

## 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 5 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. 20. **EXAMS ARE DUE BY NOON NO LATER THAN THURSDAY DECEMBER 20<sup>th</sup>**. 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 in town starting Wed. 19 December so you can turn the exam into me if you are still around at that time.**

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:

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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.**

- 1) This is based on the results you heard in the oral reports.
  - a) Do bacteria become resistant after you apply the antibiotics? Explain your answer.
  - b) If everyone essentially did the same protocol, why didn't all the lab groups get the same level of antibiotic resistance?

Lecture Questions:

**12 pts.**

- 2) As Dr. Paradise pointed out recently, Dr. C. said the phrase "Change of shape, change of function" eight-seven times.
  - a) Give one example of an ion causing a change in function. State what sort of modulation is taking place and the functional outcome of the modulation. **Support your answer with data and limit your answer to a maximum of two sentences.**
  - b) Give an example of quaternary structure that leads to a change in function. State what sort of modulation is taking place and the functional outcome of the modulation. **Support your answer with data and limit your answer to a maximum of two sentences.**
  - c) Give an example where more than one covalent modulation is required to change the function of a protein. **Support your answer with data and limit your answer to a maximum of two sentences.**

**12 pts.**

- 3)
  - a) Explain how investigators first answered the question, "Are proteins in the plasma membrane mobile?" **Support your answer with data and limit your answer to a maximum of two sentences.**
  - b) Interpret data rows 1, 3 and 5 in Figure 29. **Limit your answer to a maximum of six sentences total.**
  - c) Identify one example of proteins moving inside a cell but not through Brownian motion. **Support your answer with data and limit your answer to a maximum of two sentences.**

**15 pts.**

- 4)
  - a) Integrate the data in Figures 11, 24 and 32 to explain how a cell can be 10 feet long and still function quickly.
  - b) Microvilli have large surface area to volume ratios. Give two examples of large surface area to volume ratios that do NOT involve cytoskeleton to determine the shape of the membrane. **Support your answer with data and limit your answer to a maximum of two sentences.**
  - c) A pretzel company has a problem that you need to solve. They want to reduce the expense of their salt-covered pretzels by using less salt but customers refuse to buy pretzels that have

reduced salt on the crunchy outside. Design a pretzel that has a low salt to pretzel ratio and illustrate the shape of your pretzel by drawing (in the space below) your design in a longitudinal section as well as a cross section. Label which view is which so I know how to grade your drawings.

**16 pts.**

5)

- a) The speed of a neuron's action potential is limited by what physical property illustrated in Figure 32? **Support your answer with data and limit your answer to a maximum of two sentences.**
- b) What anatomical feature of a neuron accelerates action potentials? Explain how this feature accomplishes the acceleration. **Support your answer with data and limit your answer to a maximum of three sentences.**
- c) Neurons require ions to function. Make a list of all the ions involved in a neuron's normal function, which way the ion moves, and how the ion gets back to its starting location. **Limit your answer to a maximum of two sentences for each ion.**
- d) One ion is used in neurons and muscles but for very different purposes. Which ion? What does this ion cause to happen in the two cell types? **Support your answer with data and limit your answer to a maximum of two sentences.**

**12 pts.**

- 6) All rules in biology have an exception, except this rule. Below are some rules and your job is to find the exception. **Support your answer with data and limit your answer to a maximum of one sentence.**
  - a) Prokaryotes are smaller than eukaryotes.
  - b) DNA is a linear molecule.
  - c) Heterozygotes produce the same amount of protein from each allele.
  - d) Only plants can photosynthesize.

**9 pts.**

7) Sickle cell disease was the first time anyone had found the molecular cause for a genetic disease.

a) What causes the red blood cells to change their shape? **Support your answer with data and limit your answer to a maximum of two sentences.**

b) What is the specific difference between wild-type and the sickle cell protein? **Support your answer with data and limit your answer to a maximum of two sentences.**

c) Why has sickle cell disease persisted, given how natural selection works? **Support your answer with general data that you can remember, and limit your answer to a maximum of two sentences.**

**6 pts.**

8) Lyme disease was named for the county in which it was first characterized.

a) What cellular function does the pathogen disrupt to cause the terrible consequences? **Support your answer with data and limit your answer to a maximum of two sentences.**

b) Why does Lyme disease cause so many different symptoms given your answer to part a above? **Limit your answer to a maximum of two sentences.**

