Developmental Biology
3090-01
Week 4, Tuesday
9/16/14

Lecture 7) Patterning the Vertebrate Body: Axis Formation

This is the last lecture that will be covered on the exam, which is this Thursday (9/18/14)!!

Discussion questions for the last postings.

Yolk sac in mammals- what happens to it? Mammals do have a small yolk sac early in development. It receives blood flow and passes nutrients to the embryo. The yolk sac gets continuously smaller and the placenta develops.

Parasegments vs. segments: Parasegments are defined by gene expression (particularly pair ruled genes). They aren't actually visible structures. They are precursors of segments. For a brief period of time, parasegments and segments overlap in the developing organism, so this is how it is known that they do not line up with each other.

Clicker Question!

Do embryos at the phylotypic stage look similar in all species?

a) yes
b) no

The answer is no. Key words here being all species. The phylotypic stage deals mainly with vertebrates.

Slide 1: (Mouse Life Cycle is slide 1 here)

The wingless pathway: Deals with dorsal-ventral development, specifically future dorsal side.

Mice eggs are very tiny and don't have much yolk. There are 2 new steps in this cycle that we haven't seen yet: 1) Implantation- this is when the fertilized egg implants on the mother's uterus and 2) turning- this one we don't need to worry about.

Fetal: This is a new word that we haven't used yet in terms of development. The developing organism is first referred to as an embryo, then after a point is called a fetus.

For mice, birth is 18 days after fertilization (which also makes them poor candidates for genetic screening).

Slide 2: Mammal cell division is slow and asynchronous compared to the organisms we studied previously.

Missing bullet: early cleavage stage embryo (solid ball of cells). Clustered cells adhere tightly together so that more of their surface area is touching.

In mammals we use the term blastocyst (make sure to keep these terms straight for which organism they match with. Blastocyst for mammals, blastoderm for chicks, and blastula).

Inner cell mass: These cells will give rise to the embryo (in the picture, this is the top section of the right most picture). The inner cell mass consists of embryonic stem cells. These are what we are talking about when we are referring to stem cell treatment.

Trophectoderm: These cells completely surround the structure in the right most picture. They form the extra-embryonic structures.

At the blastocyst stage, these cells are no longer totipotent. They can only give rise to their specific structures now. Before this point, they were pluripotent. This can be tested using a transplant experiment- taking cells and implanting them in a different embryo to see how growth proceeds. Helps to determine developmental potential.

Slide 3:

Missing bullet: argues against importance of maternal determinance

This slide illustrates the transplant experiment.

Slide 4: large cluster of cells taken. Mixture of coat colors (yields chimeric animal). Shows regulative development nature in mammals.

Slide 5: Monozygotic twins: technical term for identical twins.

-even if you take some cells out (split the inner cell mass), normal embryos form. This is evidence for regulative development in humans.

Slide 6: This diagram shows one half of the female reproductive system in humans (one ovary, part of uterus). The sperm travel up the oviduct to meet egg that has been released. Once the blastocyst forms, it implants in the uterus (takes about 7 days).

Missing bullet: Placenta: Structure formed in uterine wall where blood systems of mother and embryo interface to exchange nutrients and waste products.

Uterus is large muscular structure- it must be strong to push out a fully developed baby. Most animals eat the placenta after birth (parents, or other adults- not the newborn) because it is very rich in nutrients (even some human cultures practice this).

Ectopic pregnancy: This occurs when the blastocyst stops traveling down the fallopian tube, and implants in the tube. The embryo develops there instead- usually painful to the mother and is removed.

Slide 7: This cup-like shape is peculiar to rodents; most mammals develop in a more chick like manner- flat, disc shape.

Slide 8:
Missing bullet: Node: equivalent to Spemann organizer region (frog).

Clicker Question!

The cells of the inner cellular mass:

a) are totipotent
b) are pluripotent
c) form strictly extra-embryonic structures
d) form only the digestive tract

Answer is B!

Slide 9: This slide is specific to xenopus!!

Incomplete bullet: Sperm entry occurs anywhere in the animal hemisphere.

Ventral: This is where the sperm enters on the animal side. The dorsal section forms directly opposite of the entry site.

Incomplete bullet: Maternal factors become relocated opposite site of sperm entry.

Wnt pathway molecules are the ones moving (wnt is the generic/mammalian/vertebrate term for wingless. They are the same pathways).

Slide 10: The orange ball is wnt, the yellow receptor is frizzled, and the green ball is beta-catenin. These are the ones we have to know.

Active pathway: Degradation of beta-catenin is prevented, and it enters the nucleus. It binds TCF and acts as a co-factor for transcription (dorsal).