Genetic basis of development NOTES

I. Overview of development

zygote adult

The transformation from a zygote to a multicelled organism involves a series of “_______
______________” that regulate a _____________ of developmental events

Developmental Genetics:
Concerned with the roles genes play in orchestrating the changes that occur during
development.

__________________: fruit fly, nematode, zebrafish, frog, mouse

A. Development: process by which a single cell becomes a multicellular organism

development involves:
✓ fertilization: sperm and egg unite to form zygote
✓ cell division: increase in number of cells (mitosis)
✓ cell differentiation: cells become
✓ morphogenesis: formation of

SUMMARY TABLE 21.1 Five Essential Developmental Processes

B. Stem Cells
• A cell that can divide many times (__________) for long periods and under the right
  conditions can ____________(differentiate) to many different types of cells.
  – Can potentially develop into mature cells with specialized functions, i.e. heart cells,
    nerve cells or red blood cells

• Embryonic Stem Cells = Undifferentiated cells that are “blank slates” with the capability
to transform into ________ cell type
  – Differentiate into cells derived from ____________ embryonic germ layers –
II. From a single cell to a multi-celled organism.

Cleavage
In the very first steps after fertilization, the zygote divides rapidly to form a hollow ball of cells known as a ________________

The second phase involves the movement or reorganization of cells to form three layers which will eventually give rise to the exoderm, mesoderm and endoderm.

Organogenesis
As development continues, further differentiation occurs as cells become destined to

Growth & Maturation
Finally, the organism achieves its completely differentiated state.

B. Determination & Differentiation
- Determination = the cell’s fate is defined, early changes in the cell ________________
  – Tissue-specific genes are turned on setting off cascade
- Differentiation = cells become
- Differential cell types of the body are distinguished by the ________________ of protein that they express
- ________________is the fundamental level control during development
  (controlled primarily by ________________)

Determination & differentiation of muscle cells
C. Sources of developmental information: 
1) maternal factors in cytoplasm, 2) signal molecules from neighboring cells.

III. Pattern Formation
Pattern formation = specific spatial organization of cells to provide the proper 3D arrangement of parts
- _______________ control position arrangement of proteins which determines the basic body plan of the organism
- Exemplified in *Drosophila*

A. *Drosophila* developmental gene groups, encode ____________ that act on other genes in the developmental pathway:
- Maternal genes
  - Expressed during __________ by the __________, establish body axes
- Segmentation genes
  - Expressed __________ fertilization, affect number or polarity of a segment
- Homeotic genes
  - Control the __________ of a segment

http://www.youtube.com/watch?v=c8BAfkQdMic
Cascade of gene activations involved in development

Homoeosis:

A bithorax triple mutant homozygote (3 genes in BX-C) transforms T3 into a second copy of T2

B. Pattern formation __________________________, shared common ancestry.
Clusters of Hox genes occur in virtually every animal examined, including humans.
This indicates that at least some of the molecular mechanisms of pattern formation have been __________________________ during animal evolution.
Although animal bodies are diverse in size and shape, the underlying mechanisms responsible for development are similar.
C. Changes in Developmental Pathways

IV. Apoptosis – programmed cell death

- Normal, _____________ process whereby cells undergo a series of events that leads to Development relies on apoptosis
  - i.e.

All cells die using the same genetic pathway in *C. elegans*:
- *ced-3* & *ced-4* (expression results in death)
- controlled by ___________, (binary switch gene for apoptosis)