

Spring 2014 Genomics Exam #3
Proteomics, Synthetic Biology & Systems Biology

There is no time limit on this test, though I don't want you to spend too much time on it. I have tried to design an exam that will take about the same amount of time as the first three exams this year. You do not need to read any additional papers. This exam consists of **12 questions and 1 paper**. You are not allowed discuss the test with anyone until all exams are turned in no later than 9 am on Sunday May 11. **ELECTRONIC COPIES OF YOUR EXAM ANSWERS ARE DUE BY 9 AM ON Sunday MAY 11.** You may use a calculator, a ruler, your notes, the book, and the internet. You may print this test to work on your drafted answers, but make sure to dispose of your scrap paper so that no one will find it. You may take this exam in as many blocks of time as you want.

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 may 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. Support your answers with data using screen shots liberally (no permission required since your exam is a private document).**

One characteristic of becoming educated is the ability to synthesize information so that you can distill the major points into a few key sentences. When your boss asks for a summary of the main points, he or she will not want a brain dump of all the information you have. For this reason, I am restricting your grammatical gymnastics and **limiting your answers by the number of words**. I will stop grading after the *n*th word as defined in each question.

-3 pts if you do not follow this direction.

Please do not type your name on any page other than this cover page.

Name (please type):

Write out the full pledge and sign (electronic signature is ideal):

How long did this exam take you to complete?

All the test questions are drawn from the attached systems biology paper by Garfield *et al.*, 2013.

7 points

1) In 75 words or less, summarize the apparent contradiction under investigation in this paper. In other words, what two competing interests of the species are being studied by these researchers?

7 points

2) In 50 words or less, use Figure 1 to determine how the gene SM-30 is activated. Limit your answer to just the immediate cause, not all the way back to egg production. Describe SM-30 function using as many GO terms as you can find. (You may copy and paste as long as you provide the URL of your source.)

20 points

3) Look at Figure 1 and find Notch in the endomesoderm integrated circuit of genes. Notice that it has only one arrow that winds its way upwards to point to a node. This node has a second arrow that also points to it.

a) In 40 words or less, what does this node represent?

b) In 50 words or less, interpret the meaning of two arrows pointing to this single node.

c) Find the maternal Otx and follow its arrow until it reaches Blimp1 in the endomesoderm integrated circuit of genes. Explain all the emergent properties exhibited by the subcircuit that contains these five genes: non-maternal Otx, Blimp1, FoxA, Hox11/13 and Eve. To answer this question, you must redraw (by hand and scan, or in a program and then insert screen shot) these 5 genes and their relevant edges. Then you need to use the numbered list below to analyze how each gene is regulated and any emergent properties exhibited by each of the five genes.

1 Otx:

2 Blimp1:

3 FoxA:

4 Hox11/13:

5 Eve:

Drawing here:

7 points

4) What is the significance of Figure 2C in the context of this paper? Integrate Figure 2C with Figure 1 for this answer. Limit your answer 120 words or less.

5 points

5) Interpret the biological relevance of the data in Figure 3. Limit your answer 100 words or less.

7 points

6) Figure 4A has a profound impact on the take home message for this paper. Use Figure 4A to support the claims of the authors from this research. Limit your answer 120 words or less.

15 points

7) Explain the inherent complexity of embryogenesis as exhibited by these three panels. Limit your answer 100 words or less for each panel.

Figure 5A:

Figure 5B:

Figure 5C:

7 points

8) The authors invented several complex visualization systems for this paper. Explain the meaning of the diagram in Figure 6C. Add to your explanation any apparent contradictions or aspects of the data that don't make sense. Limit your answer 150 words or less.

7 points

9) A reviewer of this paper claimed the authors have shown that early gene expression does not correlate with a morphological trait that would be subject to natural selection. Support or refute (your choice) this claim using data from this paper. Limit your answer 120 words or less.

7 points

10) Which category of genes are the most sensitive to mutations that would lead to a phenotype change that could be acted upon by natural selection? List three genes as examples of the gene category you identified. Limit your answer 100 words or less (not counting list of 3 gene names).

3 points

11) What is a pioneer transcription factor? Explain how it differs from a regular transcription factor. Limit your answer 50 words or less.

8 points

12) In your spare time, you co-authored a grant proposal to the National Science Foundation to collaborate with this research group from Duke University. Describe in general terms the most important set of experiments you would perform next to push this research forward. Limit your answer 120 words or less.