

Fall 2009 Genomics Exam #3
Circuits, Synthetic and Systems Biology

There is no time limit on this test, though I hope you won't spend too much time on it. I have tried to design an exam that will take about the same amount of time as the previous two exams. You may NOT read any additional papers. There are 4 pages, including this cover sheet, for this test. You are not allowed discuss the test with anyone until all exams are turned in by noon on Thursday December 17. **EMAILED COPIES OF YOUR EXAM ANSWERS ARE DUE NO LATER THAN NOON December 17.** You may use a calculator, a ruler, your notes, the book, and the internet but not any journal articles. You may take it in as many blocks of time as you want. Submit electronic versions before noon (eastern time zone:-).

The **answers to the questions must be typed in a Word file and emailed to me as an attachment.** Be sure to backup your test answers just in case (I suggest a thumb drive or other removable medium). You will need to capture screen images as a part of your answers which you may do without seeking permission since your test answers will not be in the public domain. Remember to explain your thoughts in your own words and use screen shots to support your answers. **Screen shots without *your* words are worth very few points. Good answers are not measured by the number of words, but rather the quality of thought and clarity of your explanation.**

DO NOT READ or DOWNLOAD ANY PAPERS or ABSTRACTS FOR THIS EXAM unless the question says you can for that one question.

-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):

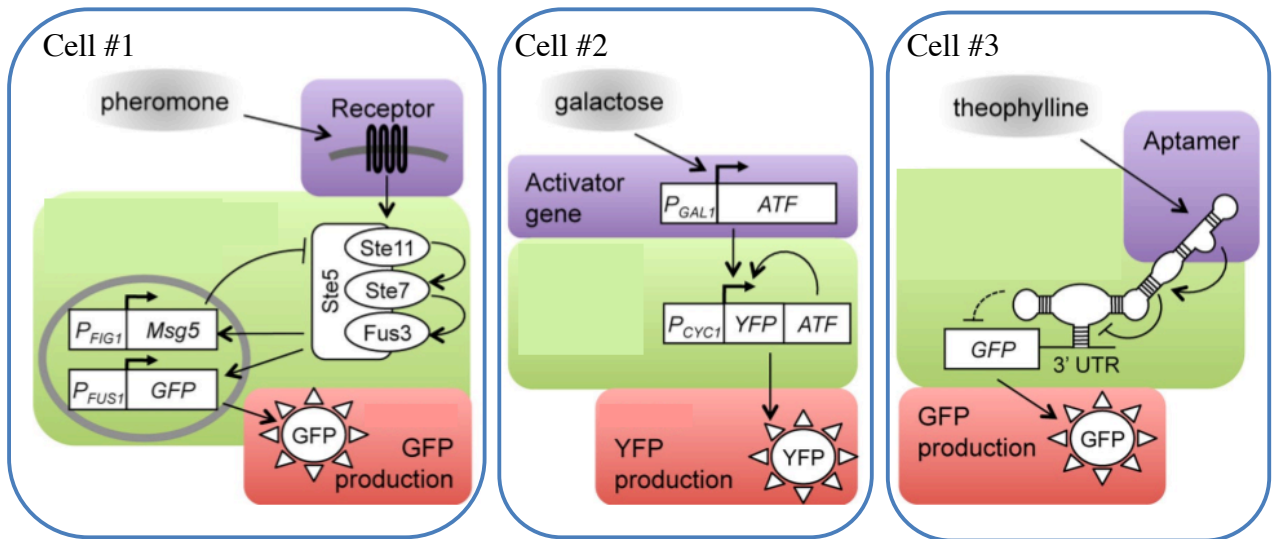
Write out the full pledge and sign:

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

25 pts

1) These questions are based on a recent paper written by a former research student of mine who is now at Harvard. She describes a series of experiments using synthetic biology in eukaryotes. Do not look for this paper, but base your answers solely on the information provided to you in this exam.

a) In the figure below, briefly describe the pattern of fluorescence produced by each of these three different cell types. Each cell type contains one purple unit, one green unit, and one red unit. Do not bother to look up each gene name. Simply base your answer on the abstracts and symbols in this figure.



