

Biology 113 Closed Book Take-Home Final Exam

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 no later than noon on Thursday Dec. 19. **HARD COPY of your EXAM IS DUE BY NOON NO LATER THAN THURSDAY DECEMBER 19th**. If you turn in your exam late, then you lose a letter grade for each day you are late. **The answers to the questions must be typed directly under the questions** unless the question specifically says to write the answer in different place. If you do not write your answers in the appropriate location, I may not find them. [Turn in your exam to Dr. Paradise, Ms. Lauren Barker in the Bio Office, or slide it under my door and send me an email. I will be back at work starting 8 am Wed. 18 December. You may turn the exam into me if personally if you are still around when I return.](#)

I have provided you with a “Data Gallery” in the form of figures and tables. To choose a figure in support of your answer, state Figure #x and do NOT move the image 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, however. 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:

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

9 pts.

1) In general, there are three ways a bacterium could be resistant to an antibiotic. List the three mechanisms of antibiotic resistance. I am not looking for answers such as mutation and horizontal gene transfer. I want you to list the molecule mechanisms for resistance. **Limit each mechanism to 60 characters not counting spaces.**

- a.
- b.
- c.

4 pts.

2) What differentiates Results and Discussion sections of a lab report, scientific paper or oral presentation? **Limit your answer to 200 characters not counting spaces.**

Lecture Questions:

8 pts.

3) This summer, Dr. Nicole Snyder (Chemist) and I will be collaborating with a current junior (Sarah Durbin). Sarah's research project is to produce a human protein in yeast cells and purify the protein. The only clues Sarah has about the protein are nine fragments from a portion of the full length protein. These nine fragments came from a portion of the protein that was isolated after digesting the full length protein with an enzyme that cuts proteins after every methionine (M). Your task is to use these fragments to determine the amino acid sequence of the protein.

Type final amino acid sequence here:

the 9 fragments in alphabetical order: AVP, FSGT, GLM, GGLQDG, IQGGL, LSP, LQDGL, PAVPF, SPAV

20 pts.

4)

There are four hallmarks of signal transduction. Make a list of these four hallmarks, choose a figure to support each hallmark and explain how each figure exemplifies the four hallmarks.

Limit each item in your list to 280 characters not counting spaces.

- 1.
- 2.
- 3.
- 4.

8 pts.

5) Membranes are often described as “fluid mosaics” composed of lipids and proteins. Choose two figures that illustrate how membranes are both fluid-like and mosaics. You must explain how each figure you chose supports the description of membranes. **Limit each part to 200 characters not counting spaces.**

- 1.
- 2.

16 pts.

6)

a) If two molecules of PKA are 200 nm apart from each other, how many molecules total would there be in an *E. coli* cell? (Show your work if you want me to give partial credit in case of a wrong answer.) **Limit your answer to 40 characters not counting spaces.**

b) If glycogen was 5 μm (micrometers) away from the nearest glycogen phosphorylase, how long would it take the enzyme to move 5 μm in the cytoplasm of *E. coli*? (Show your work if you want me to give partial credit in case of a wrong answer.) **Limit your answer to 40 characters not counting spaces.**

c) Are all membranes composed of the same types of lipids? Support your answer with data. **Limit your answer to 200 characters not counting spaces.**

d) What is the adaptive advantage to your answer to part c above? Support your answer with data. **Limit your answer to 250 characters not counting spaces.**

12 pts.

7) Compare and contrast sodium ion channels, potassium ion channels and calcium ion channels in a neuron. **Limit each answer to 450 characters not counting spaces.**

sodium:

potassium:

calcium:

8 pts.

8) When you exercise a lot, your muscles can grow. Explain how muscles grow using data to support your answer. **Limit your answer to 400 characters not counting spaces.**

8 pts.

9)

a) Choose two figures where investigators were fooled by the appearance of their study organism. Explain why they were fooled. **Limit your answer to 250 characters for each example not counting spaces.**

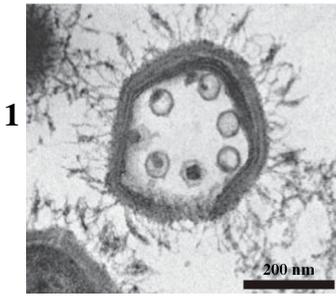
b) Give one example of how a virus can defy typical definitions of a virus. Support your answer with data. **Limit your answer to 250 characters not counting spaces.**

7 pts.

