 0
phosphofruktokinase	n.a	s2 1,500
e3	810	s3 80
e4	1,480	s4 80
e5	130	s5 50
e6	540	s6 20
pyruvate kinase	170	s6a 65

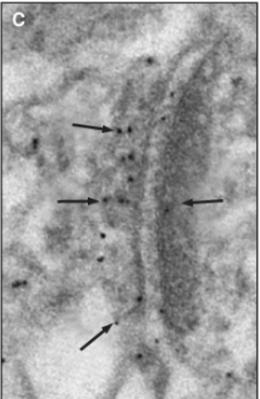
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description	green alga	bacterium	diatom	yeast, fungus	red alga	flowering weed
species	<i>O. tauri</i>	<i>E. coli</i>	<i>T. pseudonana</i>	<i>S. cerevisiae</i>	<i>C. merole</i>	<i>A. thaliana</i>
cell length	1 µm	2 µm	5 µm	5 µm	2 µm	multicellular
genome 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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