

BIO380HF—HUMAN DEVELOPMENT
University of Toronto Mississauga
Fourth Midterm Test—November 14, 2011
Professor Danton H. O'Day

Test Length: 50min; 100 Marks Total

Answer all questions giving the best or most appropriate answer in each case. No aids allowed.

KEY

A. MULTIPLE CHOICE—Underline the best answer (2 mark each; 20 marks total)

1. Which of the following is not part of the mature male genitalia
 - a. Urethra
 - b. Bartholomew's gland
 - c. Vasa efferentia
 - d. Cowper's gland
 - e. Bulbourethral gland

2. Which of the following statements about the cortical granules is true:
 - a. They modify sperm binding to the cumulus oophorus
 - b. They undergo endocytosis at fertilization
 - c. They contain hydrolytic enzymes
 - d. They modify the zona granulosa
 - e. None of the above

3. Which of the following statements about annulate lammellae is true:
 - a. They contribute to the formation of the cell membrane
 - b. They are present during spermatogenesis
 - c. They are stacks of granules
 - d. They contribute to the nuclear membrane
 - e. a and d are correct

4. Which of the following is part of the mature male genitalia?
 - a. Urethra stimulatus
 - b. Seminary gland
 - c. Vasal deferentia
 - d. Cowboy's gland
 - e. None of the above

5. Turner Syndrome is characterized by:
 - a. An extra "0" chromosome
 - b. Extra nasal apertures
 - c. Sterility
 - d. Lengthened foreskin
 - e. All of the above

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6. During oogenesis, blocks occur at:

- a. Mitotic Prophase I & Metaphase II
- b. Mitotic Prophase & Metaphase
- c. Meiotic Prophase I & Metaphase II
- d. Meiotic Prometaphase I & Anaphase II
- e. Mitotic Prometaphase I & Anaphase II

7. Which of the following is the full term for DSCR1?

- a. Down Syndrome Critical Regulator 1
- b. Down Syndrome Chromosomal Region 1
- c. Down Syndrome Critical Region 1
- d. Down Syndrome Chromosomal Regulator 1
- e. Down Syndrome Critical Receptor 1

8. Which of the following statements about calcineurin is not true?

- a. It negative regulated by DSCR1
- b. It is a calcium/calmodulin regulated protein kinase
- c. It binds to DSCR1
- d. It is a calcium/calmodulin regulated protein phosphatase
- e. It indirectly affects the phosphorylation status of NFATc

9. Which of the following statements about NFATc is not true?

- a. It is an acronym for nuclear factor of activated T-cells
- b. It is activated by calcineurin
- c. It is a critical transcription factor
- d. It is encoded on chromosome 21
- e. It regulates genes involved in neuronal development

10. The acrosome reaction does not involve:

- a. Ca^{2+}
- b. Inositol bisphosphate receptors
- c. Divalent cations
- d. Membrane fusion
- e. all of the above

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B. Answer the questions in a clearly organized way using point form and diagrams as appropriate.

1. Outline the temporal changes in the hormonal regulation of milk duct branching, then list the major molecules involved in regulating this event. (20 marks)

3 marks each:

- Branching, which began during embryogenesis, stops at birth and then is re-initiated by estrogen at the onset of puberty.
- It involves localized tissue interactions which lead to the controlled localized regulation of cell division and changes in shape.
- The extracellular matrix also needs to be modified to allow the branching to occur.

3 marks each:

Various molecules come into play to regulate the branching process:

- EGF (epidermal growth factor) and HGF (heptocyte growth factor) stimulate branching
- TGF β is an inhibitor of epithelial branching in kidneys, lungs and mammary glands
- ADAM, a disintegrin and metalloproteinase, and MMPs, matrix metalloproteinases, are important for remodeling the ECM to allow the branching to occur.