10) Provide two examples of how DNA is compacted to fit inside the nucleus of a eukaryote. Support your answer with data. **For each example, limit your answer to 250 characters not counting spaces.**

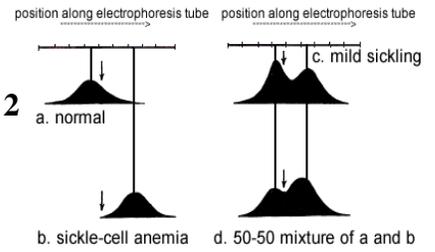
+2 pts.

Bonus Question: Andrew Huxley died in May, 2012. His research led to the understanding of action potentials in neuron AND how actin and myosin interact to cause muscle contraction. He won a Nobel prize and was knighted by the queen for his contributions to science. Just before he died, he was asked which compliment he had received over his entire life had meant the most to him. What did he say? **Limit your answer to 25 characters not counting spaces.**



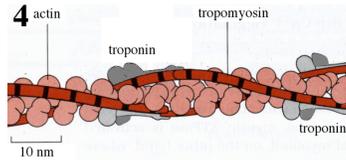
1

Data Gallery
(3 pages)

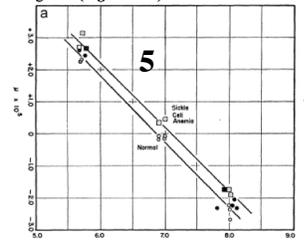


2

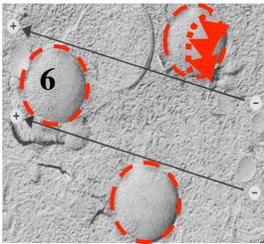
hemoglobin condition	malaria parasite present	% with high parasite density	malaria parasite absent
normal (homozygous normal)	113 (45.7%)	66.0	134 (53.3%)
mild sickling (heterozygous)	12 (27.9%)	33.3	31 (72.1%)



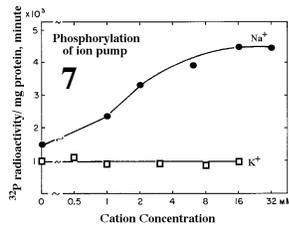
4



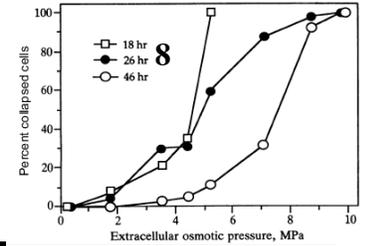
5



6

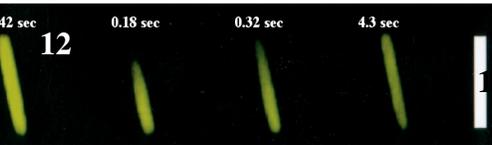


7

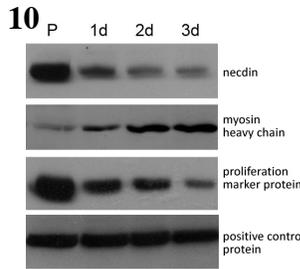


8

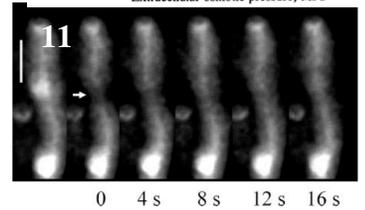
Strain used to infect mice	Infection route	Antibodies present	<i>B. burgdorferi</i> in mouse tissue	Ticks re-infected
Wild type	Injection	7/9	4/9	3/17
	Tick bite	5/6	5/6	26/28
OSP-C negative	Injection	0/12	0/12	0/20
	Tick bite	0/1	0/1	0/1
OSP-C re-inserted	Injection	4/6	4/6	5/27
	Tick bite	8/12	8/12	17/30



