

**Fall 2002 Biology 111 Exam #3 – BioEnergetics**

**Answer Key**

There is no time limit on this test, though I have tried to design one that you should be able to complete within 2.5 hours, except for typing. There are four pages for this test, including this cover sheet. You are not allowed to use your notes, old tests, the internet, or any books, nor are you allowed to discuss the test with anyone until all exams are turned in at 11:30 am on Monday November 25. **EXAMS ARE DUE AT CLASS TIME ON MONDAY NOVEMBER 25.** You may use a calculator and/or ruler. The **answers to the questions must be typed on a separate sheet of paper** unless the question specifically says to write the answer in the space provided. If you do not write your answers in the appropriate location, I may not find them.

You must have access to the web to take this exam.

**-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 (INCLUDING THE TEST PAGES) together when finished with the exam.

Name (please print):

Write out the full pledge and sign:

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.

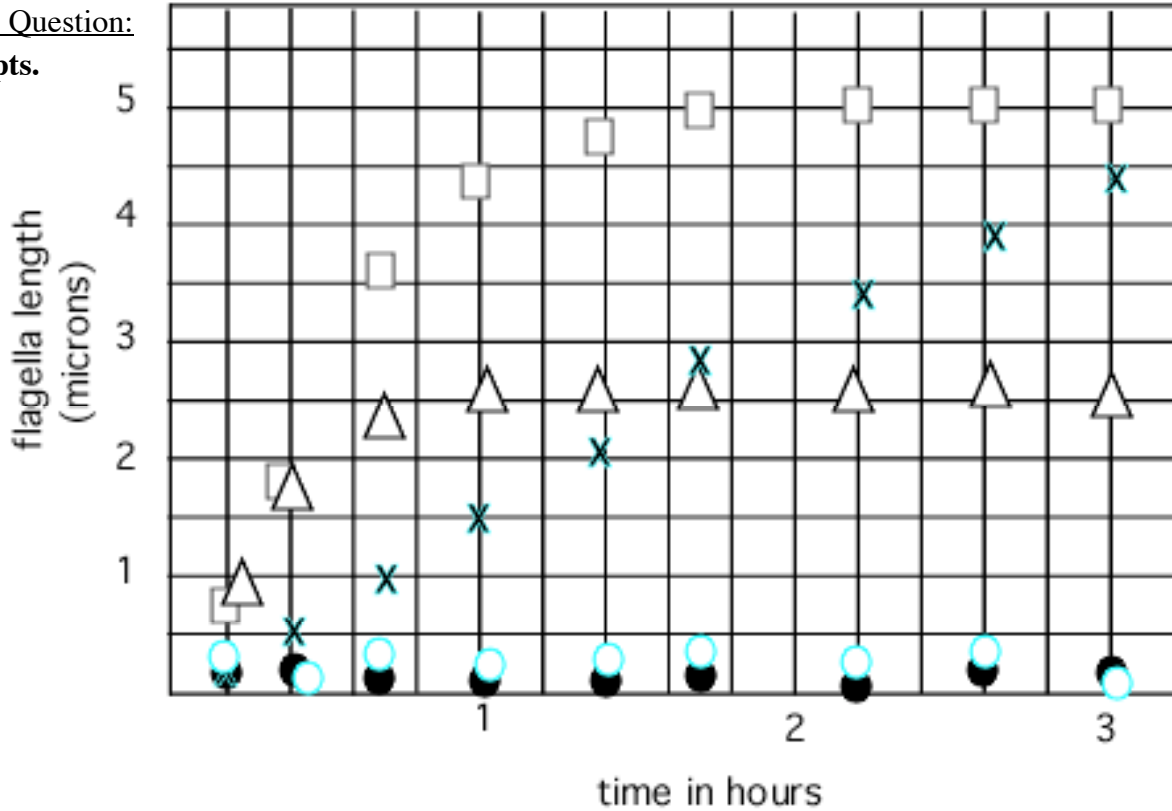
How long did this exam take you to complete (excluding typing)?