Cell #1:

Cell #2:

Cell #3:

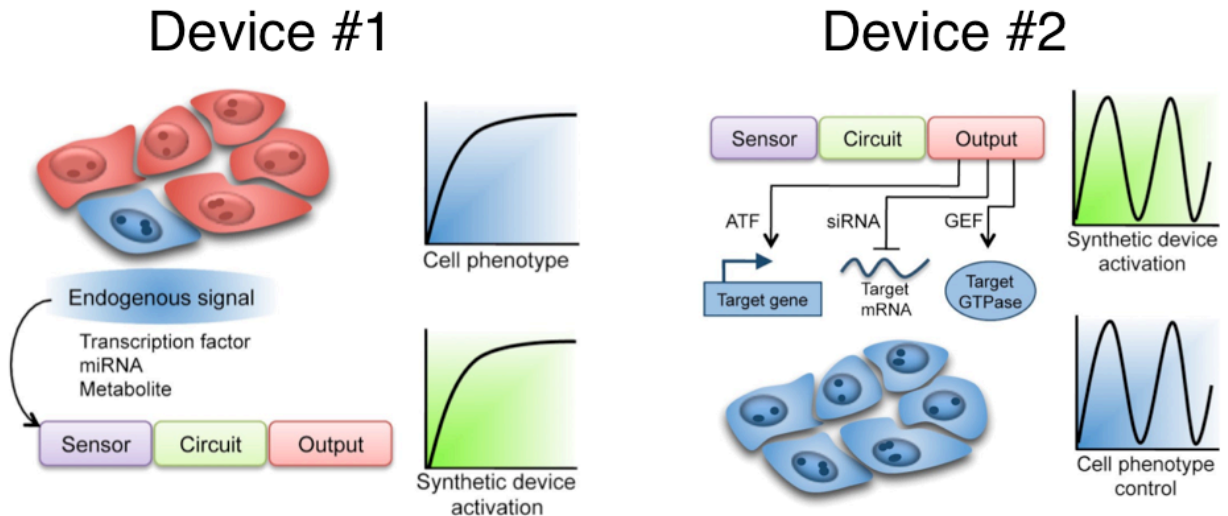
b) Name the commonly named circuits you found in each of the three cell designs above. Each type of circuit is critical to produce each cell type's unique output pattern.

Cell #1:

Cell #2:

Cell #3:

c) Below are two different devices. Use the abstractions from the figure to deduce and then describe the intended function of each eukaryotic device. Note the use of purple, green and red in this figure is related to the same colors in the previous figure.



Device #1:

Device #2:

25 pts

2) Read the 2009 paper by Guell *et al.* to answer the following questions.

- Verify how many genes there are in this species. What is the %GC and what is the % coding? Supply the URL you used to validate your answers.
- Explain figure 1A. Be sure to address not only what the data are but the implications of the data.
- Explain figure 1B. Be sure to address not only what the data are but the implications of the data. What gene is being affected by the data in this panel? Tell me how you know which gene is affected.
- Explain figure 1C. Be sure to address not only what the data are but the implications with regards to figures 1A and 1B.

25 pts

3) Continued from same paper...

- From figure 2A of Guell *et al.*, summarize what data analysis they performed. What did they do and why?

- b) Summarize the data in figure 2B. Be sure to address not only what the data are but the implications of the data.
- c) Summarize the data in figure 2C. Be sure to address not only what the data are but the implications of the data.
- d) Return to your answer to Question 2a. Evaluate your answer for the number of genes in light of what you have learned in this paper and the entire class this semester.

25 pts.

- 4) Read the paper by Wilson *et al.* and answer the following questions.
 - a) What was their research question and why was this an important question to ask? Use **YOUR** words, not theirs. Describe the importance of their research in relation to the material we have covered in class.
 - b) Summarize the results from figure 1. Annotate the figure to show me you understand how to read the data.
 - c) Summarize the results in figure 2 and annotate **FIGURE 3** to show me that you can relate the transcription factor numbers in figure 2 to the images they show in figure 3 (not figure 2).
 - d) What is the significance to figure 3D? What impact do these data have on our understanding of gene regulation?
 - e) Finally, the authors draw a conclusion about what controls gene expression – DNA sequence. Based on what you have learned this semester, make a case that linkage and linkage disequilibrium play an important role that the authors overlook. This answer cannot exceed half a page. You do **NOT** need to define linkage or linkage disequilibrium as part of your answer, but of course you will need to apply those definitions in your answer.