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, 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 9:30 am on Monday Nov. 12. **EXAMS ARE DUE BY 9:30 AM ON MONDAY NOVEMBER 12**. 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) While I was flying to San Diego on Thursday, 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 the experimental RFP outputs and 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 (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("Excel cells here"); ="stdev value"/sqrt(n) .

Lecture Questions:

12 pts.

3) Cells are more than just a theory.

a) What were nanobacteria reported to be initially? (maximum of 25 words)

b) What were nanobacteria shown to be with further experimentation? Support your answer with data. (maximum of 30 words)

c) Provide two examples from the data gallery of why it is so difficult to define what a cell is. Support your selections with short explanations. (maximum of 40 words total)

15 pts.

4) Is it circular reason to think about how neurons work?

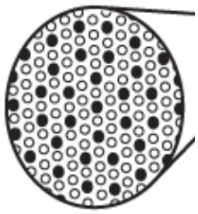
a) Given that the drug digitalis binds to the Na^+/K^+ pump, what effect does the drug have on neurons? Support your answer using information in the data gallery. (maximum of 40 words)

b) If an axon has a diameter of 0.6 µm, what is the optimum thickness of the myelin layer? Support your numerical answer with data. (maximum of 25 words)

c) What role does calcium play in a neuron's function? Support your answer with two figures from the data gallery. (maximum of 40 words total)

10 pts.

5) Now it is time to flex your knowledge of muscles.



a) Look at the cross-section diagram to the right. The dark circles are myosin and the light circles are actin. Draw one thick line in data gallery figure #45 to show where this cross-section was taken.

b) What must happen in order for a contracted muscle to relax? Support your answer using a figure from the data gallery. (maximum of 30 words)

c) Summarize how muscles grow in response to repeated exercise. Support your answer with data. (maximum of 40 words)

15 pts.

6) I hope you can remember how memories are formed.

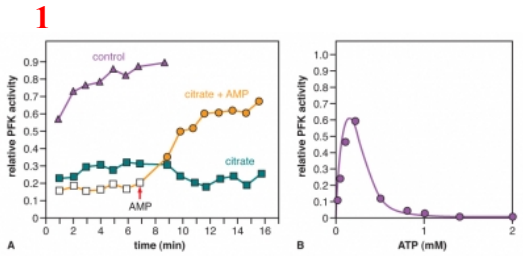
a) What is the role of proteases in the formation of short-term and long-term memories? (maximum of 40 words total)
b) Describe two physical changes you would see at synapses where long-term memory has been established. Support your answer with a figure from the data gallery. (maximum of 30 words)
c) What emergent property is required for long-term memory formation? Draw a diagram in the space provided here to illustrate your answer. This answer should be an illustration only (with labels as needed).

18 pts.
7) These questions might make you hungry.
a) Explain why it is adaptive for deamination to be inhibited by a product of the citric acid cycle. Name the inhibitory product and one enzyme that is inhibited as part of your answer. Support your answer with experimental evidence of this inhibition. (maximum of 40 words total)
b) Give an example of a metabolic pathway that is rate-limited by the speed of an enzyme rather than the availability of substrate. Support your answer with data. (maximum of 25 words)
c) Why do humans need 4 paralogs to complete beta oxidation? Support your answer by drawing an illustration of the main reason. This answer should be labeled diagrams only.

20 pts.
8) Now I leaf you with the last set of questions….
a) Summarize the choice of cyclic vs non-cyclic electron flow as an example of homeostatic regulation of energy processing. Support your answer with figures in the data gallery. (maximum of 40 words)
b) How and where are H^+ ions accumulated when plants harvest sunlight? Support your answer with data. (maximum of 30 words)
c) Provide two ways in which carbon fixation is regulated so that CO_2 is consumed at the best times possible. Support your answer with data. (maximum of 30 words)

Data Gallery

1



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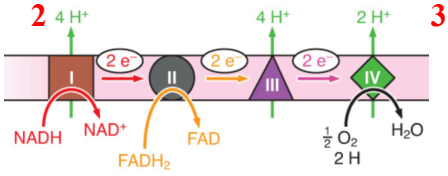

