

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 6 pages in this test, including this cover sheet, plus an Excel file. 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 8:30 am on Monday Nov. 13. **EXAMS ARE DUE BY 8:30 AM ON MONDAY NOVEMBER 13.** 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:

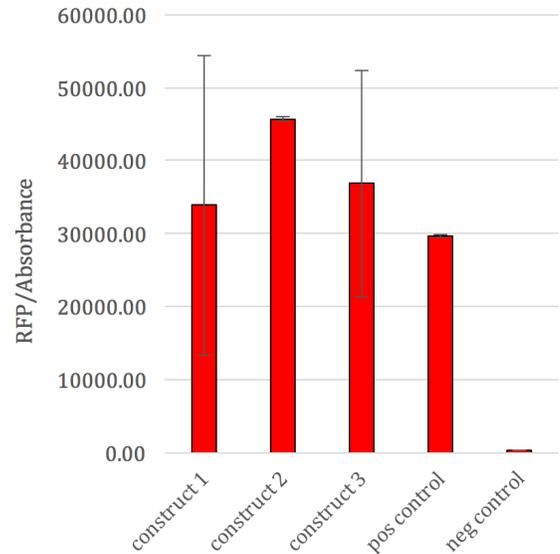
On my honor I have neither given nor received unauthorized information regarding this work, I have followed and will continue to observe all regulations regarding it, and I am unaware of any violation of the Honor Code by others.

How long did this exam take you to complete?

Lab Questions:

10 pts.

1) Yesterday, I conducted an experiment similar to the ones you have conducted. I had a positive control, a negative control, and 3 experimental clones. I measured in triplicate their RFP outputs and their cell densities (absorbance at 600 nm). I am attaching the Excel file with the raw data. I would like you to **a)** generate a graph of the data and **b)** interpret the results for the 3 experimental samples (**maximum of 40 words**). Be sure to label both axes so I can understand your graph. You should use these formulas when analyzing the data: =stdev(“numbers here”); =“stdev value”/sqrt(n) .



1-3 are better than negative control, but only 2 can be called better than positive control.

Lecture Questions: **12 pts.**

3) I don't know what I would do without my cells.

a) What mechanism does *E. fishelsoni* use to deal with its gigantic size and the limitations of diffusion? Support your answer with data. **Maximum of 40 words.**

Lots of DNA copies to provide enough mRNA and enough protein. #12

b) How did diatoms evolve? Support your answer with data. **Maximum of 40 words.**

Animal cell engulfed red alga. #44 & #9

c) Why is it difficult to distinguish a cell from an organelle, a parasite, a symbiont, and a pathogen? Support your answer with data. **Maximum of 40 words.**

#4 no clear distinction by genome size

15 pts.

4) Now it is time to use your neurons as much as possible.

a) Look at Figure 32 in the data gallery. Explain why the current gradually decreases in the summation part of this figure. Support your answer using a different Data Gallery figure.

Maximum of 40 words.

#39 random duration of open times (this was not a neuron, but patch of membrane with single channels).

b) What role does calcium play in a neuron's normal function? Support your answer with data.

Maximum of 40 words.

#29 exocytosis

c) Evolution selects for adaptive features. What is adaptive about the potassium channel opening slower than the sodium channel given they are both voltage-gated? **Maximum of 40 words.**

Neuron would never depolarize if both opened at same time

10 pts.

5) More questions to help you reinforce your muscle memory for typing.

a) Draw a sarcomere in the contracted and relaxed states, and label the key proteins. Pay attention to relative scale in the two diagrams.

b) In the figure to the right, indicate where the following proteins are located by writing the 5 indicated symbols on top of this diagram:

