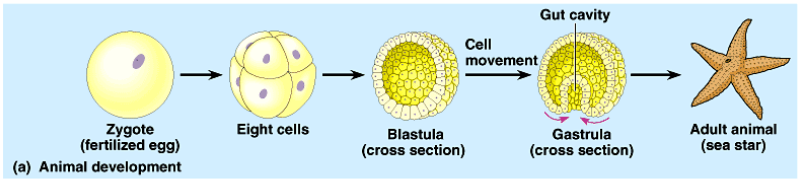
AP Biology

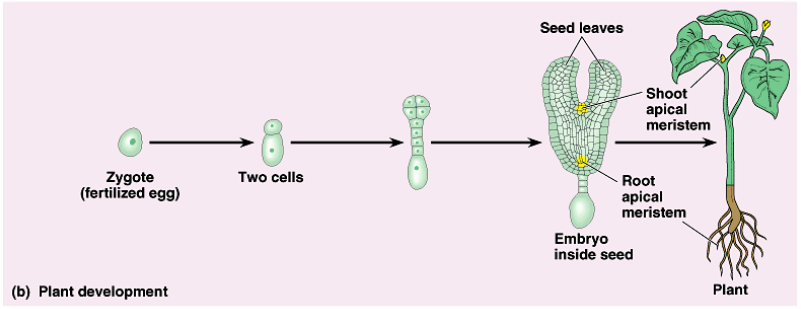
Outline Ch. 21 - THE GENETIC BASIS OF DEVELOPMENT

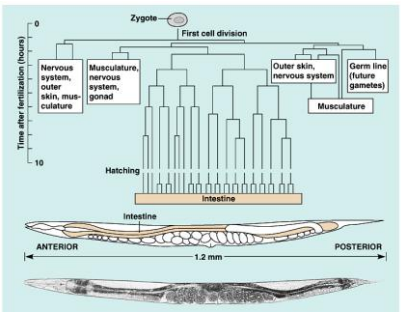
I. From Single Cell to Multicellular Organisms

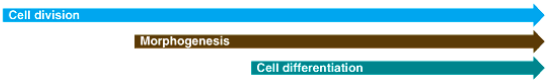
A. Embryonic development involves
   1. cell division,
   2. cell differentiation
   3. morphogenesis
      1. Apical meristems

B. Researchers study development in model organisms to identify general principles







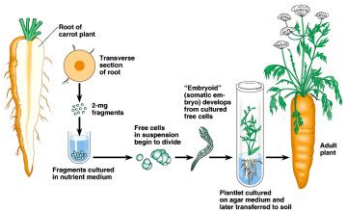


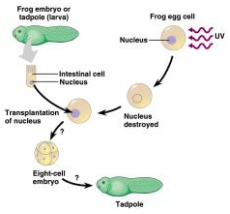
Question 21.1 What are some of the important criteria for model organisms chosen for the study of developmental genetics?

II. Gene Expression

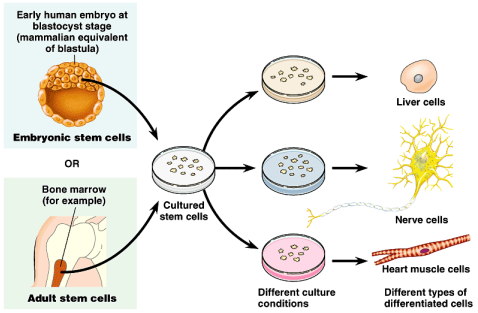
A. Different types of cells in an organism have the same DNA

