Your name:_____ Student ID#:_____

Write your name and student ID# on EVERY PAGE of your exam

MCB 141 Midterm I Feb. 16, 2010

Circle the name of your TA

Teresa Lee **John Young**

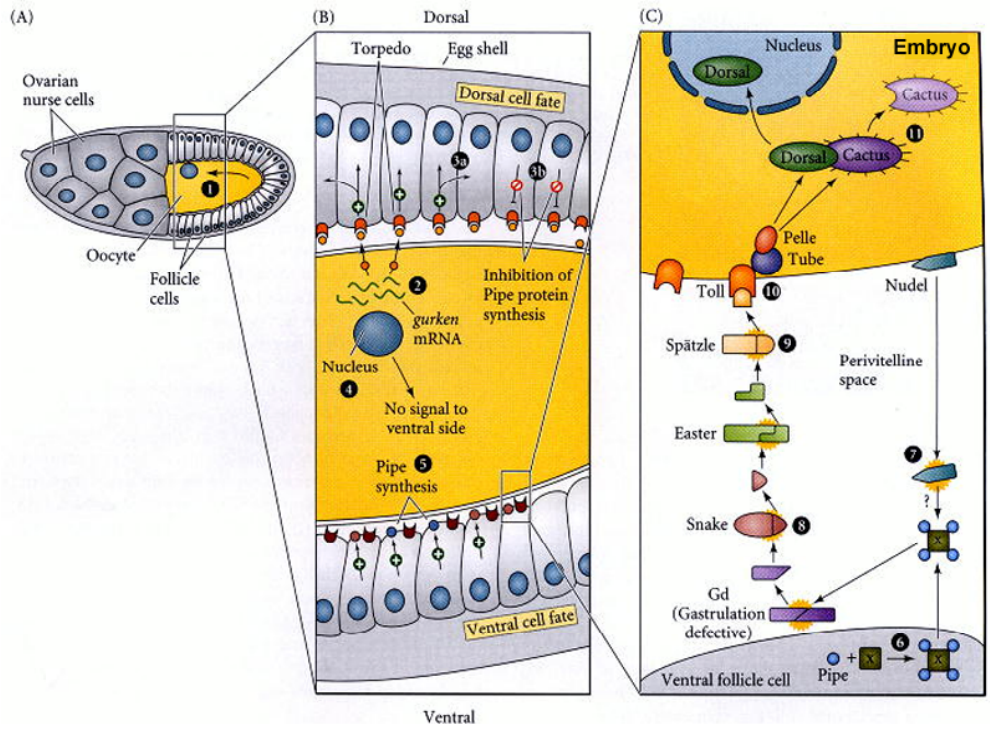
Question #1	_____	**/ 34 pts**
Question #2	_____	**/ 33 pts**
Question #3	_____	**/ 33 pts**
TOTAL	_____	**/ 100 pts**

Exam is closed book, closed notebook
NO CELL PHONES or other electronic devices
Exams must be turned in by 12:30 PM
All answers must be written in ink.
If you need extra space, write on the back of the page, but clearly indicate this on the front page of the question
Regrade policy: Turn in your entire exam to your TA and include a written explanation as to why you think you deserve additional credit.

Your name:_____ Student ID#:_____

Question #1

We have discussed the pathway that establishes the initial dorsal/ventral polarity of the fly embryo (see below).



You discover a new, dominant allele of pipe, which you call $pipe^{D}$. Females that are $pipe^{D}$ / $pipe^{+}$ produce embryos that are ventralized. When you examine the localization of pipe protein in the ovaries of $pipe^{D}$ / $pipe^{+}$ females, you discover that pipe protein is expressed by all follicle cells.

You also discover a new, dominant allele of torpedo, which you call $torpedo^{D}$. Females that are $torpedo^{D}$ / $torpedo^{+}$ produce embryos that are dorsalized. Your biochemistry colleague tells you that the protein produced by the $torpedo^{D}$ allele behaves as though it is always bound by gurken protein (even when there is no gurken present).

