Name: _____

MCB 141 Final Spring 2008
May 20, 2008

SID# _____

Section _____

Question	Points	Score
1.	12	_____
2.	10	_____
3.	10	_____
4.	5	_____
5.	12	_____
6.	15	_____
7.	10	_____
8.	6	_____
9.	9	_____
10,	10	_____
11.	6	_____
12.	10	_____
13.	8	_____
14.	4	_____
15.	6	_____
16.	18	_____
17.	15	_____
18.	34	_____

Total for Final: 200 _____

You should have 13 pages including this one.

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1. When Rosa Beddington transplanted the Node of an early mouse embryo to an ectopic site, only a partial secondary axis resulted. What is necessary in this type of experiment for a nearly complete secondary axis to form, and why is the Node alone insufficient? Include in your discussion the role of antagonists of BMP, Wnt and Nodal. (12pts)

2. Nodal plays an important role in early mouse development. How is the concentration of Nodal regulated? Is Nodal a morphogen?
Give specific examples to support your views. (10 pts)

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3. Draw a cross section, at the approximate level of the thorax, of the neural plate and notochord in a chicken embryo at early neural plate stage (i) and after closure (ii). Indicate the regional expression of the two major signals that pattern the neural tube, and indicate the location of the cell bodies of the major classes of neurons (sensory, motor, interneurons) (10 pts)

4. Retinoic acid gradients are thought to be responsible for patterning the hindbrain, yet complete elimination of RA synthesis and its replacement by uniform exposure to exogenous RA produces a regularly patterned hindbrain. How can you account for this result? (5 pts)

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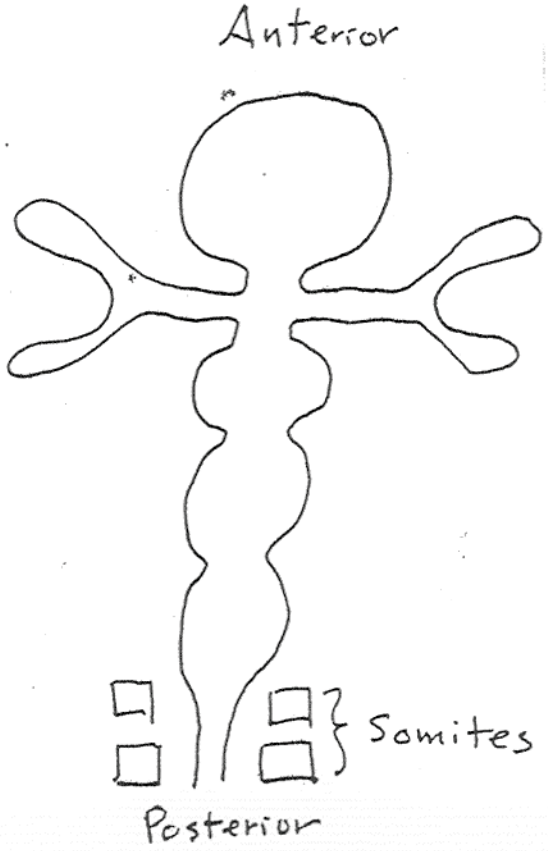
5. Name 3 different structures/tissues/cell types derived from neural crest.
Describe the cell migrations involved for each of your choices.
Describe important influences on their different modes of differentiation, so far as that is known. (12 pts)

6. On the diagram below, identify the position of:
Telencephalon, Diencephalon, Mesencephalon, Metencephalon, Myelencephalon, Isthmus, and prospective cerebellum. Furthermore, identify the positions at which the Nasal placode, Lens placode, and Otic placode would appear. (10 pts)



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(Question 6 continued)

Name a part of the adult brain that arises from each of the 5 major brain vesicles. (5 pts)

7. How do efferent neurites from the ganglion cells in different regions of the retina manage to terminate in the appropriate regions of the optic tectum? In other words, briefly describe the principal molecules and cell behaviors, insofar as they are known, that are involved in this pathfinding and selective connectivity. (10 pts)

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8. Suppose a conditional knock-out of the FGF receptor in the presomitic mesoderm has been imposed after the formation of somite pair 4. What effect does this have on gene expression in presomitic mesoderm that will form somite 5? (6 pts)

9. Describe the three major tissues formed from somites, and what are the principal signaling molecules that initially elicit their different developmental pathways? (9 pts)

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10. Describe the outcome of a transplantation of an additional Apical Ectodermal Ridge (AER) to the anterior border of an early limb bud, and contrast that with the result of transplantation of an additional ZPA (zone of polarizing activity) to the same ectopic anterior site. (10 pts)

