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 8:30 am on Monday Nov. 14. **EXAMS ARE DUE BY 8:30 AM ON MONDAY NOVEMBER 14**. 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:

6 pts.

1) One of the two experiments you have been working on incorporated brine shrimp.

a) What is the H_0 for this experiment? (maximum of 35 words)

No difference in mortality between methanol and extract treatments.

b) What is a H_1 for this experiment? (maximum of 35 words)

There would be more shrimp mortality when exposed to plant extract than solvent alone.

4 pts.

2) How did the bacteria you are testing become antibiotic resistant? (maximum of 45 words)

We selected for a subpopulation that was already resistant due to a previous mutation.

Lecture Questions:

14 pts.

3) Cells are hard to define.

a) One constraint on cell size is the balance between energy uptake and energy consumption. What two things can cells do to increase their uptake for a given demand on energy? Support your answers with data. (maximum of 40 words for each answer)

1. increase surface area (wavy membranes) #27
2. put more import proteins or accelerate import protein function #1

b) Describe how diatoms evolved. Support your answer with data. (maximum of 45 words)

animal cell engulfed red algae #11 or #45

c) If a very large protein that interacts with the sugars of glycolysis had to diffuse 100 μm through the cytoplasm of a cell, how long would it take? Support your answer with data. (maximum of 40 words)

time: 3500 seconds

supporting data: #10 and #30

12 pts.

4) This question will help me measure how many long term memories you formed over the last few weeks.

a) Sketch the feedback loop involved in normal long term memory formation. Include in your sketch the fewest possible genetically encoded elements that constitute **only** components of the feedback loop.

PKA → CREB1 + MAPK→ CREB2, CREB1→ protease gene → PKA

b) What is the cause of losing short term memories that have already formed? Support your answer with data. (maximum of 45 words)

phosphatases #40

c) Explain why it is easier to form new long term memories after recently establishing a long term memory in the same neuron. Support your answer with two figures. (maximum of 50 words)
mRNA for exocytosis protein is produced but not translated without some training #42 & 36

12 pts.
5) This question focuses on how you are telling your fingers which letters to type.
a) What extracellular molecule determines whether or not threshold depolarization is reached? Support your answer with data. (maximum of 40 words)
neurotransmitter/ligand #5 or #43
b) Choose data from the gallery that provides supporting data explaining why an action potential moves in only one direction down an axon. Describe how the figure supports this understanding. (maximum of 50 words)
#41 refractory period despite persistent depolarization
c) What is the consequence of calcium entering the cytoplasm of a neuron? Support your answer with data. (maximum of 40 words)
allosteric modulation of protein on secretory vesicle #26 = #38

12 pts.
6) This question addresses how you can make your eyes move along this line of text.
a) All of the online animations show the myosin heads moving even if they are not touching any actin. Explain why this is not biologically possible. Support your answer with a gallery figure. (maximum of 40 words)
myosin requires allosteric modulation by actin #4
b) Like a neuron, muscle cells flood their cytoplasms with Ca^{2+} when they are depolarized. Sketch a diagram showing the allosteric consequences of elevated cytoplasmic Ca^{2+}.
Moving tropomyosin off of myosin binding site when troponin binds calcium (allosteric modulation)
c) What structural feature of skeletal muscles allows rapid and uniform release of calcium from the sarcoplasmic reticulum? Support your answer with data. (maximum of 40 words)
T-tubules #44

20 pts.
7) This is a chance for you to breathe deeply and appreciate what our green friends do for us.
a) Right before the data gallery is a stylized chloroplast. Use this page to sketch how light is captured and converted into potential energy in the form of ATP and NADPH. Be sure to include in your details showing where within the chloroplast each high energy molecule is formed. This is worth a lot of points, so include details that show the flow of energy, and all the products prior to carbon fixation. You may cite figure numbers from the data gallery to augment your sketch.