Your name:_____ Student ID#:_____

1A [12 points] Predicted the phenotype of embryos laid by females of the following genotypes (assume all "–" alleles are complete lack of function alleles.). No explanations needed

$easter^{-}$, $easter^{-}$; $pipe^{\mathbf{D}}$ / $pipe^{+}$

$torpedo^{\mathbf{D}}$ / $torpedo^{+}$; $cactus^{-}$, $cactus^{-}$

$torpedo^{\mathbf{D}}$ / $torpedo^{+}$; $pipe^{\mathbf{D}}$ / $pipe^{+}$

$torpedo^{\mathbf{D}}$ / $torpedo^{+}$, $pipe^{-}$/ $pipe^{-}$

$pipe^{\mathbf{D}}$ / $pipe^{+}$; $torpedo^{-}$/ $torpedo^{-}$

$gurken^{-}$/ $gurken^{-}$; $torpedo^{\mathbf{D}}$ / $torpedo^{+}$

Your name:_____ Student ID#:_____

1B [5 points] As stated previously, $pipe^{D}$ / $pipe^{+}$ females produce embryos that are ventralized, and $torpedo^{D}$ / $torpedo^{+}$ females produce embryos that are dorsalized. As you know, the eggshell, which is made by the follicle cells, also shows dorsal-ventral patterning. Both the embryo and eggshell are dorsalized when the female is $torpedo^{D}$ / $torpedo^{+}$, but only the embryo is ventralized (eggshell is normal) when the female is $pipe^{D}$ / $pipe^{+}$. You take pole cells that are $torpedo^{D}$ / $torpedo^{+}$; $cactus^{-}$/ $cactus^{-}$ and add them to the posterior end of an embryo that is wild-type (i.e. $torpedo^{+}$/ $torpedo^{+}$; $cactus^{+}$/ $cactus^{+}$), but missing its own pole cells. You raise the resulting embryo up to be an adult female fly and mate her to a wild-type male. Predict the phenotype of the eggshells and of the embryos that are produced. No explanation needed.

1C [5 points] You take pole cells that are $torpedo^{+}$/ $torpedo^{+}$; $cactus^{+}$/ $cactus^{+}$ and add them to the posterior end of an embryo that is $torpedo^{D}$ / $torpedo^{+}$; $cactus^{-}$/ $cactus^{-}$ (and missing its own pole cells). You raise the resulting embryo up to be an adult female fly and mate her to a wild-type male. Predict the phenotype of the eggshells and of the embryos that are produced. No explanation needed.

Your name:_____ Student ID#:_____

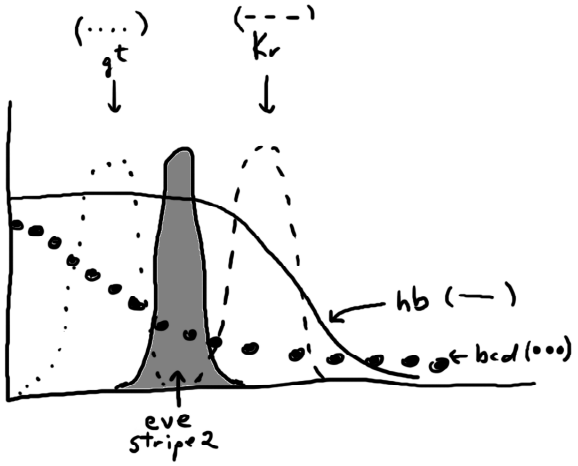
1D [5 points] You take pole cells that are torpedo^{+}/ torpedo^{+} ; cactus^{-}/ cactus^{-} and add them to an embryo that is torpedo$^{\mathbf{D}}$ / torpedo^{+} ; cactus^{+}/ cactus^{+} (and missing its own pole cells). You raise the resulting embryo up to be an adult female fly and mate her to a wild-type male. Predict the phenotype of the eggshells and of the embryos that are produced. (No explanation needed here, but you will be asked to explain in 1E on the next page).

1E [7 points] Provide an explanation for the final result seen in 1D from the previous page.

Your name:_____ Student ID#:_____

Question #2

As described in class, eve stripe 2 is activated by bicoid and hunchback and repressed by giant and Krüppel. A normal eve stripe 2 enhancer placed in front of a lacZ reporter gene gives the following pattern:



Anterior Posterior

You sequence the enhancer for eve stripe 2 and notice that four different nucleotide sequences are repeated several times within the enhancer. [Note: Do not worry about the reverse strand DNA sequence – this is not meant to be a trick question.]