**8 pts.**

9)

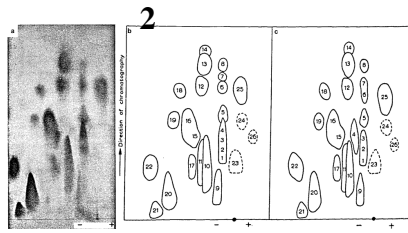
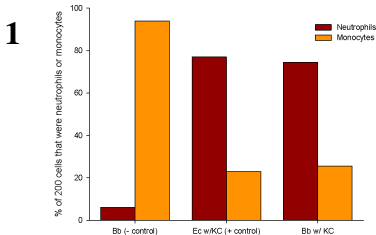
a) Draw the “shape” of an action potential on a MUSCLE cell (shape shows depolarization event). Label the axes and what ions are moving to produce the shape of an action potential.

b) If actin and myosin are present in all muscle cells at all times, why don't muscles contract all the time? **Support your answer with data and limit your answer to a maximum of two sentences.**

c) How do muscle cells get bigger when you exercise? **Support your answer with data and limit your answer to a maximum of two sentences.**

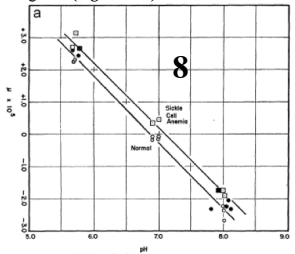
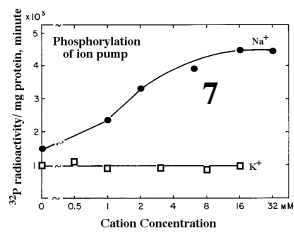
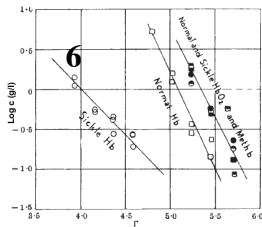
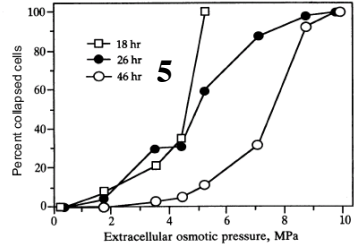
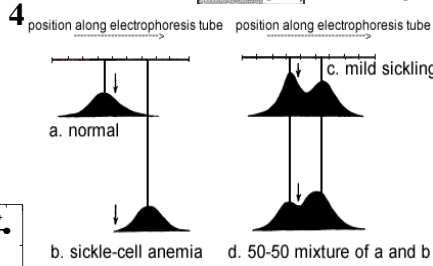
d) What has to happen to the muscle cell cytoplasm for muscles to relax? **Support your answer with data and limit your answer to a maximum of two sentences.**

**Data Gallery**  
(3 pages)



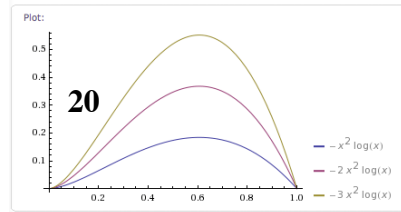
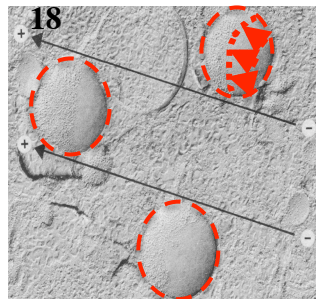
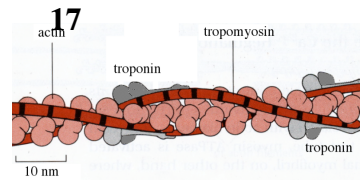
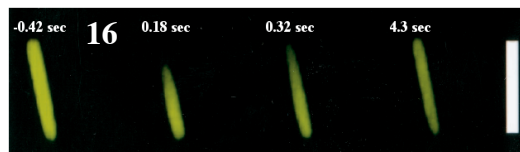
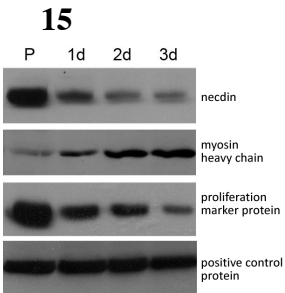
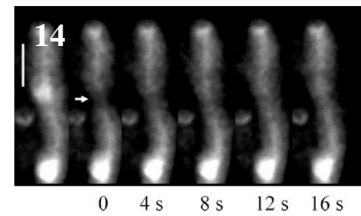
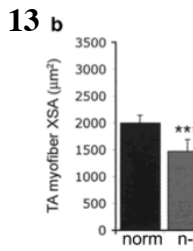
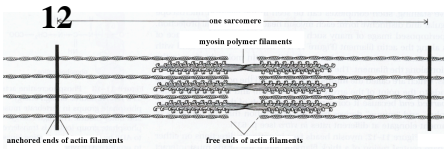
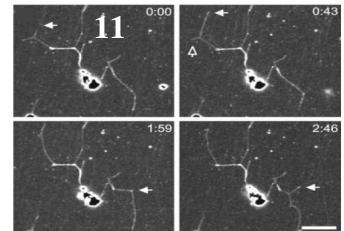
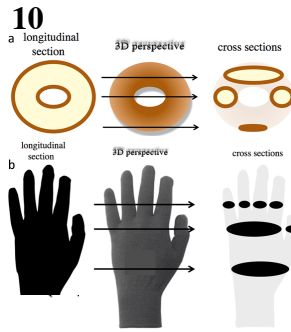
**3**