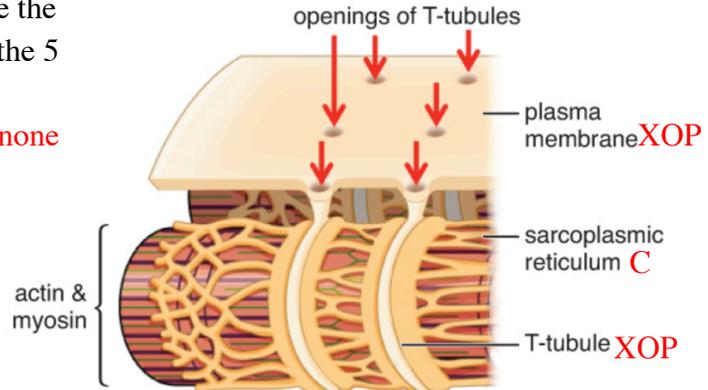
L = ligand-gated Na^+ channels → none

X = voltage-gated Na^+ channels

O = voltage-gated K^+ channels

P = Na^+/K^+ pump

C = calcium channels



A

15 pts.

6) I hope you can remember the answers to these questions...

a) Describe the evidence used to show that sea slugs can form memories. **Maximum of 30 words.**
#35 retraction for a longer time even after electrical shock no longer performed.

b) Use what you know about memory formation to hypothesize the phenotype of a person who is homozygous recessive for the protease in Figure 40. **Maximum of 40 words.**
no + feedback loop and no long term memory

c) Describe how the memory term “capture” is good news for your ability to learn more biology. Support your answer with a figure from the Data Gallery. **Maximum of 40 words.**
#42 or #37 same neuron but less effort/training to form long term memory.

18 pts.

7) One of the great joys of teaching at Davidson is that students are hungry to learn.

a) I recently was contacted by a murder mystery author who wanted to come up with a new way to kill one of her characters. She found Figure 18 online and wanted me to confirm that ATP would be the ideal poison. Critique her idea that ATP is a great poison to stop cellular respiration and thus kill someone. **Maximum of 40 words.**

ATP is not toxic. Excess ATP would be consumed then normal homeostasis resumes.

b) You breathe in O_2 and exhale CO_2 . Does the oxygen in CO_2 come from the O_2 you breathed? Explain why or why not. Support your answer with two good figures from the Data Gallery. **Maximum of 40 words.**

O_2 you breath in is consumed in ETC and reduced to water (#2). CO_2 you exhale comes from cystic acid cycle (#17) or post-glycolysis (#25).

c) What sign is given to the symbols below for figure 17 in the Data Gallery? You must explain why you chose your answer for each one (**Maximum of 20 words each**):

$\Delta G = \underline{\quad}$ because:

$\Delta H = \underline{\quad}$ because:

$\Delta S = \underline{\quad}$ because:

Could go either way but rationale had to match the sign (-,-,+ for breakdown of sugars; +,+,- for production of NADH.

20 pts.

8) Now it is time for the sun to set on this exam....

a) Identify two figures from the Data Gallery that explain the pH change in Figure 16. You must explain how these two figures contribute to the data in Figure 16. **Maximum of 40 words.**

#20 light moves electrons through cytochroms which move H^+ into thylakoid space. #10, H^+ move from space to stroma via ATP synthase.

b) Trace the carbon in CO_2 from the air to the protein in your muscles and then back to the air (ignore the time each step would take). Use figures 17, 25 and 46 to support your answer.

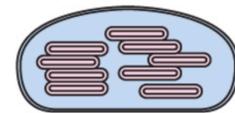
Maximum of 60 words.

#46: CO_2 fixation into proteins and sugars in plants. We eat both, proteins/amino acids covered to our proteins. Some amino acids deaminated into 2 carbon bits. #25: sugars broken down in glycolysis acetyl-CoA and CO_2 afterwards. #17: citric acid cycle consumers 2 carbon bits and produces CO_2 waste.

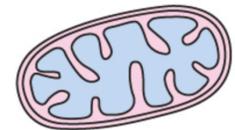
c) Carbon fixation is often called the “dark reaction”. Choose one figure and explain why carbon fixation is optimal during daytime instead of night. **Maximum of 40 words.**

#22: rubisco works best at elevated pH and Mg^{2+} concentrations which are produced when light.

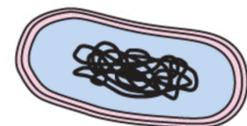
d) Draw 3 pictures that show the evolutionary connection between prokaryotes, mitochondria and chloroplasts and where each one stores the potential energy used to produce ATP.



chloroplasts

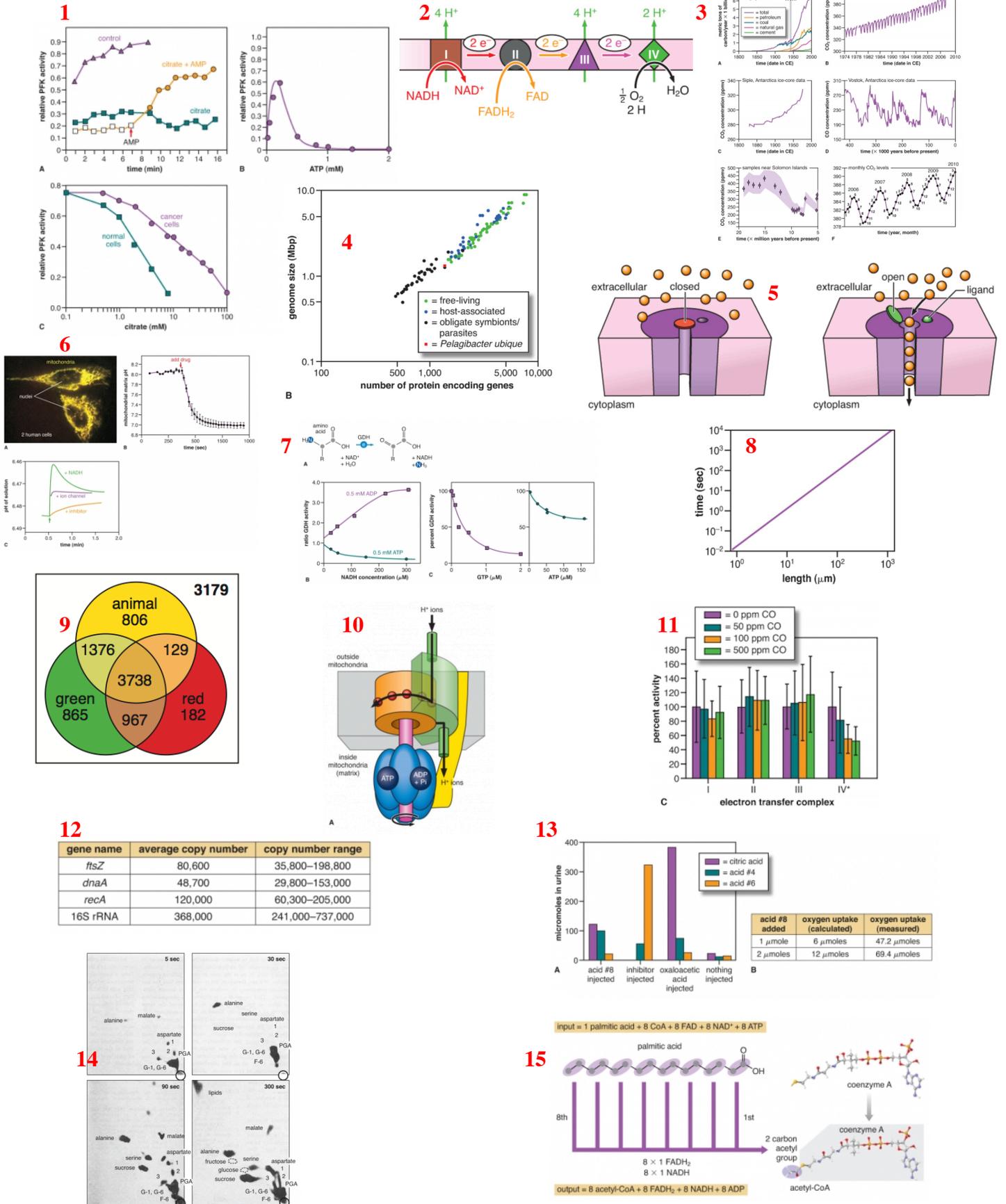


mitochondria

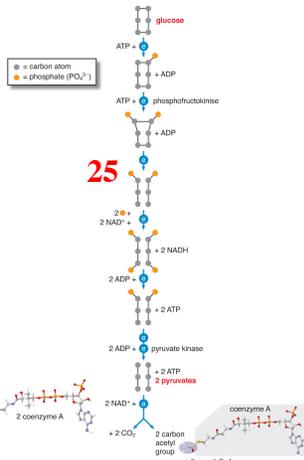
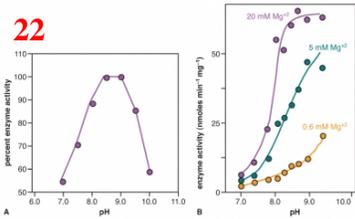
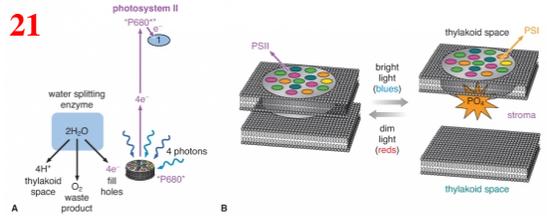
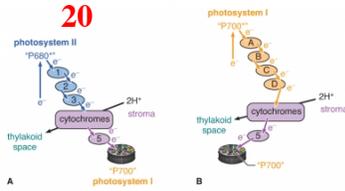
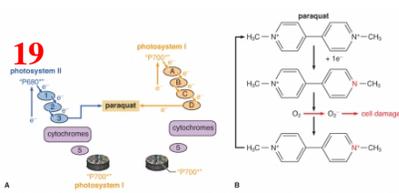
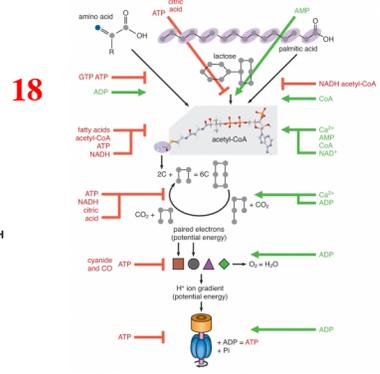