2 additional marks for organization and clarity of answer

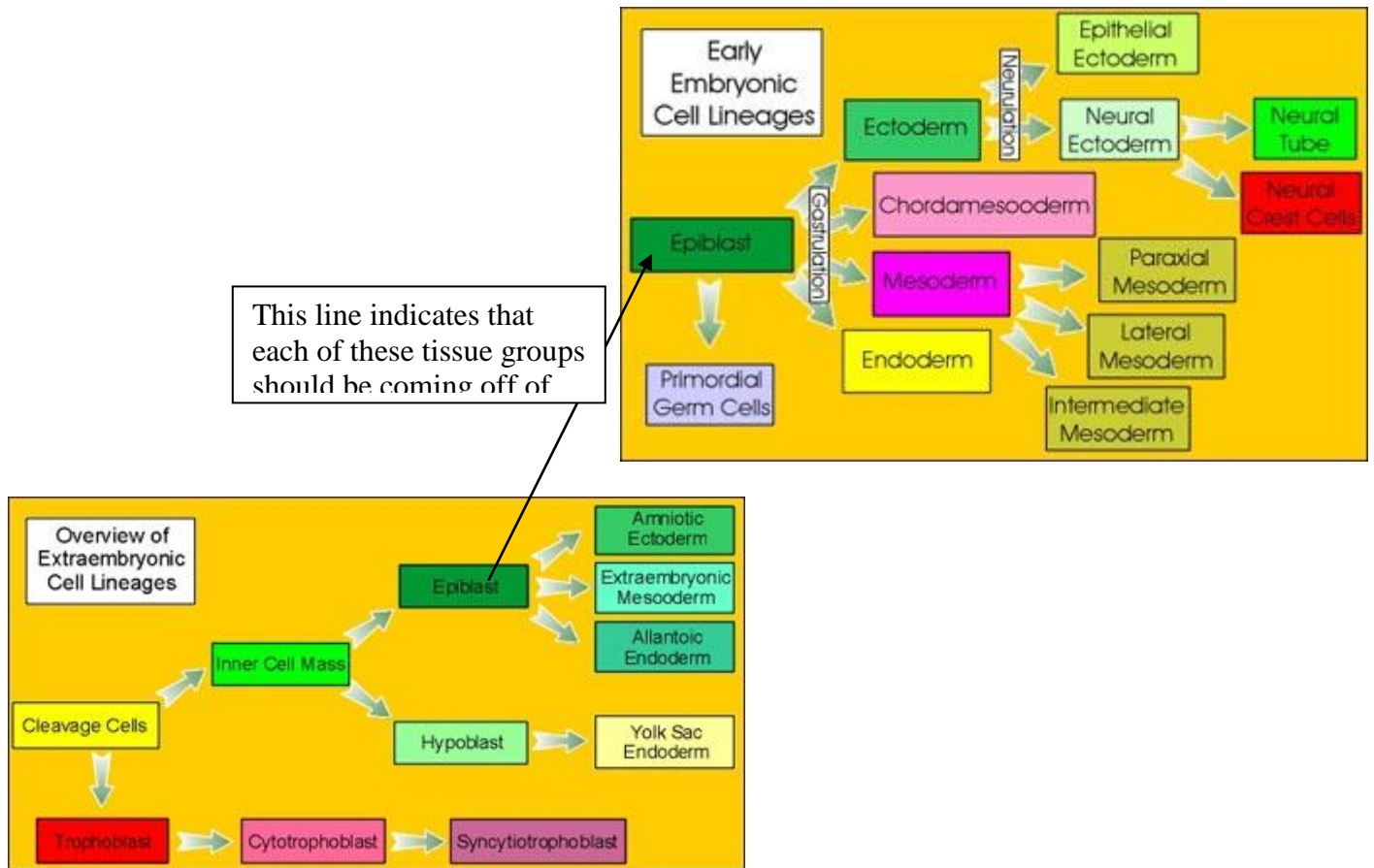
2. On a single diagram, show the cell lineages for both the embryonic and extraembryonic tissues that comprise the embryo at the end of neurulation. (30 marks)

cell lineage:

1 mark for each tissue (23 pts)

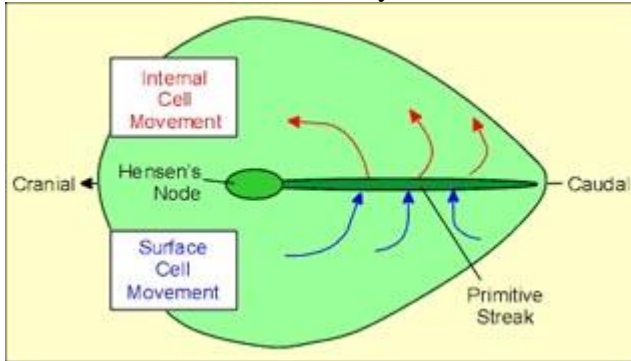
1 mark each for clarifying extraembryonic vs embryonic lineages (3 marks)

-4 marks if lineages drawn as continuous entities as shown



3. Using clear sentences or well written point and diagrams, discuss the morphogenetic movements of gastrulation and the cellular changes that are involved. Be sure to emphasize the importance of each step to future embryogenesis. (30 marks).

Gastrulation in Human Embryo



Sequence of Events (10 marks)

Epiblast is bilaminar disk

Initially cells move along surface (blue arrows) but upon reaching the center line will pile up and move internally (red arrows).

The moving surface cells first pile up to form a prominent bump known as the node. This occurs because the cells move along the top faster than they can separate off and move internally. It's sort of like crowds at a major concert. People stream into the venue from all over the city but pile up at the door before spreading out again once they're inside.

The node was discovered in mammals by Hensen and is appropriately named Hensen's node in rabbits and other organisms but is only referred to as the node in humans.

Importance of movements to future embryo (10 marks)

The cells that enter through the node will become the notochord (see lecture on neurulation).

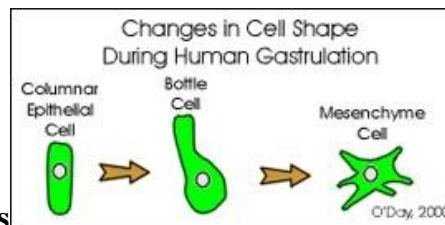
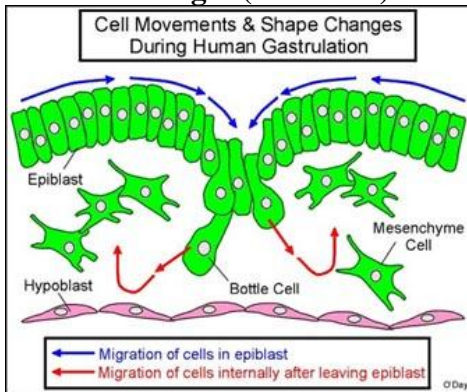
As the cells continue to move in and the primitive groove forms

The cells that migrate internally first will become the endoderm which contains the presumptive notochordal tissue as well

The cells move internally later will migrate over the endoderm and form the mesoderm

The cells that remain on the surface will form ectoderm

Cellular changes (10 marks)



Bottle Cells

- Bottle cells were first observed in amphibian gastrulation
- Occur during gastrulation in humans and many other species
- Also seen during neurulation and during other types of cellular rearrangements
- Involves a shape change from an epithelial morphology to bottle shape

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- Involves a loss of cell-cell adhesion so cells can move as individuals; recent work has shown that this is due to the loss of E-cadherin
- Experiments with frog embryos have shown that isolated bottle cells show active movement in vitro
- Cells move internally under own motive force