Average 85.5%  
added 7 pts to each exam

Lab Question:

10 pts.

1)



This question requires that you generate graphs using the grid above. Be sure to label the X and Y axes and provide real numbers and units. Extend your graph for 3 hours of regeneration. Assume standard lab conditions unless told otherwise.

- Using a pencil, draw squares to graph the regrowth of *Chlamydomonas* flagella under control conditions.
- Using a pencil, draw triangles to graph the regrowth of *Chlamydomonas* flagella when all protein synthesis is blocked after deflagellation and the block were maintained for 3 hours.
- Using a pencil, draw filled circles to graph your prediction of what would happen if the cells in b were deflagellated a second time and allowed to grow for 3 hours.
- Using blue ink and X's, graph your prediction of what would happen if cells were grown at 10° C for 3 hours.
- Using blue ink and open circles, graph your prediction of what would happen if cells were grown at 80° C for 3 hours.

Lecture Questions:

6 pts.

- Use photosynthesis as an example of the two laws of thermodynamics. In other words, use photosynthesis to define the two laws.

Light energy is neither lost nor destroyed. It is captured in excited electrons, transferred to electron transport pathway and converted to H<sup>+</sup> gradient that is used to create ATP. Some energy is lost as heat and entropy along the way.

All things tend towards randomness, unless energy is invested (light). Water is broken down and H<sup>+</sup> and O<sub>2</sub> diffuse away from each other (randomness). But the light energy in the form of ATP and NADPH is invested to produce a less random 3 carbon sugar (G3P).

**6 pts.**

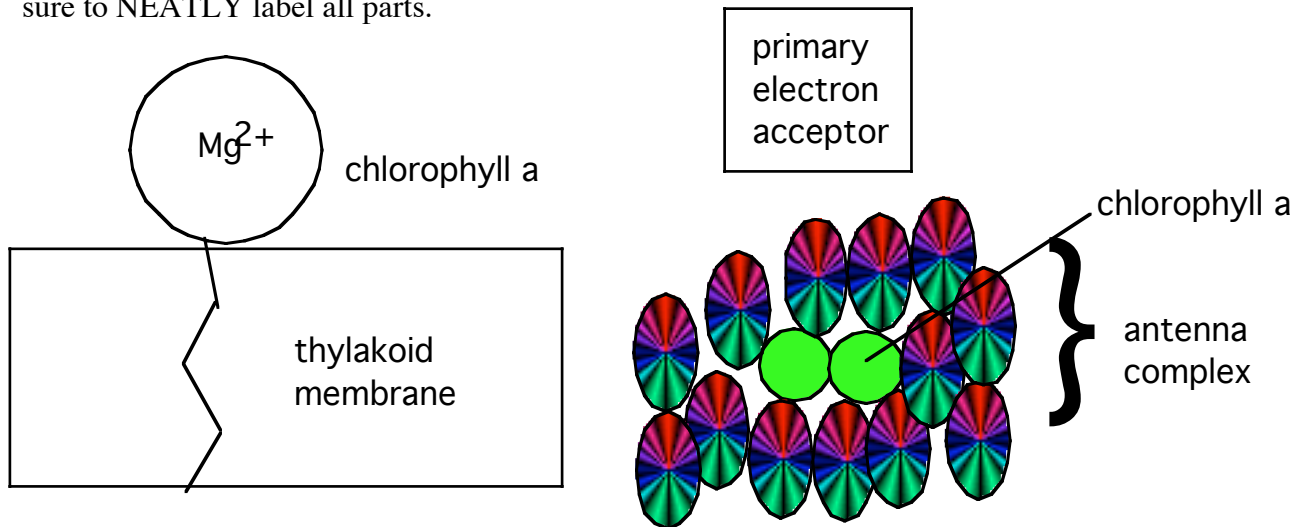
3) Make a list with the names of leaf pigments in one column and colors of light absorbed in the second column. List as many as you can remember.

You could have gotten more specific and been correct.

Chlorophyll a	red and blue
Chlorophyll b	red and blue
carotenoids	not green, but many other colors depending on particular pigment. Includes yellow, red, purple and blue.

**6 pts.**

4) In the space provided below, draw a picture/cartoon of a photosynthetic reaction center. Be sure to NEATLY label all parts.



**Either half would be correct. Technically, the reaction center is only the chlorophyll molecules, but I accepted either diagram.**

**12 pts.**

5) Draw any chemical structures you know to demonstrate the following terms. Be sure to clearly indicate which parts I should look at and type out sentences to explain your drawing. Leave a blank space to draw in after you have typed and printed your answers.

many possible answers

- a) reduction
- b) reducing agent
- c) oxidation
- d) oxidizing agent

**3 pts.**

6) How is energy stored in glucose? Use words with pictures as needed.

Covalent bonds between the carbons and the hydrogens.

**8 pts.**

7) several  $\text{NADH} + \text{C}_3\text{O}_3\text{H}_3 \rightarrow \rightarrow \rightarrow \text{several NAD}^+ + \text{CO}_2 + \text{C}_2\text{H}_6\text{O}_1$

Define the following for the reaction above:

- a)  $-\Delta G$  or  $+\Delta G$ ?
- b) spontaneous or non-spontaneous
- c)  $-\Delta H$  or  $+\Delta H$ ?
- d)  $-\Delta S$  or  $+\Delta S$ ?

**6 pts.**

8) a) Why do plants need water?

Water provides the electrons that photosystem 2 uses to replenish the electrons excited and the lost in the non-cyclical electron flow.

b) Do plants ever produce  $\text{CO}_2$  as a waste product?

Yes, plant cells experience cellular respiration in their mitochondria.

**9 pts.**

9) a) In what form or forms must nitrogen be supplied to non-legumes in order for them to absorb the nitrogen?

$\text{NH}_3/\text{NH}_4^+$  and nitrate ( $\text{NO}_3^-$ )

b) How do legumes absorb nitrogen?

Their symbiotic bacteria, Rhizobium, fixes or reduces atmospheric nitrogen and supplies it to them as  $\text{NH}_3/\text{NH}_4^+$

c) How many species are needed to produce the mighty soy bean (exclude humans but include all others)?

Three: the plant, Rhizobium and the pollinator (a bee?).

**3 pts.**

10) Explain the passive transport of glucose.

Glucose is transported across the plasma membrane of cells which binds glucose equally well on both sides of the membrane. However, there is more glucose on the outside of most cells so it moves to the cytoplasm. Once inside a cell, the glucose is phosphorylated and thus does not get transported back out of the cell.

**20 pts.**

11) In a flow diagram or in an outline format, show the flow of energy from **glucose** to **ATP** production. In your diagram, be sure to account for all carbons and all electrons.

I wanted glycolysis, citric acid cycle and electron transport.

If you had all 3, you could get 20 points.

If you had only glycolysis you could get 7 points maximum.

If you did not have electron transport pathway in detail, you could get only 14 points maximum.

**5 pts.**

12) a) Which step in cellular respiration is allosterically modulated to regulate the entire pathway.

Phosphofructokinase is the enzyme which regulates the entire pathway.

b) Explain why this enzyme is the best one to be the regulator of the pathway.

It is the slowest and thus rate-limiting enzyme. It is also one that consumes ATP so why not regulate before investing the last ATP?

**6 pts.**

13) List the substrates and the resulting products for all forms of fermentation. Then tell me how many ATPs were produced for each pathway you list.

pyruvate and NADH → lactic acid and NAD<sup>+</sup> (zero ATP)

pyruvate and NADH → → ethanol and NAD<sup>+</sup> (zero ATP)