This is the same diagram I had you draw in class as a group. Need to include: stacking, H+ in thylakoid space → ATP in stroma, PSI cyclic in unstacked(H+ only), PSII in stacked (H+ and NADPH in stroma), water split in thylakoid

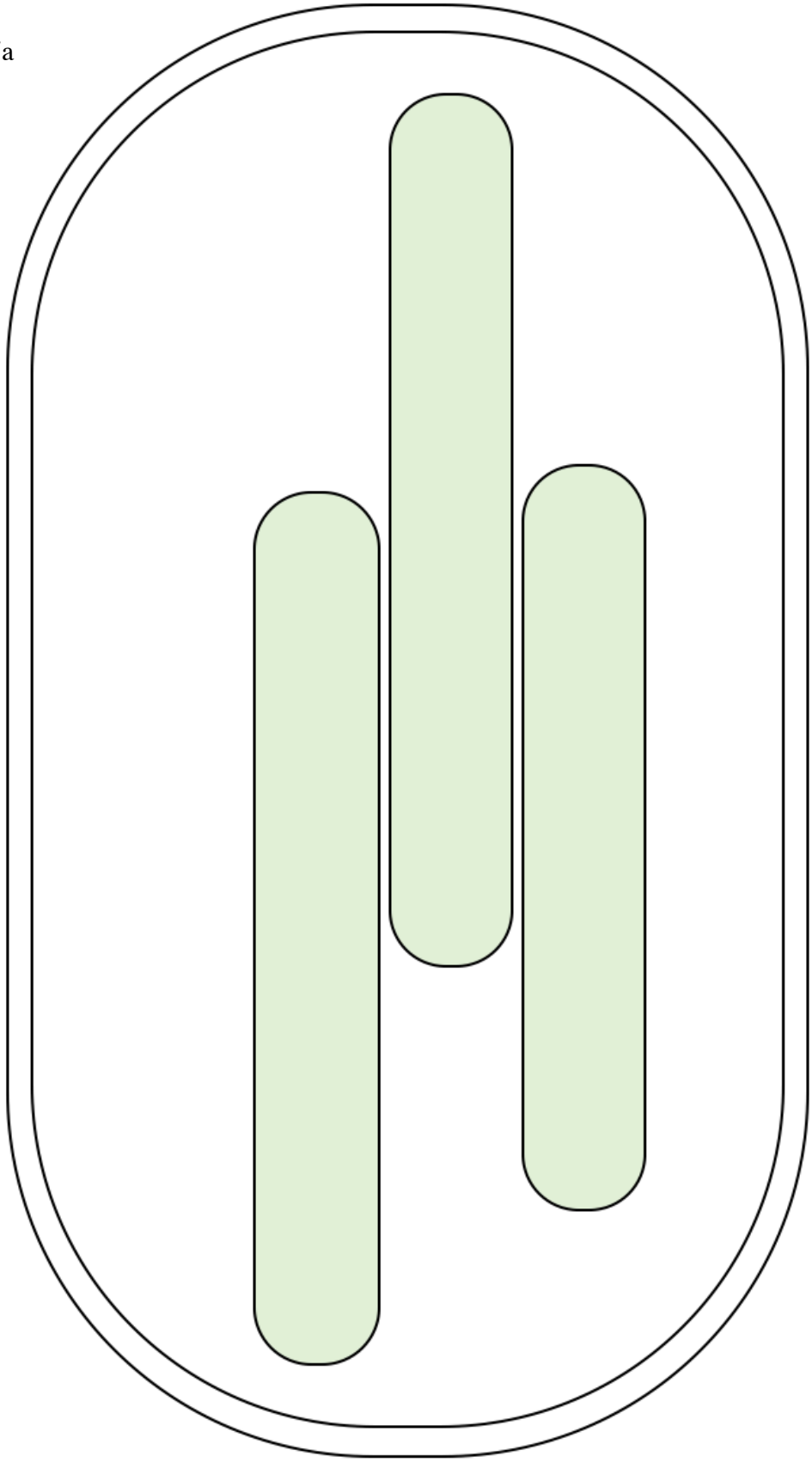
b) My cousin always says, "What goes around comes around." I don't think she was describing carbon fixation, but she could have. Sketch out how carbon enters plants and is turned into organic molecules. Do not name the molecules, but do keep track of the number of carbons using this system: #C where hashtag is replaced by a number. Also track the use of energy during carbon fixation. Your sketch must include the cyclical nature of carbon fixation.
[1C + 5C → 6C → 2x3C] x 3 consumes 9 ATP and 6 NADPH and removes 1x3C to leave 5x3C rearranged back to 3x5C.

c) List two homeostatic mechanisms that regulate photosynthesis from parts a and b in this question. Describe briefly how each mechanism works. (maximum of 50 words for each)
part a. light intensity regulates cyclic vs non-cyclic
part b. pH and Mg2+ regulated rubisco

20 pts.
8) With the last question, you can tap into your energy reserves.
a) Using the convention of #C from the question above, sketch the flow of carbons and the production of high energy molecules when proteins, lipids and sugars are broken down prior to the citric acid cycle.
proteins: see Figure #2
lipids: see Figure #14
sugars: 6C → 2x3C → 2x CO_2 + 2x acetyl-CoA + 4 NADH + 2 ATP
b) How do products of the citric acid cycle participate in homeostatic regulation of protein, lipid and sugar catabolism? Support each one with data. (maximum of 40 words for each)
proteins: GTP #2
lipids: CoA #14
sugars: citrate #1

c) Carbon monoxide can kill animals and plants through the same mechanism. What form of potential energy is not formed in animals when poisoned by CO? Support your answer with *three* figures from the data gallery. (maximum of 50 words)
blocks electron transport chain (three of #6, 7, 8, 9, 28)

question #7a



Data Gallery

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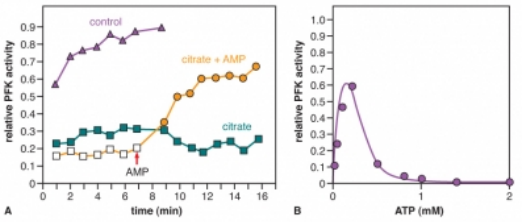

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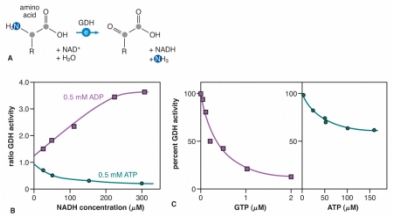

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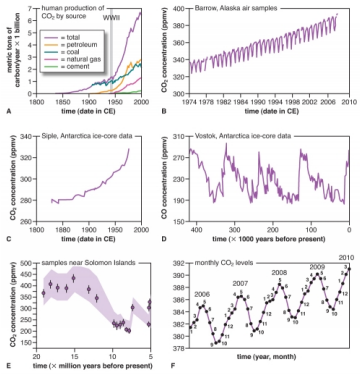

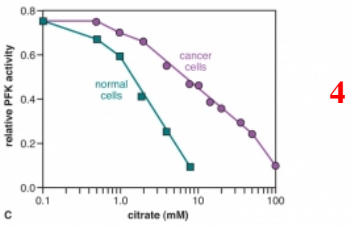

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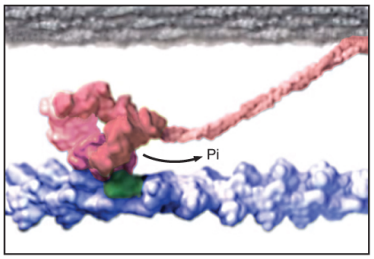

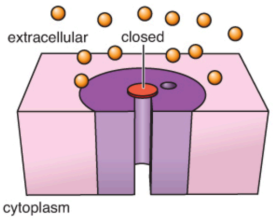

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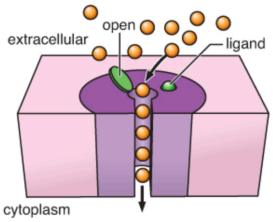

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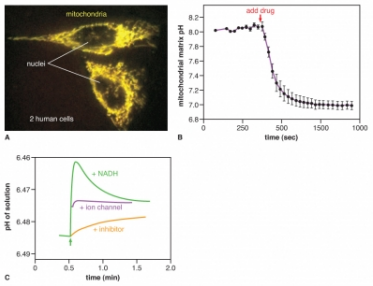

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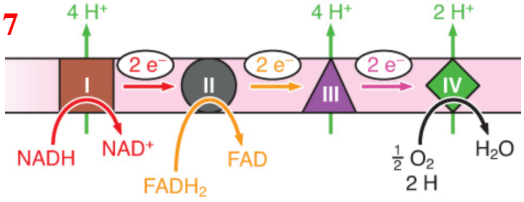

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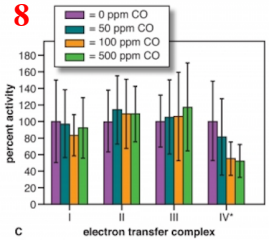

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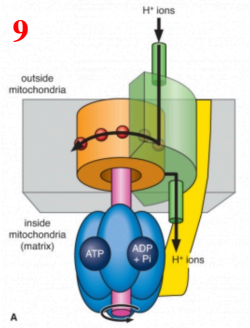

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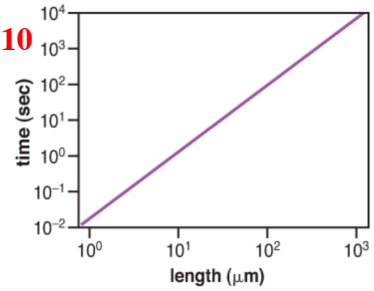

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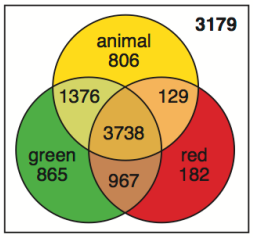

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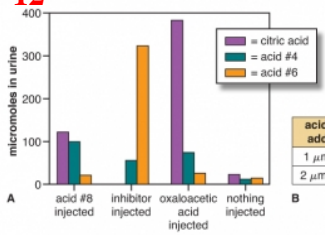
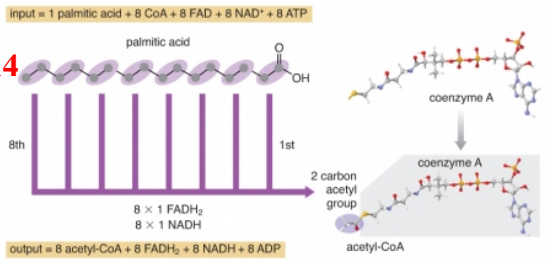


acid #8 added	oxygen uptake (calculated)	oxygen uptake (measured)
1 μmole	6 μmoles	47.2 μmoles
2 μmoles	12 μmoles	69.4 μmoles

13

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

14



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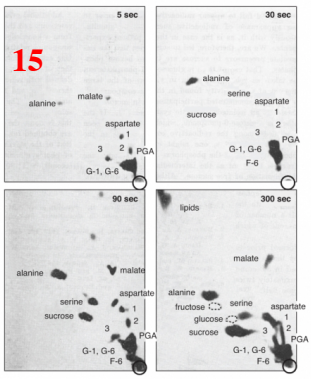

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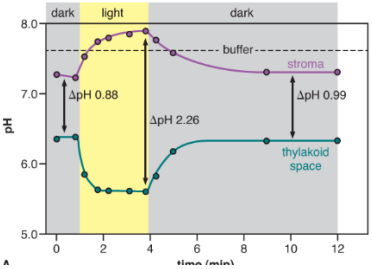

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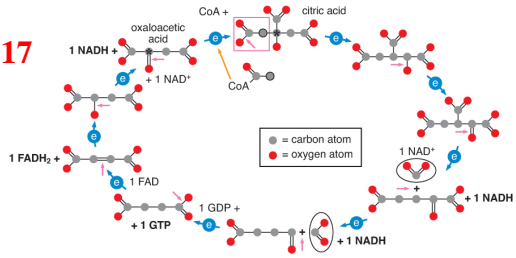

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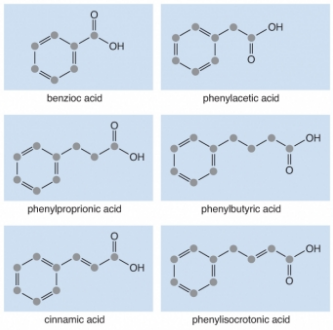

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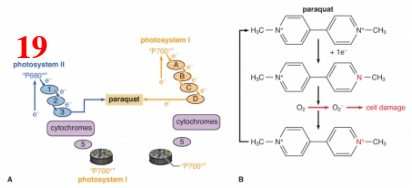

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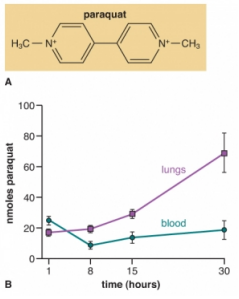

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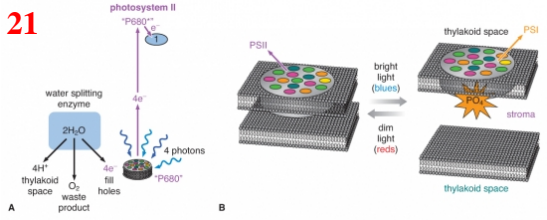

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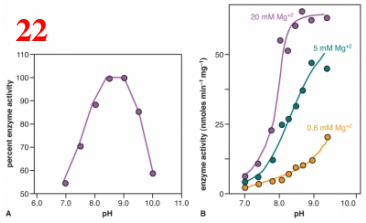