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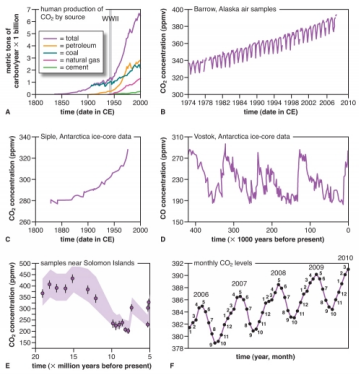

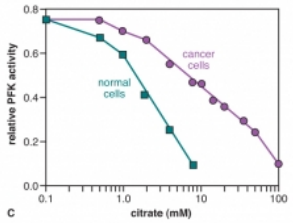

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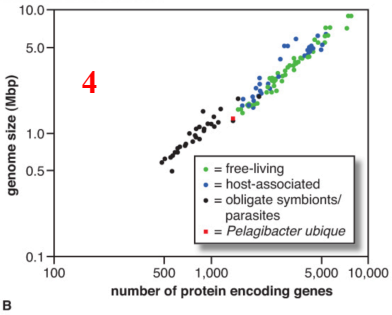

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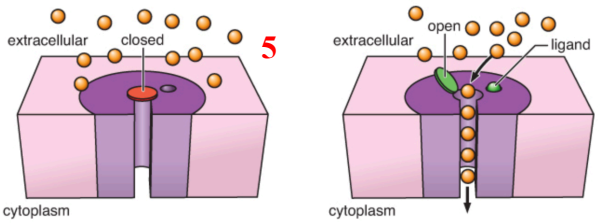

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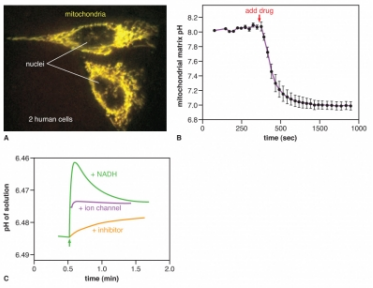

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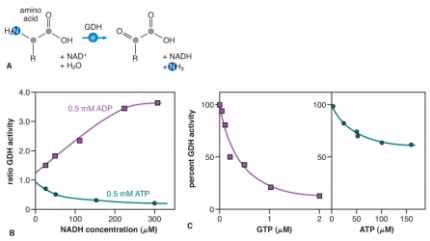

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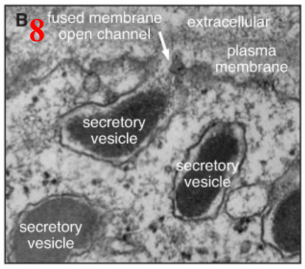

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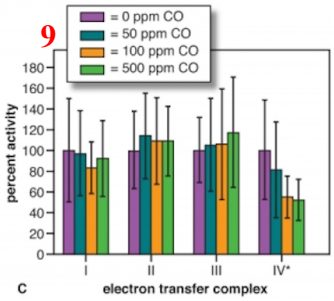
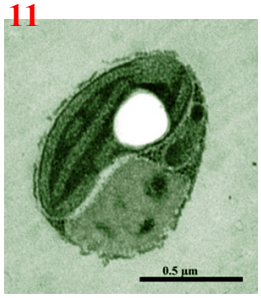


10

enzyme identification	enzyme (μM)	substrate (μM)
e1	n.a	s1 near 0
phosphofructokinase	n.a	s2 1,500
e3	810	s3 80
e4	1,400	s4 80
e5	130	s5 50
e6	540	s6 20
pyruvate kinase	170	s6a 65

11



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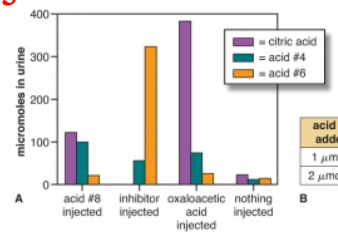
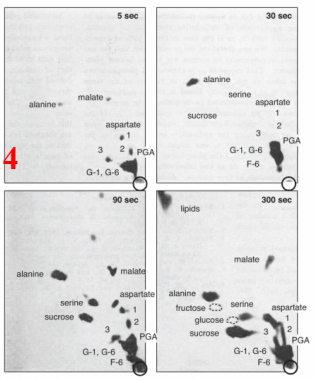
gene name	average copy number	copy number range
ftsZ	80,600	35,800–198,800
dnaA	48,700	29,800–153,000
recA	120,000	60,300–205,000
16S rRNA	368,000	241,000–737,000

