

BIOLOGY 52 - - CELL AND DEVELOPMENTAL BIOLOGY - - FALL 2002

Third Examination - - November , 2002

Put your name at the top of **each page**. Please read each question carefully before answering- i.e. **read the instructions**. In all answers, be as specific as possible, while respecting the amount of space allotted for each answer. If a question seems ambiguous, do not hesitate to ask me about it. No regrades will be made of exams completed in pencil.

1. (2 points—all or none) Order the following objects by size, from smallest to largest.

- A. Matt Doherty's shoe.
- B. Sucrose
- C. A ribosome
- D. Diameter of a human somatic cell
- E. Diameter of a frog egg.
- F. Twist protein
- G. Diameter of a human oocyte

_____ < _____ < _____ < _____ < _____ < _____ < _____

2. (6 points) For each junctional type, fill in the correct answer in each column

Junction	cell-cell or cell-matrix	Class of transmembrane adhesion protein used	Anchors which type of cytoskeleton
Adherens junction	_____	_____	_____
Hemidesmosome	_____	_____	_____
Focal adhesion	_____	_____	_____
Desmosome	_____	_____	_____

3a. (2 points) Scientists used early blastomeres of the frog to study the ability of cells to transfer certain things from the cytoplasm of one cell to the cytoplasm of another cell. Which type of junction mediates this transfer? _____

(7 points) They injected radioactively-labeled versions of the following molecules/macromolecular structures into one blastomere and looked for transfer into the others. For each, what would the result be if the cells ARE joined by this sort of junction, and what would the result be if they ARE NOT coupled by this junction?

<u>Molecule/</u> <u>Macromolecule</u>	Did it move from one cell to another? (answer YES or NO)	
	<u>Cells are coupled by this junction</u>	<u>Cells are NOT coupled</u>
ATP	_____	_____
Ribosome	_____	_____
Protein kinase C	_____	_____
Estrogen	_____	_____
Mitochondrion	_____	_____
Calcium ion	_____	_____
mRNA for actin	_____	_____

3b. (3 points) During oogenesis of the fruit fly the nurse cells and the oocyte are coupled by a VERY different structure, which allows the nurse cells to transfer things to the cytoplasm of the oocyte. If scientists injected radioactively-labeled versions of each of the following molecules or macromolecular structures into a nurse cell and looked for transfer into the oocyte, what would the result be?

Molecule/

Macromolecule _____ Did it move from the nurse cell to the oocyte? (answer YES or NO)

ATP _____

Ribosome _____

Protein kinase C _____

Estrogen _____

Calcium ion _____

mRNA for actin _____

4. (2 points) Scientists began with yeast of the A mating type, and mutated the gene encoding alpha factor receptor so that it was no longer functional. With which sort of yeast would the mutant yeast mate?

- a. Both types.
- b. A mating type.
- c. Alpha mating type.
- d. Neither mating type.

5. (2 points) Dicytostelium amoebae aggregate with one another to form a slug. To do so, they chemotax toward high concentrations of _____.

6. (4 points) For the following cell types, fill in the blank to indicate whether they are somatic or germ cells.

Kidney _____ Sperm _____ Uterus _____

Follicle cell _____ Oocyte _____ Fallopian tube _____

Nurse cell _____ Neural tube _____

7. (4 points) During gastrulation in the sea urchin, integrin receptors play an important role in the behavior of two different groups of cells, the _____ cells and the _____ cells. After upregulating integrin receptors, what do both of these cell types do?

_____.

8. (6 points) Scientists mutated the fruit fly gene encoding the Toll receptor so that the embryo no longer had a functional copy of this receptor. Which body axis of the embryo was affected? _____

In *Toll* mutant embryos, all cells take on which fate? _____

Scientists mutated the fruit fly gene encoding Bicoid so that the embryo no longer had a functional copy of this protein. Which body axis of the embryo was affected? _____

9. (4 points) Match the term with the BEST definition (one choice will NOT be used)

- A. Signaling molecule that regulates mammalian oogenesis.
- B. Signaling molecule that regulates anterior/posterior patterning in fruit fly epidermis.
- C. Steroid hormone that plays a role in insect metamorphosis.
- D. Transcription factor that regulate dorsal/ventral cell fates in the fruit fly.
- E. Cytoskeletal protein that mediates apical cell constriction.
- F. Mammalian eggshell protein.
- G. mRNA localized to the posterior end of the fruit fly egg.
- H. Signaling molecule that regulates frog mesoderm development.
- I. Peptide hormone that plays a role in insect metamorphosis.

Actin _____ FGF _____
 Nanos _____ PTTH _____
 FSH _____ ZP3 _____
 Wingless _____ Dorsal _____

10. (4 points) For each of the following molecules, pick from among the following list the BEST definition of the job it does inside the cell or outside the cell (some answers MAY be used twice or NOT used at all).

- A. Transcription factor
- B. Steroid hormone.
- C. Transmembrane protein
- D. Peptide or protein signaling molecule (ligand)
- E. Extracellular matrix component.
- F. Ribosomal protein.
- G. Mitochondrial protein.
- H. Cytoskeletal protein

Microtubules _____ Ecdysone _____
 TGF-β _____ Fibronectin _____
 NF-kappa-B _____ Wingless receptor _____
 Cadherin _____ Hyaluronic acid _____

11. (4 points) For each of the following molecules, pick from among the following list the BEST choice for where within or outside the cell it would be located (some answers MAY be used twice or NOT used at all).