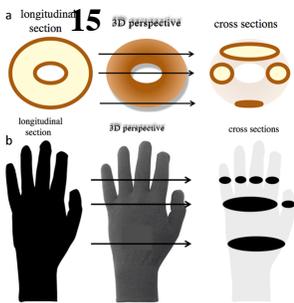
9



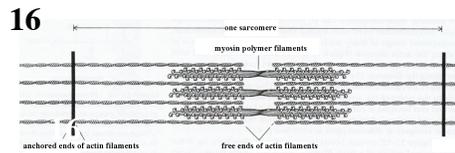
10



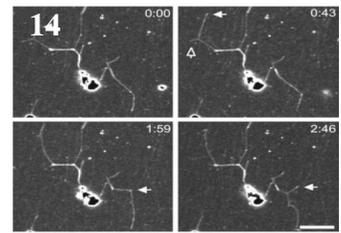
11



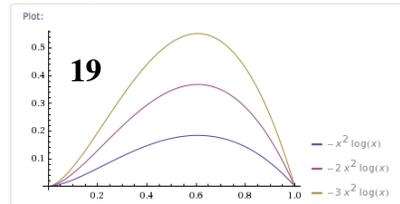
12



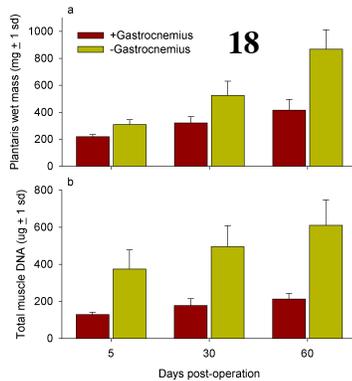
13



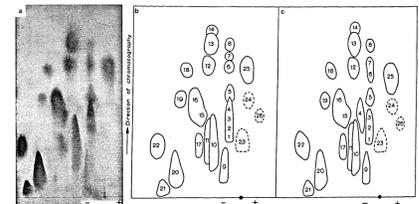
14



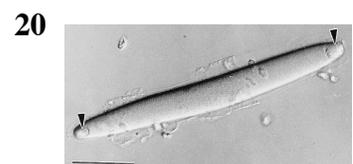
15



16



17

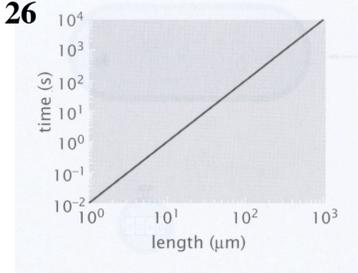
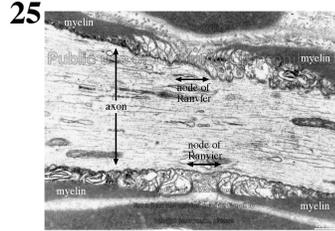
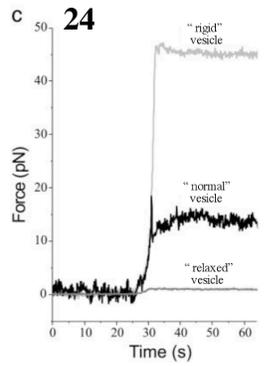
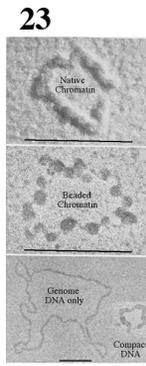
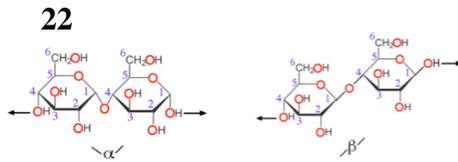
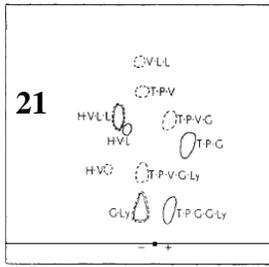