11. Contrast the roles of FGF10 and Tbx 4/5 in limb development. (6 pts)

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12. Suppose you could remove (either surgically or a functional removal with appropriate conditional molecular knock-out) the intermediate mesoderm of the prospective mesonephros. Predict the effects on development of the reproductive system of both males and females and explain why. (10 pts)

13. Suppose you were able to "knock-out" the GDNF gene of mice by homologous recombination, and to obtain homozygotes of this condition. What would be the effect on kidney development? Explain why. (8 pts)

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14. Mesodermal cells from several different locations participate in formation of the erythrocytes that form in the developing mammalian embryo. List 4 of them; indicate the order in which each of them becomes an important sources of erythrocytes. (4 pts)

15. Signals emanating from cardiac mesoderm, notochord, and dorsal aorta are recognized and transduced by developing pancreas. Compare the effects of these various signals. (6 pts)

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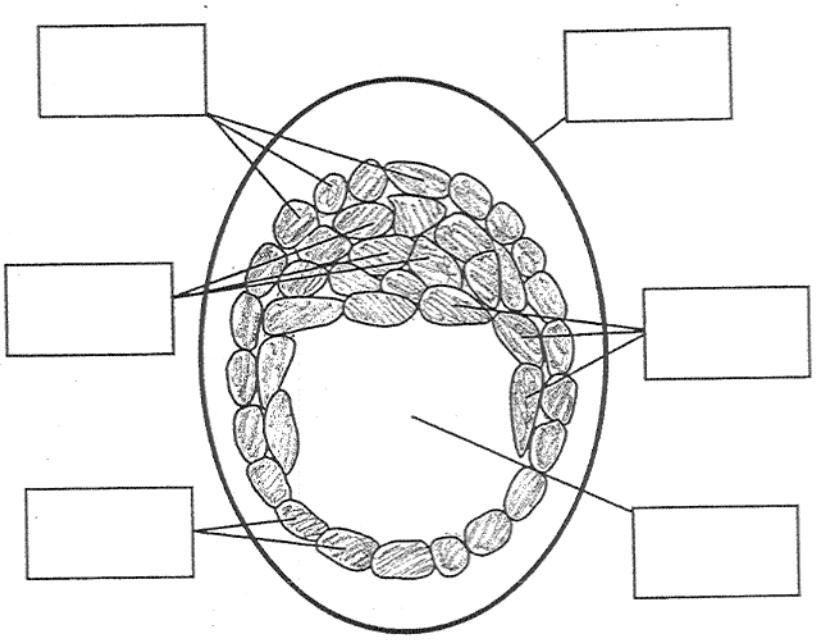
Question 16 (18 points)

A. (6 points)

A cross section is shown of a 128-cell mouse blastocyst, with lines and boxes to designate particular regions of cells. Into each box, put the appropriate letters from the list to best identify each region.

A. cells of the hypoblast
B. cells of the mural trophoblast
C. cells of the epiblast
D. cells of the polar trophoblast
E. fertilization envelope (zona)
F. blastocyst cavity
G. cells that form embryonic stem cells if cultured in a Petri dish
H. cells that will later develop into the mouse
I. cells that will later develop into extraembryonic endoderm
J. cells derived from the outermost cells of the 64 cell stage embryo
K. cells derived from inner cells of the 64 cell stage embryo
L. will be broken down before the blastocyst implants



B. **(6 points)** By the 32-64 cell stage, the mouse embryo contains irreversibly different trophoblast cells and inner cell mass cells. Describe briefly how compaction and cleavage contribute to the formation of these different cell populations.

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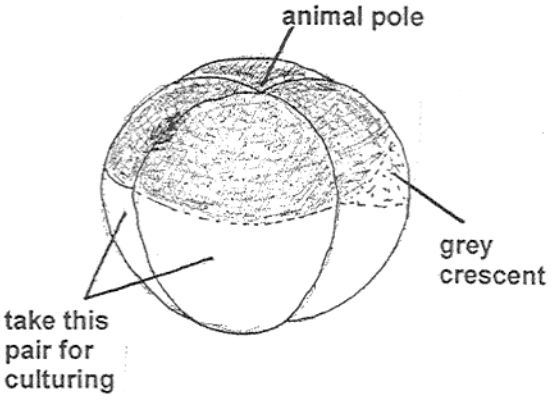
(Question 16 continued)

C. (6 points) By the 64-128 cell stage, the mouse embryo (the "blastocyst") contains irreversibly different epiblast cells and hypoblast cells. Briefly describe blastocyst cavity formation, and tell how it and cell sorting contribute to the formation of these two cell populations.