- A. Nucleus
- B. Mitochondrion.
- C. Plasma membrane
- D. Cytoplasm
- E. Secreted outside the cell.
- F. Lysosome

Dorsal protein in a dorsal cell _____
 Integrin _____
 FGF receptor _____
 Juvenile hormone when bound to and thus having activated its receptor _____
 Fertilin/ADAM _____
 Dorsal protein in a ventral cell _____
 Folded gastrulation protein _____
 Twist protein _____

12. (3 points) What three events occur at the midblastula transition?

13. (4 points) To which of the three germ layers do each of the following cells belong or from which are they derived?

Sea urchin primary mesenchyme cells _____ Kidney _____

Neural crest _____ Lung _____

Skin _____ Somatic cells of the ovary _____

Sea urchin secondary mesenchyme cells _____ Intestine _____

14. (2 points) When epithelial sheets fold into a tube, this movement is triggered by contraction of what sort of cytoskeletal filament? _____

(Circle one) These filaments are anchored to the plasma membrane near the apical / basal side of the cell sheet.

15. (1 point) During the first few cell division of the nematode, P granules are asymmetrically segregated into a subset of the daughter cells. The daughter cells that inherit the P granules go on to make which cell type in the adult? _____

16. (2 Points) During embryonic development, different cells come to "express different genes". This involves the process called "transcription"-- what is transcription? _____

17. The following 4 true-or-false questions are worth 6 points in total. Mark each as T or F **and for any that is/are false, indicate briefly why in the space below.**

a. T F All cell types have the same complement of genes as part of their DNA.

b. T F All cell types express the same genes in the form of mRNA.

c. T F Fibronectin is a carbohydrate component of the extracellular matrix.

c. T F Integrins are heterodimers of alpha- and beta- chains.

18. (2 points) If one treats a frog egg with ultraviolet radiation, what cytoskeletal element is affected?

_____.

19. (6 points). Which asymmetric cue determines the location of the blastopore during frog gastrulation? _____

A second axis of asymmetry was already set up by the mother frog. The poles of this axis are known as the _____ pole and the _____ pole. These differ because the _____ pole is much richer in _____.

20. (5 points) The cells which invaginate to form the neural tube are on which side of the developing vertebrate embryo.

- a. Anterior
- b. Dorsal.
- c. Posterior.
- d. Ventral
- e. South of the border.

Of the cells that invaginate to form the neural tube, the dorsalmost cells will become the _____ which will make many structures, including the _____

21. (4 points- Put yes or no in each blank) A scientist sought to understand how the signal transduction pathway in the egg led to specific effects following fertilization. To test her hypotheses, she injected individual molecules into an unfertilized egg. Which of the following treatments would produce:

	Cortical granule release?	a pH increase?
Injection of active phospholipase C	_____	_____
Injection of DAG	_____	_____
Injection of InsP3	_____	_____
Injection of Ca ⁺⁺	_____	_____

22. (4 points) Which cell contains the acrosomal vesicle? _____

The contents of the acrosome are released when _____

What is the function of the acrosome's contents

_____.

23. (3 points- in each choose the most accurate choice from the following options; you may use the same letter twice if necessary)

A scientist transplanted the gray crescent from a donor embryo to a host embryo that had previously been irradiated with UV light (blocks cortical rotation). What happens : _____

- a. The embryo develops with two heads.
- b. The embryo develops no head; in fact it does not gastrulate.
- c. The embryo develops normally, with gastrulation lead by the cells descended from the donor gray crescent..
- d. The embryo strongly resembles James Moeser.
- e. The embryo develops normally, with gastrulation lead by the cells 180° opposite the donor gray crescent..

Which letter best describes what happens when an embryo is UV irradiated but otherwise unaltered?

_____ Which letter best describes the result in which the gray crescent is transplanted near the sperm entry point of an unirradiated host which thus has its own normal gray crescent? _____

24. (Circle one-1 point) By fusing two eggs, from one of which the nucleus was removed, **an egg is manipulated so that it has twice the normal amount of cytoplasm**. How many cell divisions will it undergo before the start of gastrulation?

- a. One more than normal.
- b. Two more than normal.
- c. One less than normal.
- d. Two less than normal.

25. A new organism was discovered the day before yesterday. It develops in a very similar way to the frog *Xenopus*. In this animal the following experiment was done. After gastrulation cells were disassociated. Different combinations of cells were made, with the following results:

Isolated ectodermal cells produce only epidermis. Isolated mesodermal cells produce only muscle.

When ectodermal and mesodermal cells were cultured together the ectodermal cells produced both epidermis and nervous system, while mesodermal cells continued to produce only muscle.

(4 points) A new molecule, neurogen, was identified and scientists did the following experiment to determine if it could be the inducer **in this event**. Cells were isolated from the ectoderm and incubated in the presence or absence of neurogen. Describe what tissue(s) would be produced if neurogen is the inducer, and what tissues would be produced in neurogen is not the inducer.

<u>TISSUE</u>	<u>NEUROGEN</u>	<u>Tissue(s) produced if neurogen is inducer</u>	<u>Tissue(s) produced if neurogen is not inducer</u>
Ectodermal cells	Added	_____	_____
Ectodermal cells	Not Added	_____	_____
Mesodermal cells	Added	_____	_____
Mesodermal cells	Not Added	_____	_____

(2 points) If neurogen is the inducer, by which cell type should it be expressed? _____

I certify that I have performed my work on this examination in full conformity with the provisions of the Honor Cod

Signature _____