18

19

20

Dr. Campbell's Bio113 Exam #4 – Fall 2013



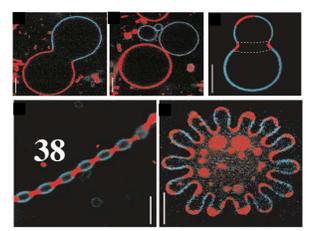
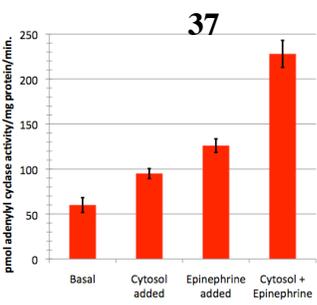
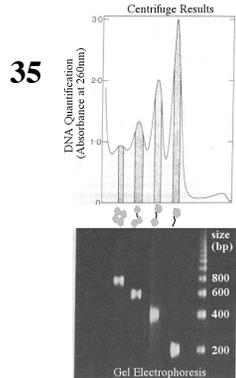
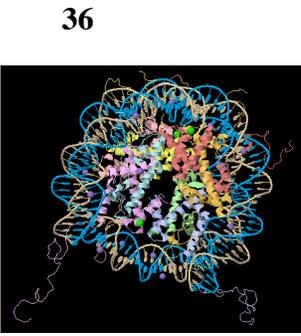
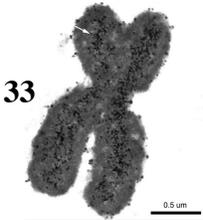
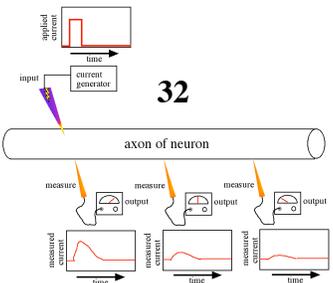
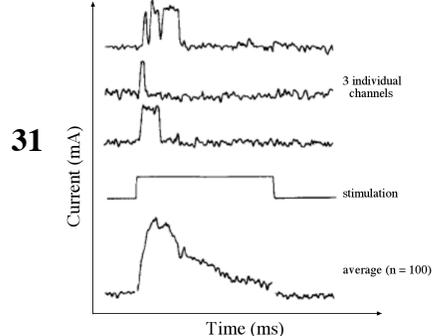
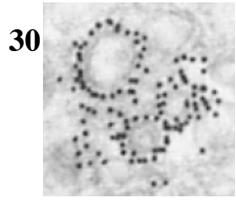
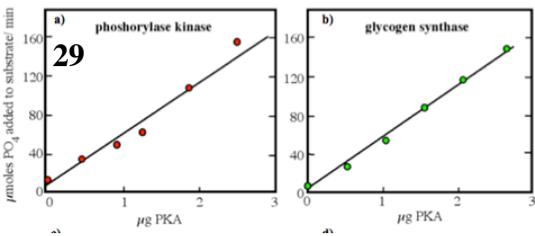
27

Table 11.2 Mobility of proteins in and on *E. coli*.

Protein	Location	Diffusion Rate ($\mu\text{m}^2/\text{sec}$)	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-binding 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 + TatA protein	Outer Membrane <i>E. coli</i>	0.13 ± 0.03	-669 X

28

Lipid Name	Rat Liver ER ^a	Rat Liver Plasma Membrane ^a	Rat Liver Golgi ^a	Mouse Skin plasma membrane ^a	Yeast Inner Mitochondria ^b	Yeast Outer Mitochondria ^b
phosphatidylcholine	58	39	50	43.0	38.4	45.6
phosphatidylethanolamine	22	23	20	16.1	24.0	32.6
sphingomyelin	3	16	8	12.2	0	0
phosphatidylinositol	10	8	12	7.6	16.2	10.2
phosphatidylserine	3	9	6	6.4	3.8	1.2
phosphatidic acid	0	0	0	0.0	1.5	4.4
cholesterol	n.d.	n.d.	n.d.	13	--	--
cholesterol or diphosphatidylglycerol	n.d.	n.d.	n.d.	--	16.1	5.9



Dr. Campbell's Bio113 Exam #4 – Fall 2013

