

Developmental Biology
3090-01
Week 6, Tuesday
9/30/14

Lecture 10) Patterning the Vertebrate Body: Neural Inuction

Its my own opinion that even if you are using a print out of these notes, it would be extremely helpful to print them in color or use them on blackboard as well. Its really helpful to be able to distinguish colors in this lecture.

Remember that molecules don't strictly have one function in an organism. TGF beta for example functions in development and is found in different pathways later in an organisms life. What is key is that TGF beta is not functioning in this pathways at the same time. These events must be separated by time and space.

Also, somite cells are multipotent. This means that the somite cells are not pre-decided to which one will form the myotome, dermatome, etc...

The sclerotome is the region of the somite that develops into vertebrae and ribs (cartilage).

Slide numbers start with *Major Lineages of the Amniote Mesoderm* as slide 1.

Slide 1: Amniote is referring to mammals and reptiles, or any organism that develops with an amniote.

For the intermediate mesoderm, the example to remember is the kidneys. Gonads won't be important.

There are three arrows leading off somite. The blanks here are: sclerotome, myotome, and dermatome.

The splanchnic and somatic are only distinguished when the lateral plate mesoderm develops in two layers. The splanchnic gives rise to the blood and heart. The somatic gives rise to the limbs and abdominal wall.

Slide 2:

(incomplete) Invert new somite: still develops normally (early somites are not developed yet).

(incomplete) Graft an extra notochord: dermomyotome is inhibited and more sclerotome (cartilage) is produced.

An important note: when we say here that early somites are not determined, we mean that they are not determined to which cell will form muscle or bone. They ARE determined with respect to their anterior/posterior identity.

Grafting a notochord induces developmental issues, and so does removing the notochord!

Clicker Question!

Somatic mesoderm gives rise to _____.

- a) heart
- b) somites
- c) notochord
- d) kidney
- e) limbs

Answer is E! Also gives rise to the abdominal cavity.

Slide 3:

(incomplete) sonic hedgehog is the signal from the notochord and floor plate.

Sonic hedgehog is the vertebrate version of drosophila's hedgehog gene (remember hedgehog is a segmentation gene). It was named because they ran out of types of hedgehogs for the multiple homologous genes they discovered, and they decided on sonic.

Slide 4: Neural tube is the source of neurons and glial cells. The vast majority of neurons come from the neural tube, but we can not technically that ALL of them come from this.

Also, the light blue region that is shown is the neural ectoderm folding to form the neural tube.

Slide 5:

(incomplete) Mid gastrula grafts induce trunk and tail, but no head.

(incomplete) Late gastrula graft induces just the tail.

The left image shows early development where the another head structure is induced. Mid is not shown. The right image shows late development where just a tail structure is forming.

Slide 6:

(incomplete) Cerberus: involved in the induction of the anterior (head) structures.

Inducing too much Cerberus can cause multiple heads. Inducing it in the wrong spot can cause heads in inappropriate areas of the developing organism.

However, two headed creatures that you might see in the world (snake, turtle, etc...) are not a result of too much Cerberus being expressed. These creatures normally result from twins that are developing becoming conjoined.

Slide 7: This slide shows more transplant experiments. On the left there is fate mapping being done.

Slide 8:

(missing) Default is for ectoderm to form neural tissues.

Slide 9: (This slide is NOT in the new edition of the text) The upper left image shows a chick embryo. Lower right is the xenopus embryo. Box C at the top of the primitive streak (which tells us it's a chick embryo) is showing Hensen's node. On the right shows a northern blot test. Northern blot tests work with RNA. It shows us that taking cells from Hensen's node is the only way to induce the desired result. A and B don't work.

Southern blot tests use DNA instead of RNA. There is also a western blot.

Clicker Question!

What is/are the function(s) of BMP-4?

- a) dorsalize membrane
- b) induce epidermis
- c) induce neural tissue
- d) all of the above
- e) two of the above are correct

Answer is B! BMP-4 induces the epidermis. But the induction of neural tissue occurs by noggin and chordin inhibiting BMP-4.

Slide 10: Rhombomeres are developmental units of the same genes They are also compartments.

Only the hindbrain is segmented. It is involved in basic functions, such as breathing and maintaining blood pressure.

Slide 11: Can see on the right here how everything is in compartments. Its not on the left.