Question 17 (15 points):

Shortly after fertilization, a *Xenopus* egg is injected with antisense morpholinos to Bmp2, 4, and 7 mRNAs. At the four cell stage, the ventral pair of blastomeres is isolated, that is, the pair lacking the grey crescent (see diagram). The pair is allowed to develop for several days, until hatching. Predict the phenotype of the half-sized hatched embryo, and explain your prediction.



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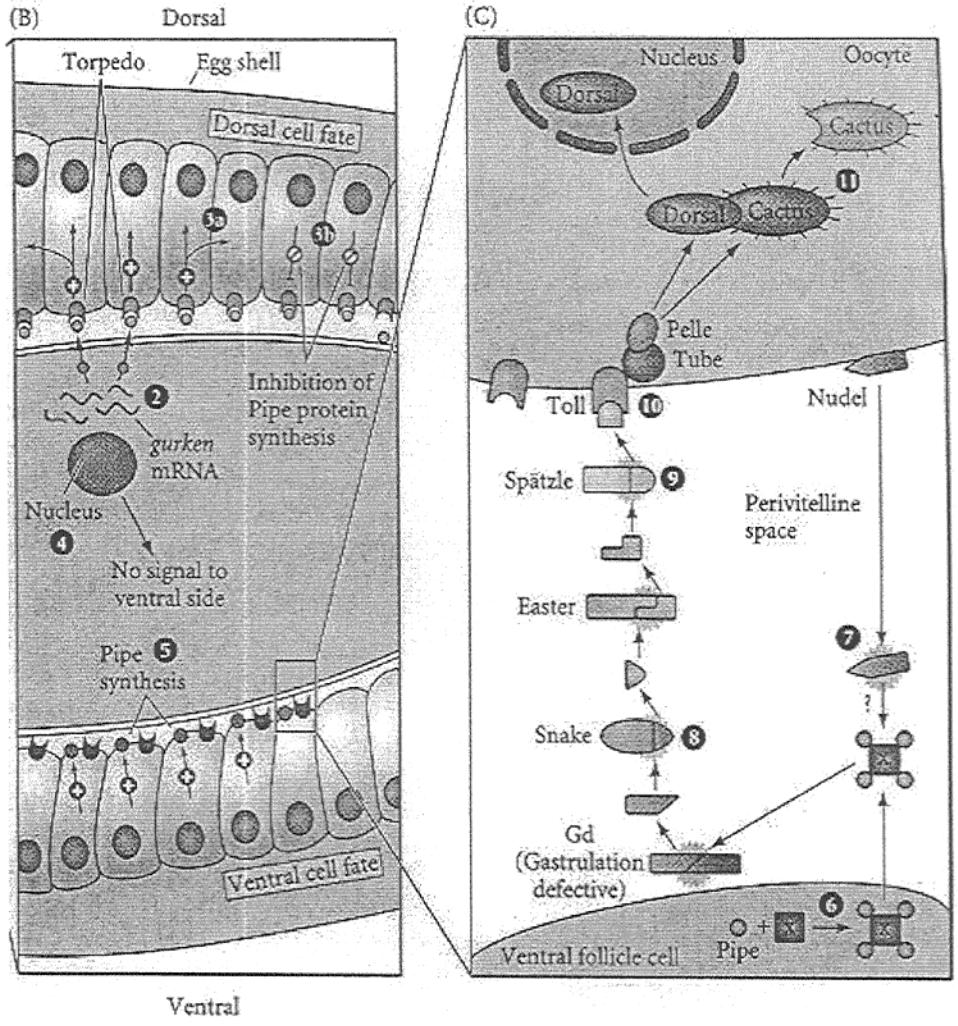
Question 18 (34 points)

Here is a schematic of the dorsal-ventral patterning pathway in Drosophila:



You discover a new gene Z. Mothers that are homozygous mutant for a null (complete lack of function) allele of Z lay eggs that develop into embryos that are ventralized. You are told that gene Z encodes a protein involved in the cascade between Gd and the activation of the Toll receptor. Your goal is to more precisely define where in the pathway Z functions during development. Describe the genetic experiments (hint: think double mutants; you already have available to you individual fly strains mutant for Z plus each of the other D/V patterning genes) that you would carry out to answer the question, and how you would interpret your results.

(Write answer on next page)

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Question 18 answer page: