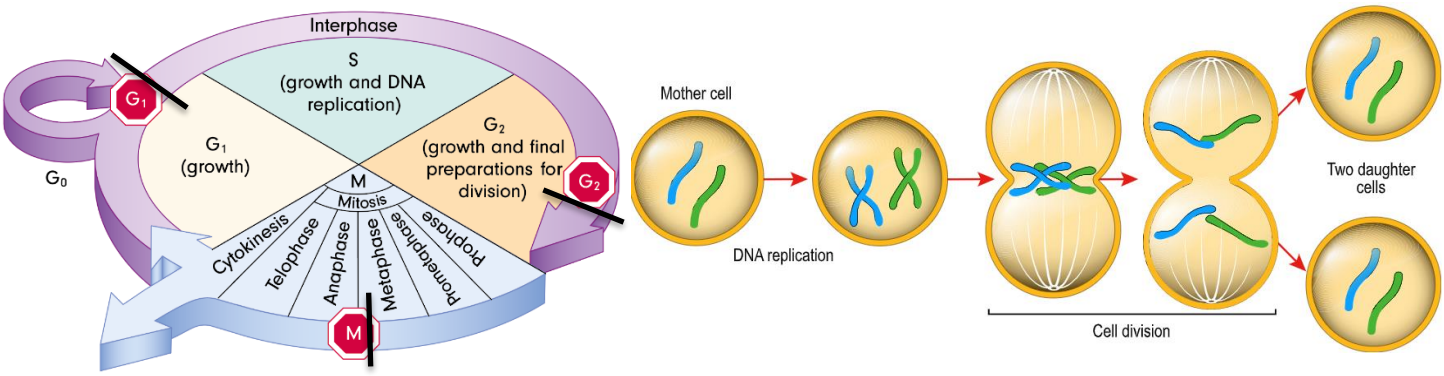
CONCEPT: OVERVIEW OF DEVELOPMENT

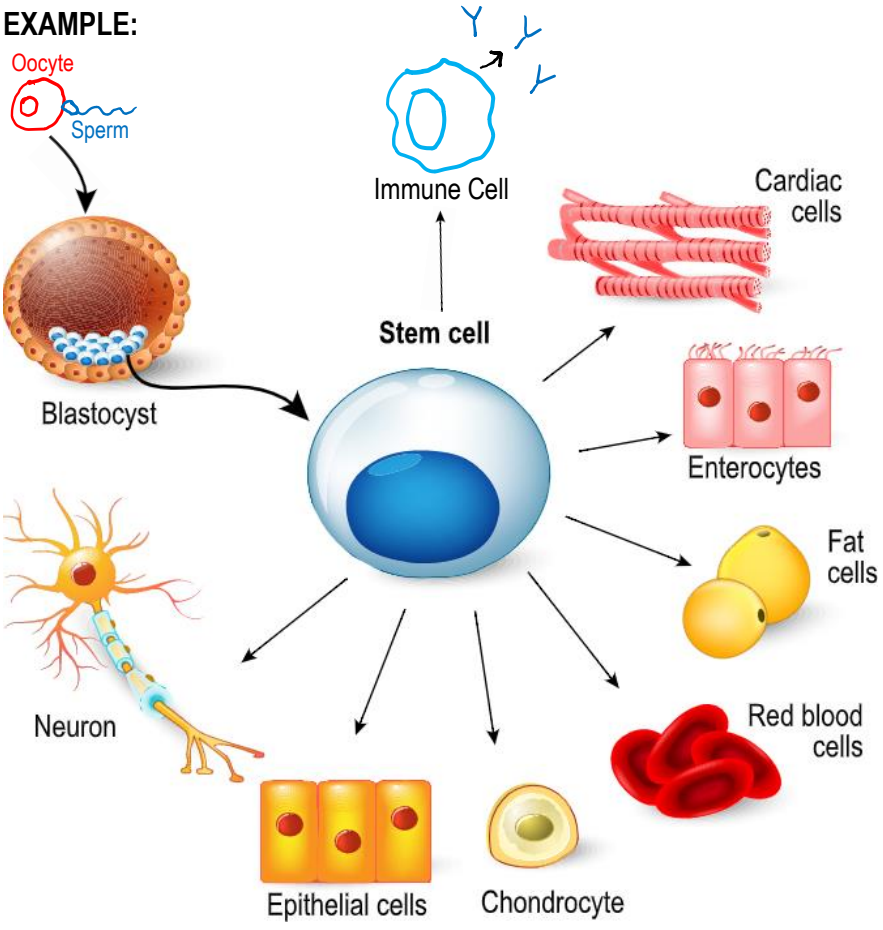
- Certain processes are common to the development of multicellular organisms:
- Cell division – the timing and location of cell division is crucial to proper development and is highly regulated
    - □ Mitotic regulation involves checkpoints and social control

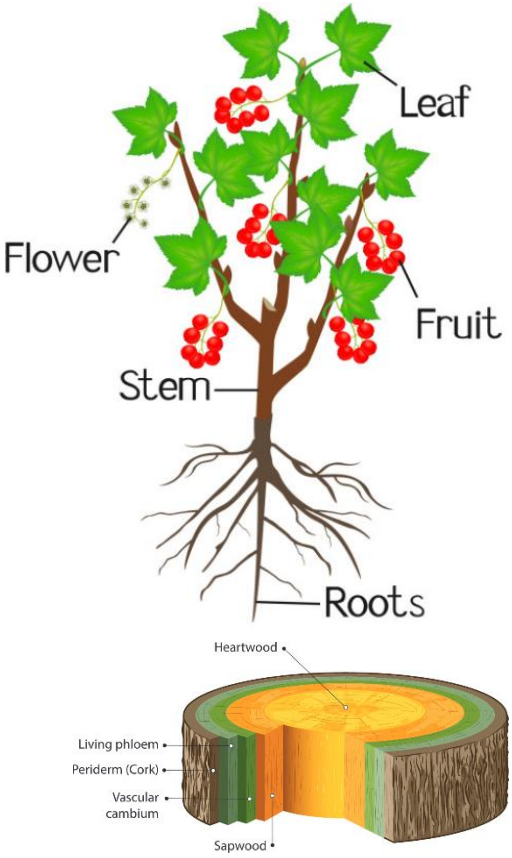
EXAMPLE:



- ***Cell differentiation*** – the process of becoming a specialized type of cell
    - □ ***Cell fate*** – what a cell will become in the course of development
- ***Stem cells*** – undifferentiated cells
    - □ ***Meristems*** – stem cells in plants located at areas that continue to develop throughout the plants life
    - □ Animals use stem cells to repair wounds, replace cells, and to create cells of the immune system

EXAMPLE:





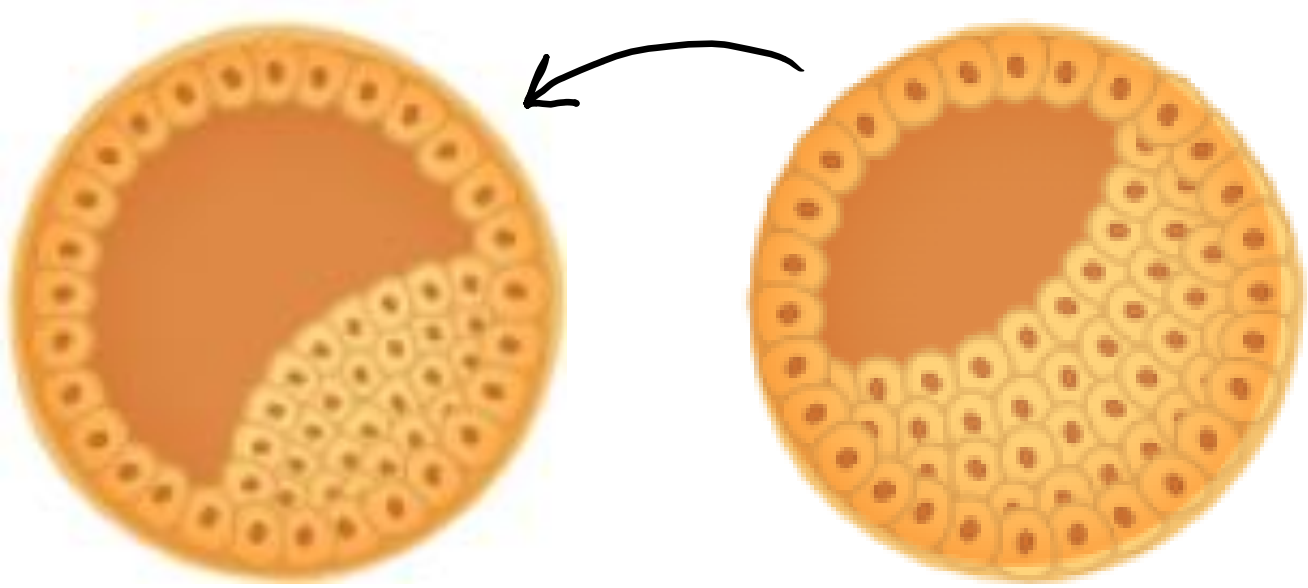
CONCEPT: OVERVIEW OF DEVELOPMENT

- Cell-cell interactions – cells signal other cells to move, divide, differentiate, and die
    - □ Differentiating cells can induce differentiation in nearby cells

EXAMPLE:

- Some cells must move around, rearranging their positions, or breaking away to move to an entirely new location
- Plant cells can expand their size to cause changes in the shape and form of a plant

EXAMPLE:



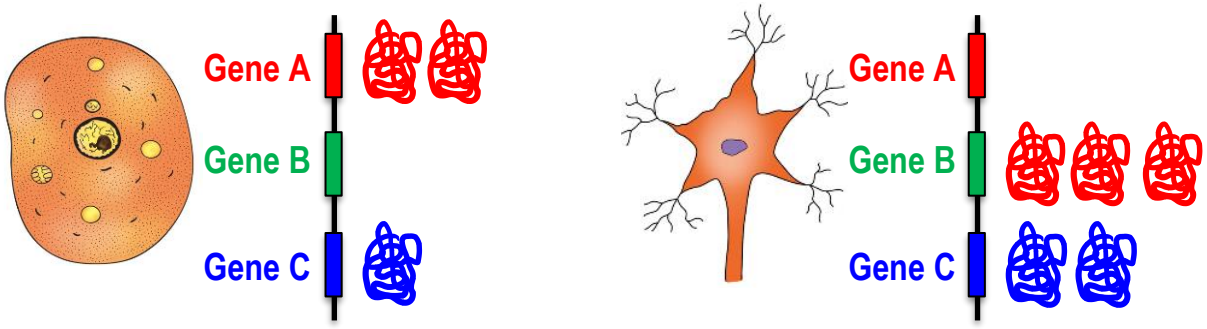
- Programmed cell death is an important part of development
    - □ Apoptosis is the most common type of cell death in animal development

EXAMPLE:

CONCEPT: OVERVIEW OF DEVELOPMENT

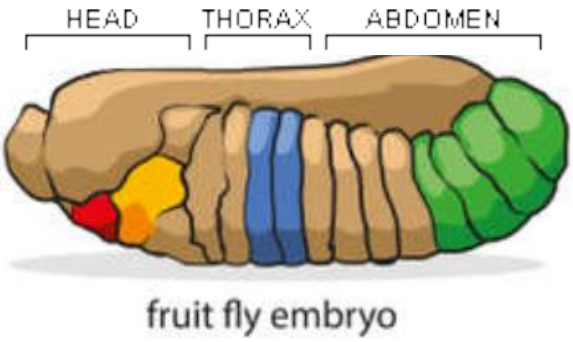
- ***Differential expression*** – different patterns of gene expression in different types of cells lead to their differentiation
  - □ Cell differentiation results from differential expression, not changes in genetic makeup
  - □ Chemical signals cause differential gene expression
  - □ Gene expression patterns are modulated by:
    - transcriptional regulation, RNA splicing, translational regulation, and post translational modification
  - □ Regulatory transcription factors used by eukaryotes to influence transcription
- ***Genetic equivalence*** – cells have the same genes

EXAMPLE:



- ***Pattern formation*** – complex organization of cell fates in space and time, controlled by genes
- ***Morphogen*** – molecule used to indicate cell position via concentration gradient during pattern formation
  - □ Morphogen concentration is highest around the cells emitting them, and decrease over distance
  - □ Cells respond to local concentrations of morphogens to produce specific responses, and achieve specific fates
  - □ Morphogens set up the major body axes

EXAMPLE:

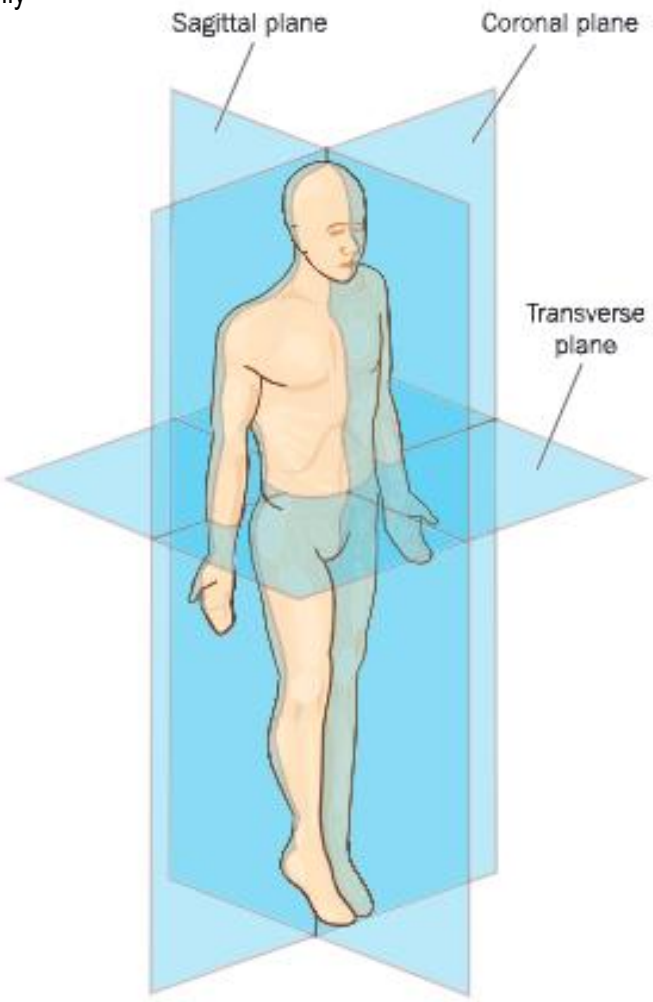


fruit fly embryo

CONCEPT: OVERVIEW OF DEVELOPMENT

- ***Body Axes:***
  - □ ***Anterior*** – toward the head
  - □ ***Posterior*** – towards the tail
  - □ ***Dorsal*** – toward the back
  - □ ***Ventral*** – toward the belly

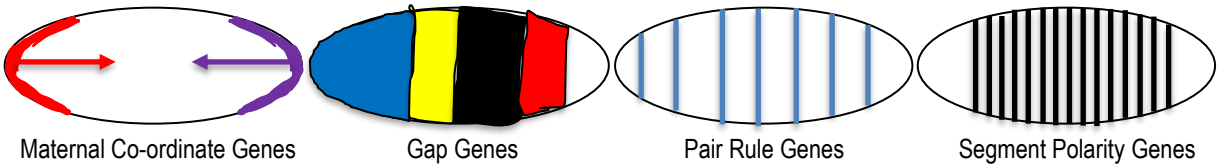
EXAMPLE:



- Complex body plans develop over time, and chemical signals come and go to fine-tune development

- Morphogens □ gap genes □ pair-rule genes □ segment polarity genes □ Hox genes □ effector genes

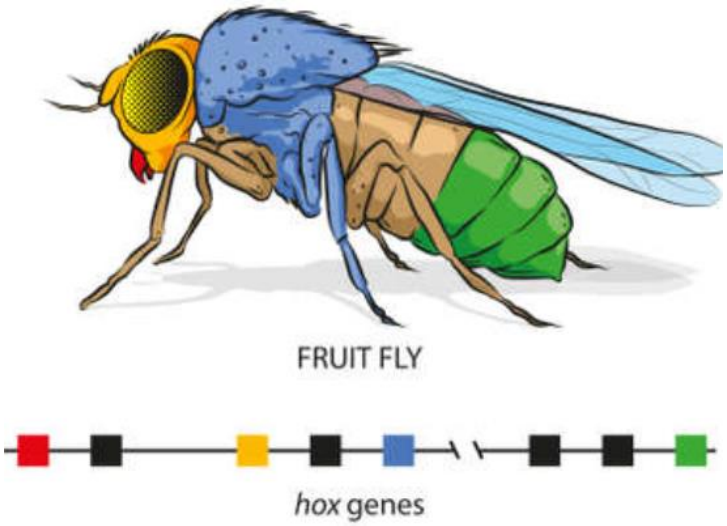
EXAMPLE:



CONCEPT: OVERVIEW OF DEVELOPMENT

- ***Tool-kit genes*** – the small subset of genes that control and organisms development
- ***Homeotic genes*** – genes that control the development of anatomical structures
- ***Hox genes*** – highly conserved genes that help control development along the anterior-posterior axis
    - □ Activated after segments form, they determine the specific segment structures, like wings or antennae

EXAMPLE:



- Development is a highly conserved process
    - □ Development is directly linked to evolution
    - □ Many different animals use the same genes and chemical signals to govern body plan development
    - □ Many of the same chemical signals are used repeatedly during the course of development, to different effects

EXAMPLE: