Developmental Biology
3090-01
Week 5, Tuesday
9/23/14

## Lecture 9) Patterning the Vertebrate Body: Germ Layer formation

(Slide numbers start with the slide after the outline slide)
First some dropped exam questions! Everyone got the points for these questions.

1) Which process is most responsible for endoderm formation ending up on the inside of the embryo?

Answer is C, epiboly. Epiboly is the process of surrounding the embryo, which results in the endoderm being on the inside.

2) A genetic screen _____.

Answer is B: involves random mutagenesis of the genome.

3) Which describes a region of an embryo that is derived from a common cell lineage?

Answer is E: Two of the above are correct. Compartment and Parasegments were both correct answers, so E is the appropriate response.

4) Each pair rule gene is expressed in _____ segments in adults.

Answer is A: 0. Parasegments are expressed for a finite time in the developing embryo, but are not expressed in adults.

Slide 1: Zygotic Gene expression is Turned On at the Mid-Blastula Transition

Incomplete: Cell cycles become asynchronous. This slide deals mostly with drosophila and xenopus, not vertebrates! The ratio of cytoplasm to DNA is what regulates this. It is **not** about the cell counting the number of divisions. Zygotic gene expression happens very early in mammals- no maternal effector genes.

Clicker Question!

What would happen to the Mid-Blastula Transition (MBT) if more DNA was present in the cells?

a) it would occur later
b) it would occur earlier
c) timing would not be affected

d) I don't know

The answer is B: it would occur earlier. More DNA would lower the ratio of the repressor to DNA, so it would hit the threshold faster.

Slide 2:

Incomplete: Label individual cells by injecting a fluorescent dye. By injecting this dye, we can follow the progression of the cell and its progeny (shown in the second image). The fate of a cell can be changed.

Slides 3 and 4 show key images of fate maps. Fate maps in vertebrates are similar, even in humans.

Clicker Question!

How do you study the state of determination of a cell?

a) culture in isolation
b) label with fluorescent dye
c) kill cell and observe embryo
d) transplant the cell to a different location in another embryo

Answer is D: transplant the cell to a different location in another embryo. B may look like a good answer, but this only allows us to follow the course of the cell and the progeny. It doesn't tell us the state of determination. To do this, we need to transplant the cell to another area and see what happens.

Slide 5:

-mice: change the number of cells in early embryo (missing). Take blastomeres of two mice (making it twice as large) and you still get a normal mouse.

-humans: monozygotic twins, and PGD (missing). We can pull cells out of an embryo for pre-implantation for genetic diagnosis (PGD). This is testing for in vitro procedures prior to implantation to see if the embryo will have a genetic condition or be a carrier of one. This also allows for early detection of the sex of the embryo- this is where the ethics get a little complicated. Theoretically, parents could choose the embryos that would be healthy, but then also whether they wanted a male or female embryo. Another ethical issue is that some parents who are both deaf selecting for a child that is deaf (instead of hearing) so that the child will grow up in an environment and have experiences similar to the parent's growing up. Is this right? Should we allow it?

Slide 6: These signals are soluble and secreted. Induce different cell development.

Slide 8: Shows multiple signals coming from the ventral region.

Missing bullets:

- Induce mesoderm (Xnrs)
- Pattern Mesoderm (BMP4)
- Inhibited by signals from the organizer (noggin and chordin)

This slide is very helpful in understanding the patterning process.

Slide 9: Spemann Organizer

Incomplete: dorsalizes mesoderm.

Dorsalizes ectoderm.

Slide 10:

Missing bullet: factor and its receptor must be in the right place at the right time.

Slide 11: Be aware of this slide and its pathways for the next exam!

The receptors are Serine (S) / Threonine (T) kinases.
Smad4 (Co-smad) acts with others to form transcription complexes and transcribe genes.

BMP: Bone morphogenic protein.

Slide 12:

Missing bullet: defective receptor "soaks up ligand". The right side of the image shows the pathway with a missing cytoplasmic region. Without this there is no signal!

Slide 13:

B catenin also stimulates Xnr → dorsal/ventral patterning, rotation of molecules in B catenin pathway.

Slide 14: This is a good summary slide (along with slide 8!)

Slide 15: Two missing bullet points on this side.

First is: promotes ventralization of the mesoderm

Second is: dorsalizing factors Noggin and Chordin

Slide 17: dpp: Dorsal side in xenopus, but ventral side in drosophila. Sog is homologous to Noggin.