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%)

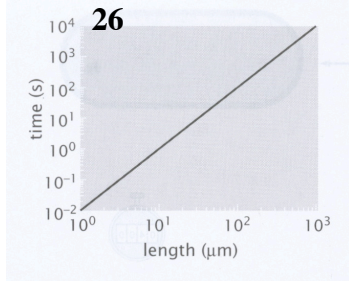
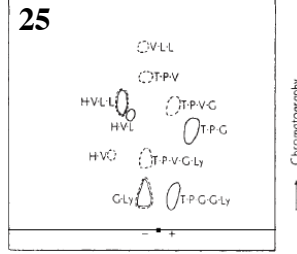
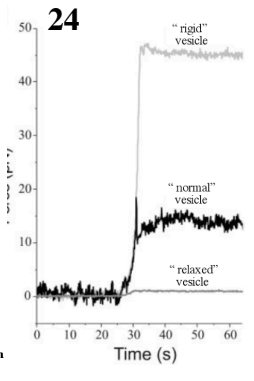
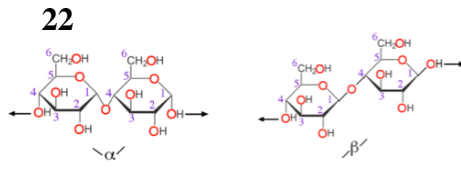
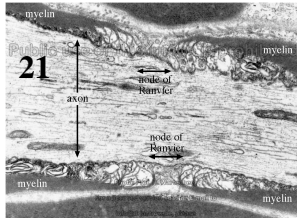


**9**

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

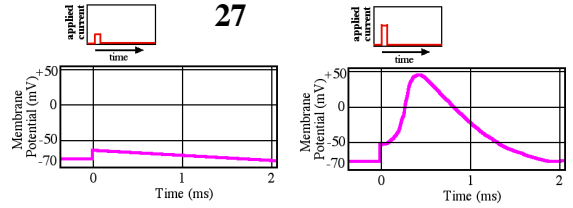
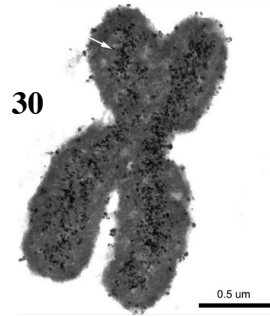


Dr. Campbell's Bio113 Exam #4 – Fall 2012



**28**

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
<i>recA</i>	120,000	60,300-205,000
16S rRNA	368,000	241,000-737,000



**29**

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	$87.0 \pm 2.0$	n.a.
GFP	Cytoplasm <i>E. coli</i>	$8.0 \pm 2.3$	~10 X
GFP over produced	Cytoplasm <i>E. coli</i>	$3.6 \pm 0.7$	~24 X
GFP + sugar-binding protein	Cytoplasm <i>E. coli</i>	$2.5 \pm 0.6$	~35 X
GFP	Periplasm <i>E. coli</i>	$2.6 \pm 1.2$	~33 X
GFP + TatA protein	Outer Membrane <i>E. coli</i>	$0.13 \pm 0.03$	~669 X

