BIOL 369: DEVELOPMENTAL BIOLOGY
LEARNING OBJECTIVES FOR UNIT ONE

1. Be able to list the types of characteristics that make an organism ideal for the study of developmental biology. Some of these traits may be the same ones that make an organism ideal for genetic studies, but several species ill-suited for traditional genetic studies have other compensating features that are helpful to developmental biologists. Similarly, not all genetic models are great models for the study of development (e.g. yeast).

2. Know the broad phylogenetic relationships of animal phyla and some of the traits used to support our current understanding of these evolutionary relationships (e.g. diploblasts vs triploblasts, deuterostomes vs protostomes {ecdysozoa and lophotrocozoa}, radial vs bilateral symmetry).

3. Be familiar with the events that lead up to and comprise the process of fertilization. Be able to discuss the critical contributions of the sperm and the egg to the zygote, and how structure informs function. Be able to describe the mechanism of the acrosomal reaction and understands its function. Be able to describe the mechanisms responsible for the fast block and slow block to polyspermy during fertilization in sea urchins; know the mammalian equivalent mechanisms.

4. Be able to draw the first four rounds of cell division of the sea urchin embryo. Understand how the planes of cell division relate to cell fate specification. Be able to label macromeres, mesomeres, and micromeres and know which cell types are derived from each of these cell layers in the early embryo (e.g. primary and secondary mesenchyme, ectoderm, endoderm, mesoderm).

5. Be able to describe the stages and cellular mechanisms (ingression, invagination, convergent extension) of gastrulation in the sea urchin. Be able to describe the functions of gastrulation.

6. Be able to describe in general terms how vertebrates gastrulate (frog, fish, chick, and mammal). Be able to compare and contrast the process of gastrulation in the various model organisms discussed during this unit.

7. Understand the role of the Nieukoop center and the Spemann-Mangold organizer in frog development. Know the equivalent tissues in fish and chick embryos. Be able to describe experiments that demonstrate the inductive functions of these tissues. What are some of the “organizer” molecules? Are there ventralizing inductive signals?

8. Be able to describe how cortical rotation in the frog sets up the dorsal-ventral and anterior-posterior axes of the frog. Be familiar with the genetic pathway involved and be able to predict the effect on development of mutations in this pathway.

9. Understand the difference between specification and determination. Be able to describe experiments that would help you distinguish between when a cell has become specified and when its fate has become determined.

10. Know the difference between autonomous versus conditional modes of specification. Mechanistically, how do these two modes differ? Be able to provide examples of each and experimental approaches that would help you to distinguish between the two.

11. Be able to categorize experiments (both classical and modern) into “FIND IT”, “BLOCK IT”, and “MOVE IT” categories. Understand how “FIND IT” experiments can establish correlations, whereas the other two can help establish causation. Be able to distinguish between experiments that show necessity and those that show sufficiency. Be able to design a set of experiments that will demonstrate whether a proposed factor is both necessary and sufficient to cause a developmental event.