1. Totipotency in Plants
   a. Cloning
   b. Totipotent



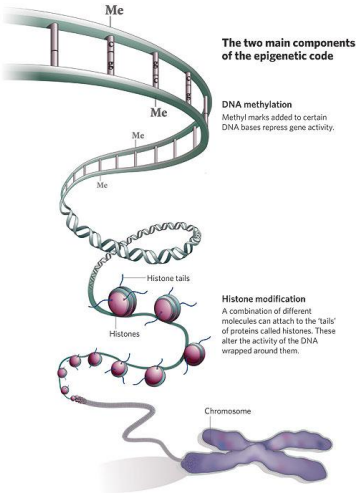


Differential



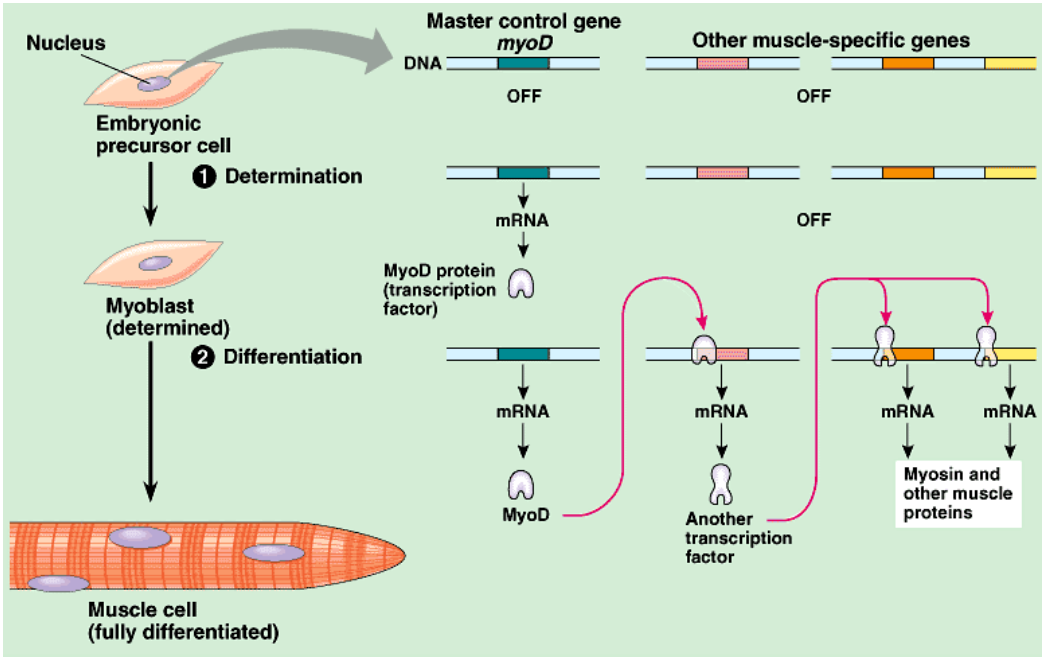
2. Nuclear Transplantation in Animals

3. The Stem Cells of Animals



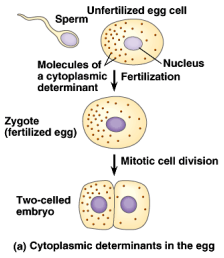
Question 21.2 Although numerous mammals have now been cloned successfully, only a very small percentage of cloned embryos develop normally. What is a likely cause of this development failure?

B. Different cell types make different proteins, usually as a result of transcriptional regulation
    1. Determination
    2. Tissue specific proteins

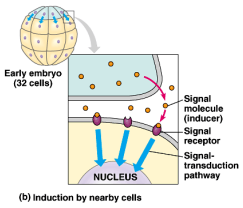


Question 21.3 The MyoD protein has been shown to be able to transform some, but not all, differentiated cells into muscle cells. Why doesn't it work on all kinds of cells?

C. Transcriptional regulation is directed by maternal molecules in the cytoplasm and signals from other cells
    1. Cytosplasmic determinant
    2. Induction



(a) Cytoplasmic determinants in the egg



(b) Induction by nearby cells

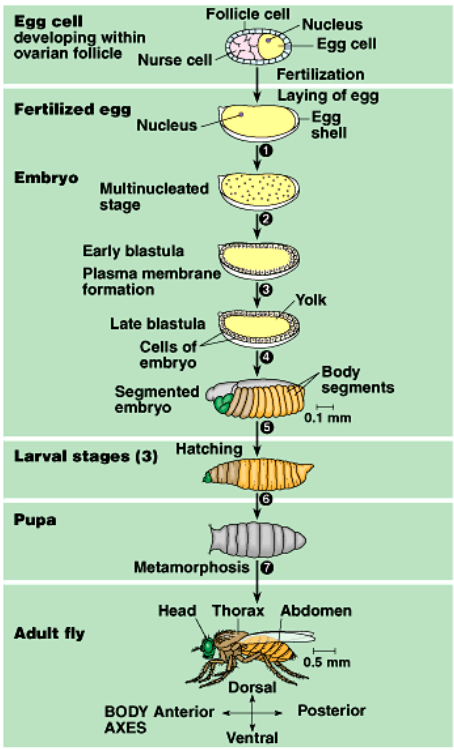
III. Genetic and Cellular Mechanisms of Pattern Formation

A. Pattern formation

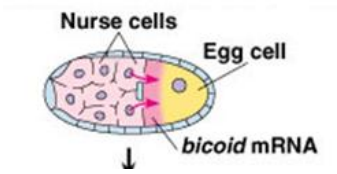
B. Positional information

C. Genetic analysis of Drosophila reveals how genes control development

1. The life cycle of Drosophila
   - Edward B. Lewis – detailed development
2. Genetic Analysis of Early Development in Drosophila using "Lethal Genes"
   - Christiane Nüsslein-Volhard and Eric Weischaus – linked genes (1200) to specific developmental events. (Nobel)