13



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

14



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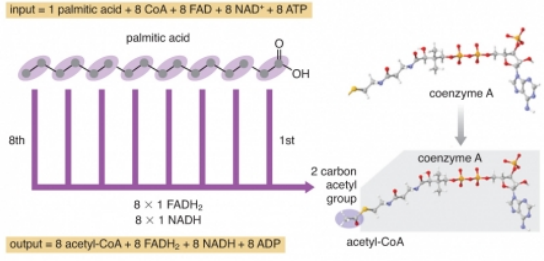

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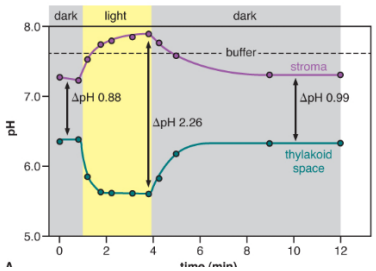

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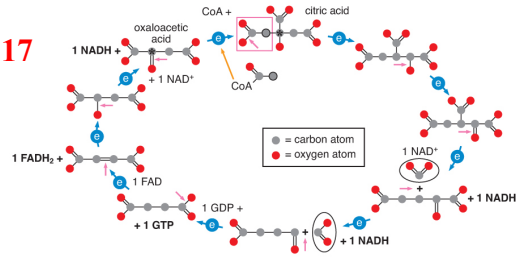

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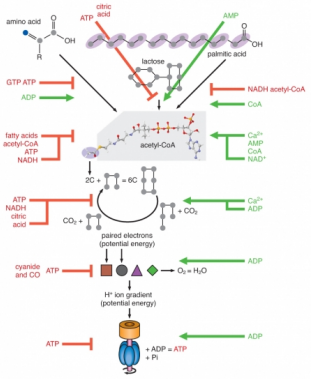

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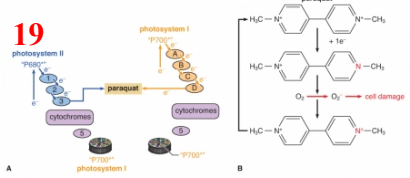

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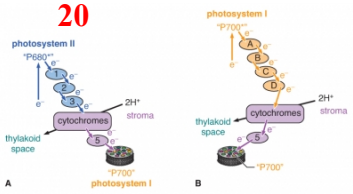

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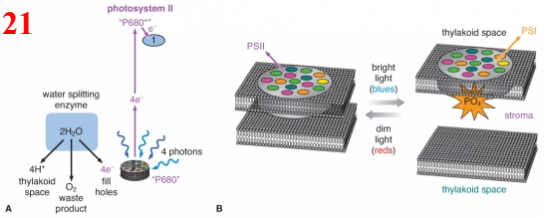

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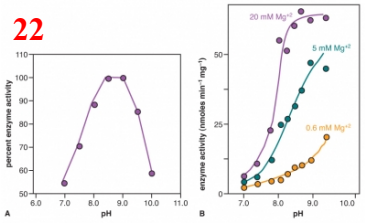

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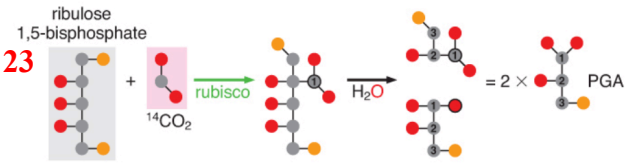

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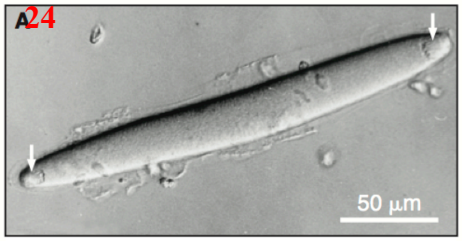

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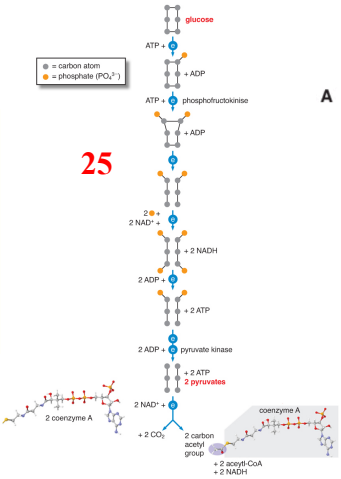

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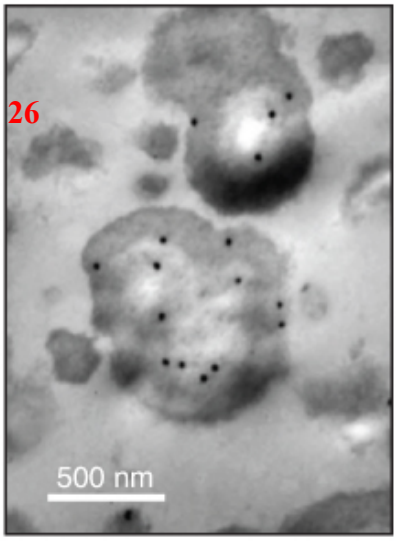

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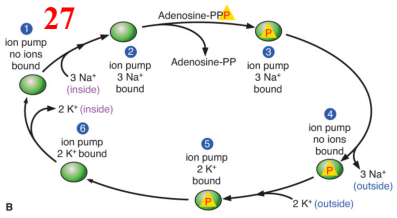

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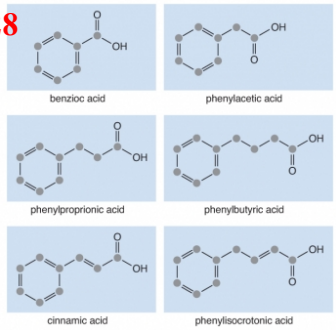

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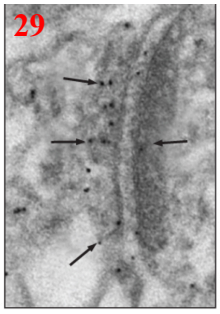

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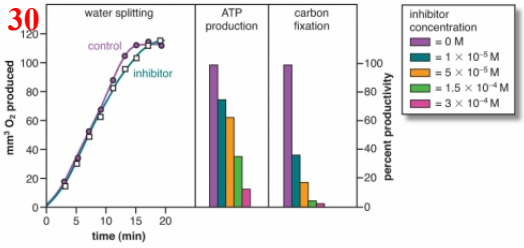

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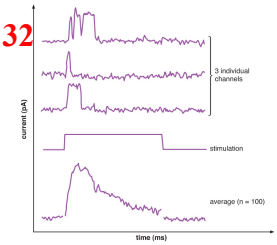
ion	intracellular concentration	extracellular concentration
K^+	155 mM	4 mM
Na^+	12 mM	145 mM
Ca^{2+}	0.0001 mM	1.5 mM
Cl^-	4 mM	120 mM

32



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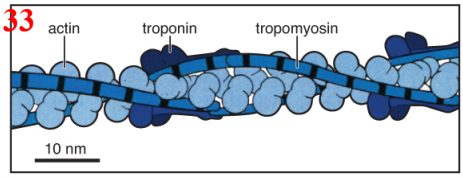

Plot:

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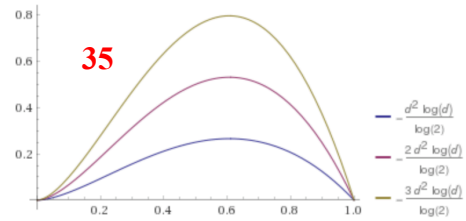

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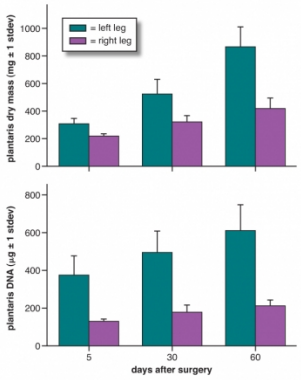

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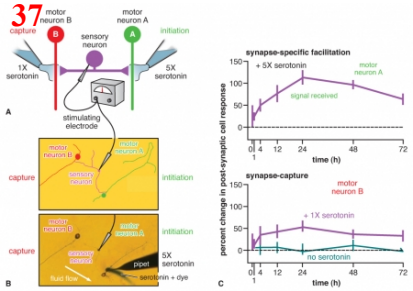

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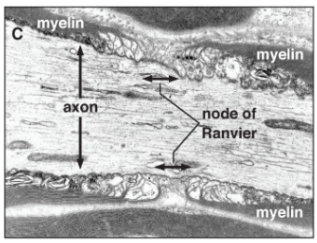

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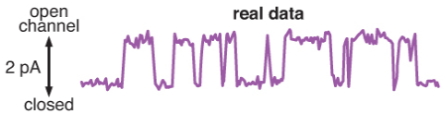

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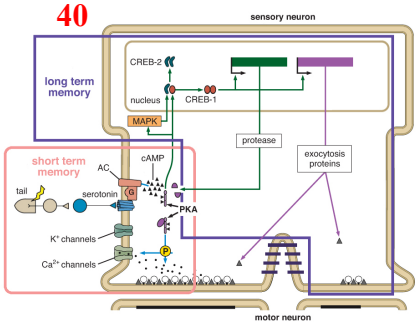

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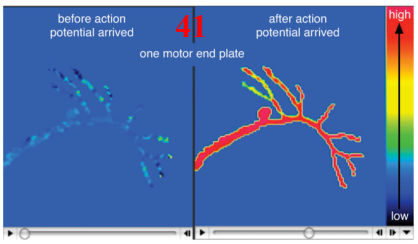

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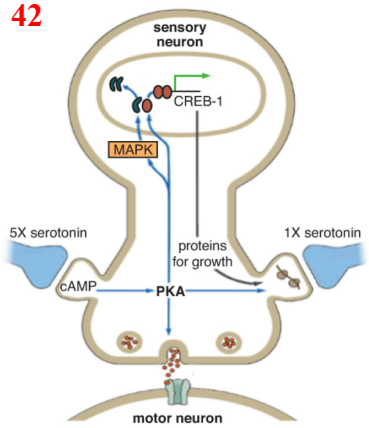

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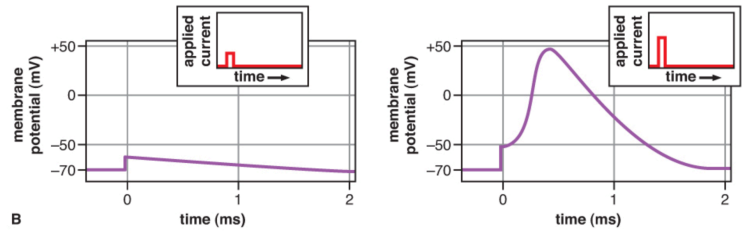

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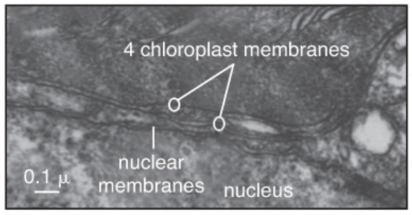

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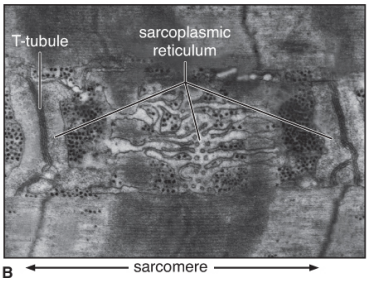
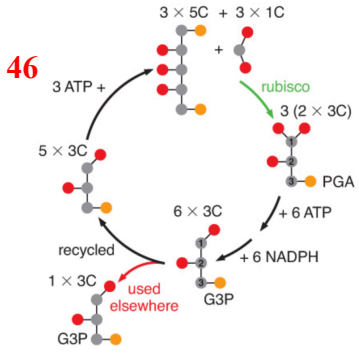
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