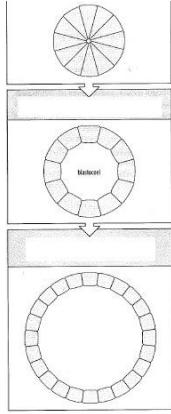


Problem Set 2

- 1) (1) In two successive embryonic cleavages, which factor(s) among the following can determine spindle orientation in the second cleavage relative to the first cleavage?
- Whether the first cleavage was meroblastic or holoblastic.
 - Whether the two blastomeres resulting from the first cleavage are unequal in size.
 - The plane in which the duplicated centrosomes migrate around the envelopes of the nuclei that form following the first cleavage.
 - Whether microtubules pull on the spindle poles to change spindle orientation prior to the second cleavage.
- 2) (1) Developmentally important proteins in the early cleavage-stage embryo (e.g. 8-cell stage) in *C. elegans* (and *Xenopus*) are
- all synthesized in the oocyte from transcripts made during oogenesis
 - partly synthesized in the oocyte and partly after fertilization from transcripts made during oogenesis.
 - partly synthesized in the oocyte from transcripts made during oogenesis, and partly after fertilization from transcripts made after fertilization from the embryo's genome.
 - mostly synthesized in the early cleavage stage cells from transcripts made after fertilization from the embryo's genome.
3. (1) In *C. elegans*, when you separate the AB and P1 cells at the two-cell stage, neither can form a complete larva. In humans, identical twins can form up to the 16 cell stage by splitting of the embryo into two separate cell clusters. Moreover, individual human embryonic cells (blastomeres) up until about the same stage can be separated and cultured individually in a dish and still make a complete embryo. What do these results suggest about differences in the characteristics of early blastomeres between humans and *C. elegans*?
4. (1.5) In experiments on *Xenopus* cleavage, you treat 1-cell embryos with a drug that completely blocks RNA polymerase II, which is required for all mRNA synthesis. Explain briefly if and how you would expect this treatment to affect the processes of cleavage and gastrulation



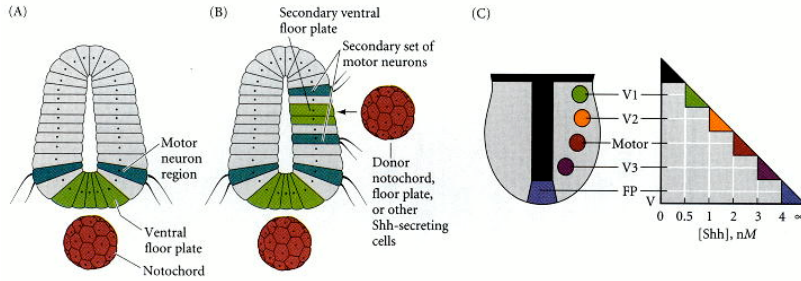
5. (1) Almost all animals form a blastocoel (a fluid-filled cavity in the middle of the embryo) of some sort in the middle of the developing embryo, usually quite early in development. The diagram shows the progression of 8 cells in a tight ball-shape to a ring of cells around the blastocoel. Describe what must be happening at each of the two steps in order to generate these changes within the embryo.

6. (.5) Which of the following are possible reasons for an embryo to have a blastocoel?
- space for future movement of cells
 - keeps cells separated that will signal each other later
 - pre-formed endodermal cavity
 - to allow for storage of nutrients

7. (1) Imagine that gastrulation is blocked in a *Xenopus* embryo. Predict one consequence for the embryo regarding the differentiation of cell types, or future morphological events.

8. (1) A cell that migrates through the dorsal lip of the blastopore at the very end of gastrulation in *Xenopus* is likely to differentiate into what kind of cell type (endoderm, ectoderm or mesoderm) and be located in what general region of the embryo?

9. (1) In the figure below (A, B) are the results of an experiment showing the effects of levels of Sonic hedgehog (Shh), secreted from notochord cells, on the differentiation of neurons in the intact neural tube. In panel C, cells from chick neural tube were cultured *in vitro* in the presence of different concentrations of Shh, then immunostained for proteins characteristic of the different types of neurons shown in the picture (e.g. floor plate=FP, Motor, etc.). The left diagram in (C) shows the positions of cells that stain for these proteins in the normal intact neural tube.



Based on the data shown in the figure (don't worry about the details of the nervous system development!!), how is it functioning in specification of neural tube cell fates?

- Shh works as an autocrine signaling molecule
- Shh works as a juxtacrine signaling molecule
- Shh works as a paracrine signaling molecule
- Shh works as a morphogen
- High concentrations of Shh dictate ventral fate
- High concentrations of Shh dictate dorsal fate

10. (1) The diagram below shows a cartoon drawing of the developing neural tube (b) and the overlying non-neuronal epithelium (a). If these cells are dissociated with trypsin into single cells and put into a cell culture system called a "drop culture", they first associate loosely together as shown in (c). A drop culture is literally a small drop of culture solution that allows the cells to associate with each other. After some time, the two cell populations separate from each other (d and e). Explain what is most likely responsible for their segregation (again think about the features of these cells that might be responsible, not details about the nervous system), and how this behavior relates to what is happening with these cells during the neurulation process in vivo.