The four sequences that are repeated are:
ATATCCATAT
GCGCCCGCGC
GTGTCCGTGT
CACACCCACA

You create a series of synthetic enhancers (see below) and place each one in front of a lacZ reporter gene and introduce each into flies via P-element transposition. You then observe the pattern of lacZ expression in embryos of the transgenic lines that you establish.

Synthetic enhancer A (SynA) – all the ATATCCATAT and CACACCCACA repeats are specifically eliminated. Instead of a normal eve stripe 2 pattern, you see virtually no expression of the lacZ reporter in an otherwise wild-type embryo.

Synthetic enhancer B (SynB) – all the GCGCCCGCGC repeats are specifically eliminated. Instead of a normal eve stripe 2 pattern, you see a broadened stripe of lacZ expression (broadened in the anterior direction) in an otherwise wild-type embryo.

Synthetic enhancer C (SynC) – all the GTGTCCGTGT repeats are specifically eliminated. Instead of a normal eve stripe 2 pattern, you see a broadened stripe of lacZ expression (broadened in the posterior direction) in an otherwise wild-type embryo.

Your name:_____ Student ID#:_____

2A [9 points] Based on these data, predict the sequence that is bound by giant protein (circle the correct answer below). Give a brief explanation for your answer. [Note: this is not the actual binding sequence of giant, just something we have made up for the exam.]

ATATCCATAT

GCGCCCGCGC

GTGTCCGTGT

CACACCCACA

2B [9 points] Based on these data, predict the sequence that is bound by Krüppel protein (circle the correct answer below). Give a brief explanation for your answer. [Note: this is not the actual binding sequence of Krüppel, just something we have made up for the exam.]

ATATCCATAT

GCGCCCGCGC

GTGTCCGTGT

CACACCCACA

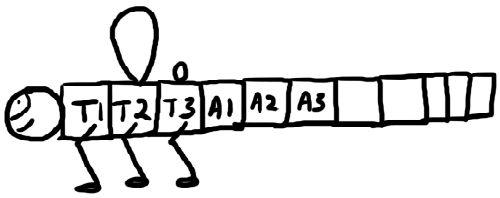
Your name:_____ Student ID#:_____

2C [15 points] Imagine that you create embryos in which Krüppel protein is present in all blastoderm nuclei (without altering the expression pattern of any other gap gene). Predict what you would see for the expression of the SynB eve stripe 2 reporter in these embryos and for the SynC eve stripe 2 reporter in the these embryos. Provide a brief explanation for your answers.

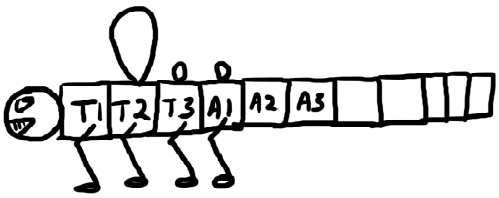
Your name:_____ Student ID#:_____

Question #3

You discover a fascinating insect, Octopod, that is closely related to flies, but it has four pairs of legs (instead of the three pairs seen for flies). In Octopod, T1 has a pair of legs, T2 has a pair of legs and a pair of wings, T3 has a pair of legs and a pair of halteres, and A1 has a pair of legs and a pair of halteres. In flies, it is Ubx that represses legs from developing in A1 (abdA represses legs in the rest of the abdominal segements). You expect that the pattern of Ubx expression is different in Octopod than in Drosophila, and you find that this is true.



Drosophila



Octopod

3A [15 points] What pattern do you think you would see for Ubx expression in (1) early stage embryos (before Distal-less expression begins), in (2) late stage embryos (after Distal-less has become autoregulatory), and in (3) the imaginal disks of Octopod animals. How does this differ from what is seen in Drosophila?

Your name:_____ Student ID#:_____

3B [18 points] Describe an experiment that would help you tell if these differences in Ubx expression between Octopod and Drosophila were cis changes in Ubx or were trans changes (changes in other genes). Use diagrams as needed.