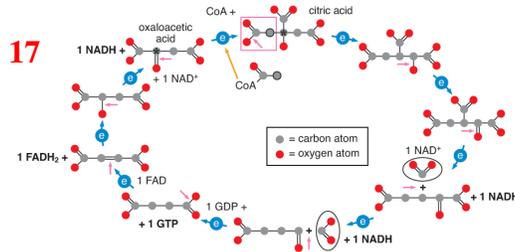
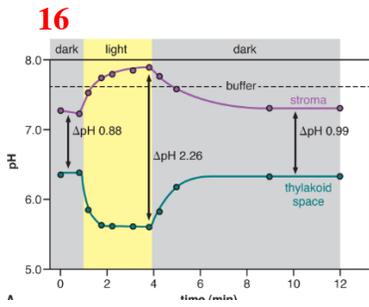


prokaryotes

Data Gallery



Dr. Campbell's Bio111 Exam #3 – Fall 2017



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protein	location	diffusion rate	fold slower
GFP	water	87.0 ± 2.0	n.a.
GFP	cytoplasm <i>E. coli</i>	8.0 ± 2.3	~10 X
GFP over produced	cytoplasm <i>E. coli</i>	3.6 ± 0.7	~24 X
GFP + sugar-bound protein	cytoplasm <i>E. coli</i>	2.5 ± 0.6	~35 X
GFP	periplasm <i>E. coli</i>	2.6 ± 1.2	~33 X
GFP + membrane protein	membrane <i>E. coli</i>	0.13 ± 0.03	~669 X