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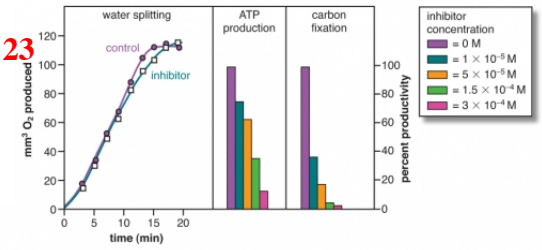

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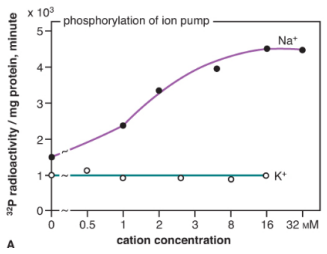

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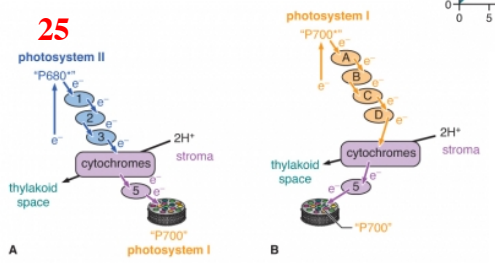

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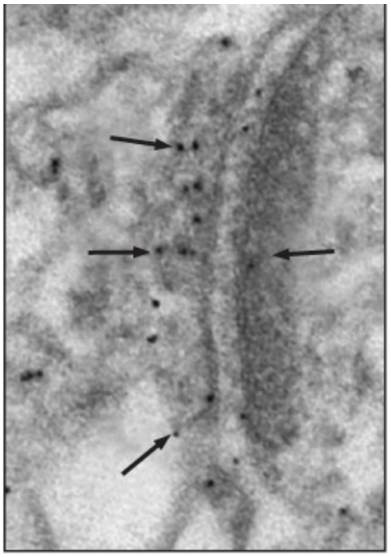

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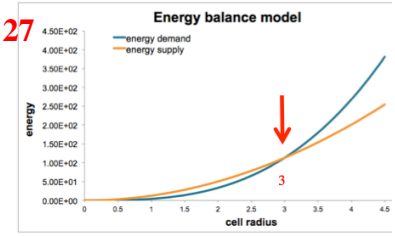

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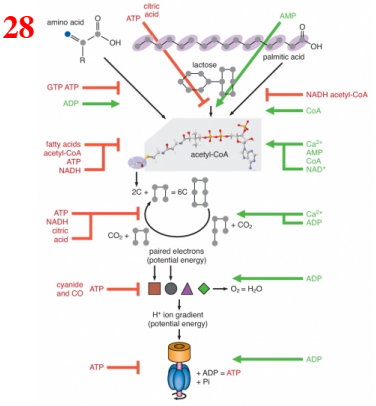

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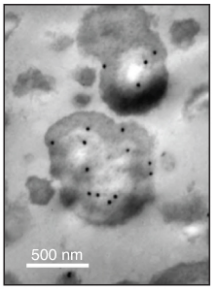

30

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

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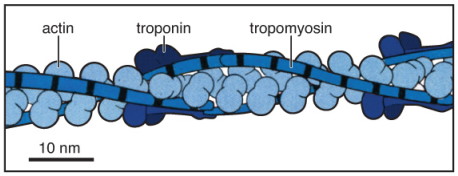

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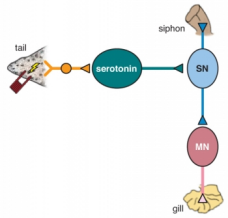

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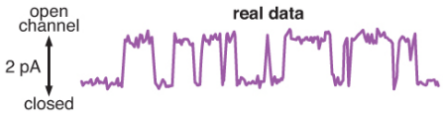

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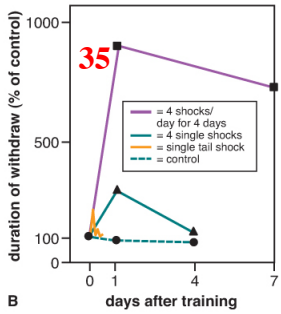

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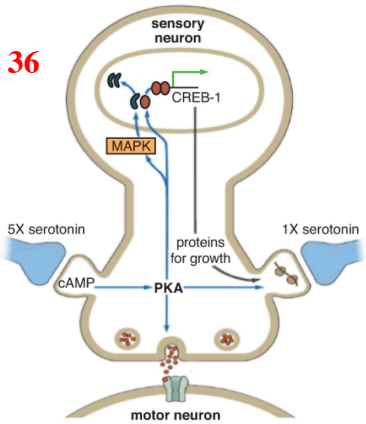

