

Problem Set 3

Development of dorsal structures in *Xenopus*. For each given experiment (questions 1-4), select the best single outcome (a-c) from the choices below.

- a. The embryo does not develop any dorsal structures
- b. The embryo develops normally
- c. The embryo develops extra dorsal structures

1. (.5) Brief UV irradiation at the 4-cell stage.
2. (.5) Brief UV irradiation just after fertilization, followed by transplantation of a ventral vegetal blastomere from a normal 32-cell embryo onto the dorsal vegetal side of the irradiated embryo at the 32-cell stage
3. (.5) Injection of Disheveled into the ventral cells of a normal 32-cell embryo.
4. (.5) Brief UV irradiation just after fertilization, followed by transplantation of a dorsal vegetal blastomere from a normal 32-cell embryo onto the ventral vegetal side of irradiated embryo at the 32-cell stage.
5. (1) Which of the following is the way in which Wnt pathway components establish dorsality in *Xenopus* embryos?
 - a) The fertilizing sperm brings in a Wnt ligand, which through a Frizzled receptor activates cortical Dishevel molecules on the opposite side of the embryo.
 - b) Activated Dishevel is moved to the ventral side by cortical rotation.
 - c) Activated Dishevel turns on GSK3, which phosphorylates β -catenin.
 - d) On the ventral side, phosphorylated β -catenin blocks formation of an organizer region.
 - e) Non-phosphorylated β -catenin ultimately activates synthesis of the organizer-specific transcription factor Goosecoid.
6. (2) Up to the 12th cell cycle, the *Drosophila* embryo is syncytial (nuclei share a common cytoplasm). If you poke a hole in the anterior end of a fly embryo up to the 12th cell cycle, and allow some cytoplasm to leak out, some anterior structures will be missing in the resulting larva. If you do the same at the posterior end of the fly embryo, the larva will be missing posterior structures. If you replicate this experiment in *Xenopus*, destroying some cells at either the approximate future anterior or posterior ends of the *Xenopus* embryo, just prior to gastrulation, explain the results you would expect to see.

7. (2) Localization of molecules that specify cell fate and cell movements in the chick embryo is quite similar to those in *Xenopus*. Based on the picture below, predict where the following molecules would be localized in the chick embryo at the onset of gastrulation (ignore the extraembryonic mesoderm, as it does not exist in *Xenopus*). Match the regions to the molecules

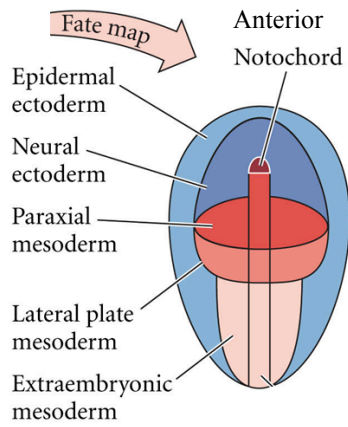
molecules:

- high levels of Nodal (equivalent to Xnr in *Xenopus*)
- low levels of Nodal
- BMPs
- chordin (bound)

regions:

- notochord (dorsal mesoderm)
- lateral mesoderm
- paraxial mesoderm
- neural ectoderm
- epidermal ectoderm

Anterior is at the top.



8. (2) If you have isolated a molecule from chick embryos that you suspect is involved in the induction of mesoderm in this embryo (similar to *Xenopus*), what two experiments could you do to prove that your candidate molecule is required for mesoderm induction in the normal embryo?

9. (1) The organizer and the Nieuwkoop center are both inductive centers in the early *Xenopus* embryo. Compare the role of each in the development of dorsal structures in the embryo by explaining a. the time at which each center is "active", and b. the molecules present in the cells that define their role.