D. Gradients of maternal molecules in the early embryo control axis formation



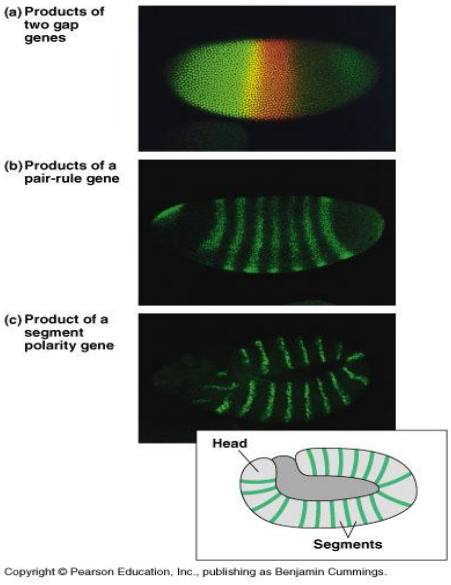
1. Maternal effect genes – mRNA's inserted into egg by mother before fertilization. Lopsided
2. Egg-polarity genes - because they code for front / back of embryo
3. Morphogen- Gradated dist. Of proteins (from polarity gene) in fertilized egg. At mitosis, one daughter cell gets more. These will become anterior.

Question 21.4 In saturation screening for mutations affecting development, the phenotypic effect of a maternal effect gene does not show up in the F1 or F2 generations, but is seen by studying the F3 generation, in which some of the offspring die as embryos. Explain these results.

E. A cascade of gene activations sets up the segmentation pattern in Drosophila

1. Segmentation genes
2. Gap genes
3. Pair rule genes
4. Segment polarity genes

F. Homeotic Genes direct the identity of body parts



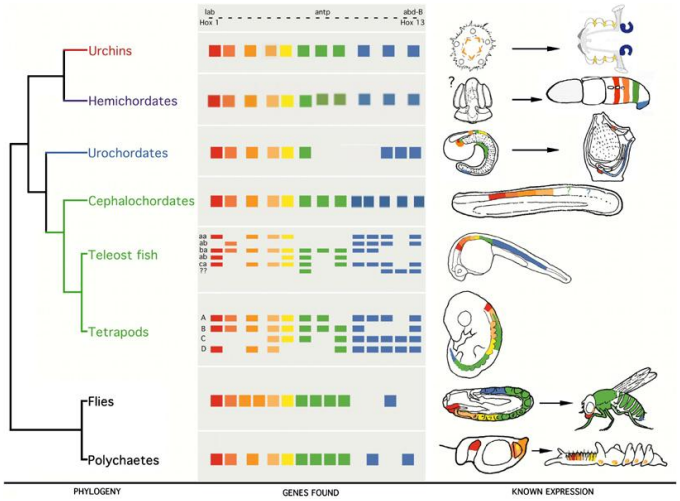
Question 21.5

a. What could cause mutant fly embryo to develop two tail ends but no head?

b. What could cause a mutant embryo to have half the normal number of segments?

c. What could cause a fruit fly to have legs growing out of its head in place of antennae?

G. Homeobox genes have been highly conserved in evolution



Question 21.6 In *Drosophila*, Homeobox sequences have been found not only in the Homeotic genes, but also in the egg-polarity gene *bicoid*, in several segmentations genes, and in the master regulatory gene for eye development. Is this just a coincidence? Explain.

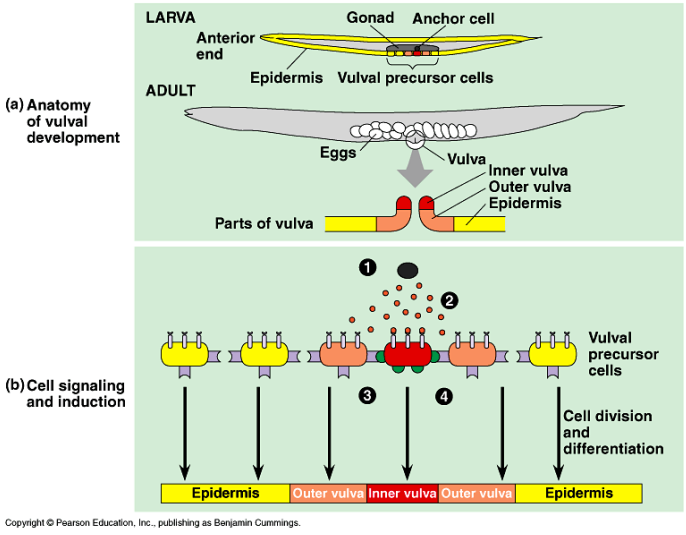
H. Neighboring cells instruct other cells to form particular structures: cell signaling and induction in the nematode

Question 21.7 The study of vulval development in *C. elegans* supports the following generalizations regarding the role of induction in development:

a. The pathway to organ formation often follows a series of steps that involve _____.

b. The effect of an inducer on its possible target cells often depends on the _____ of the inducer.

c. Inducers often initiate _____ in the target cell that lead to _____ _____ of important developmental genes.



I. Programmed Cell Death (Apoptosis) See video

Question 21.8

a. What can one conclude from the fact that the apoptosis genes of nematodes and mammals are similar?

b. Give some examples of programmed cell death in humans.

J. Plant development depends on cell signaling and transcriptional regulation

1. Cell signaling and flower development
2. Chimeras

3. Organ identity genes in plants