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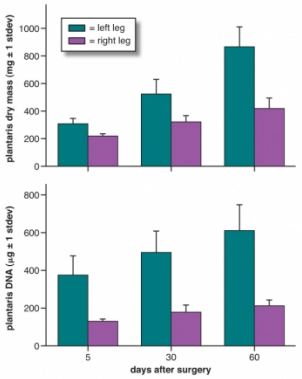

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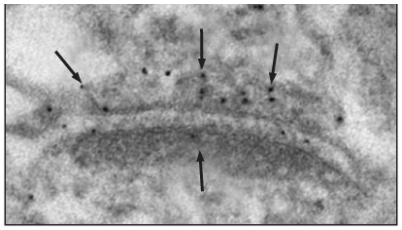

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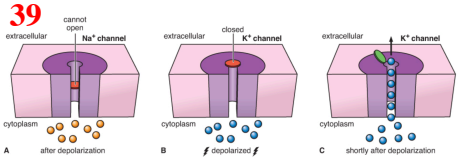

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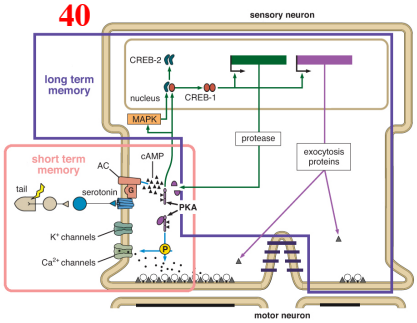

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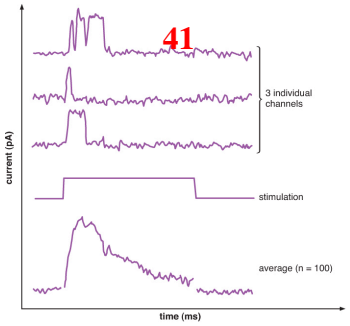

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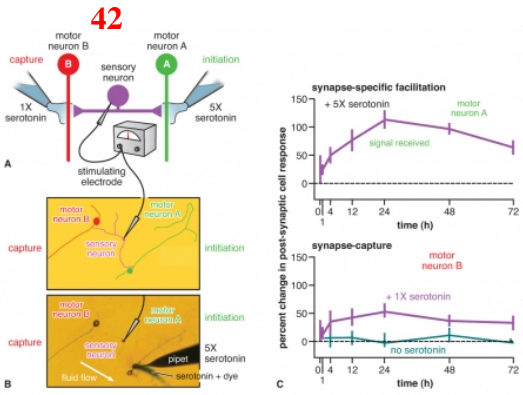

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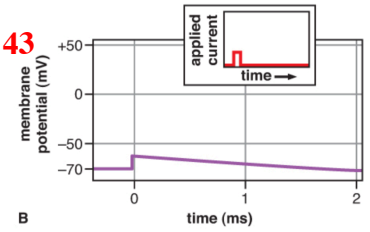

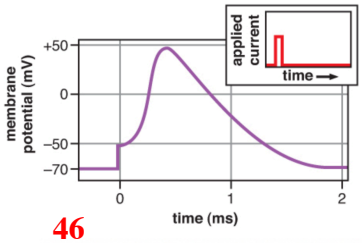

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ion	intracellular concentration	extracellular concentration
K^+	155 mM	4 mM
Na^+	12 mM	145 mM
Ca^{2+}	0.0001 mM	1.5 mM
Cl^-	4 mM	120 mM

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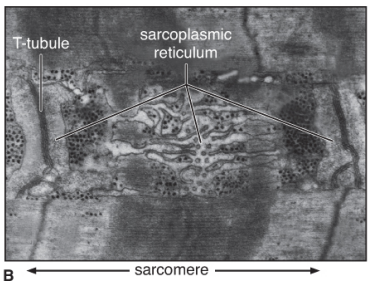

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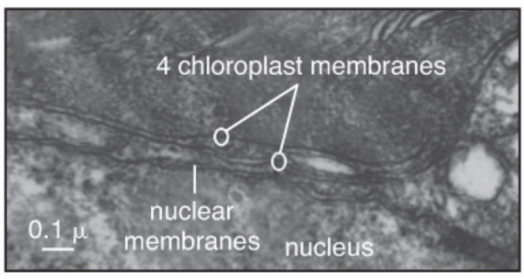

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