CONCEPT: DEVELOPMENTAL PATTERNING GENES

● The first _____ to development is to determine the front, back, top, and bottom of an organism

□ The **anterior** (front/head) and **posterior** (back) are determined first

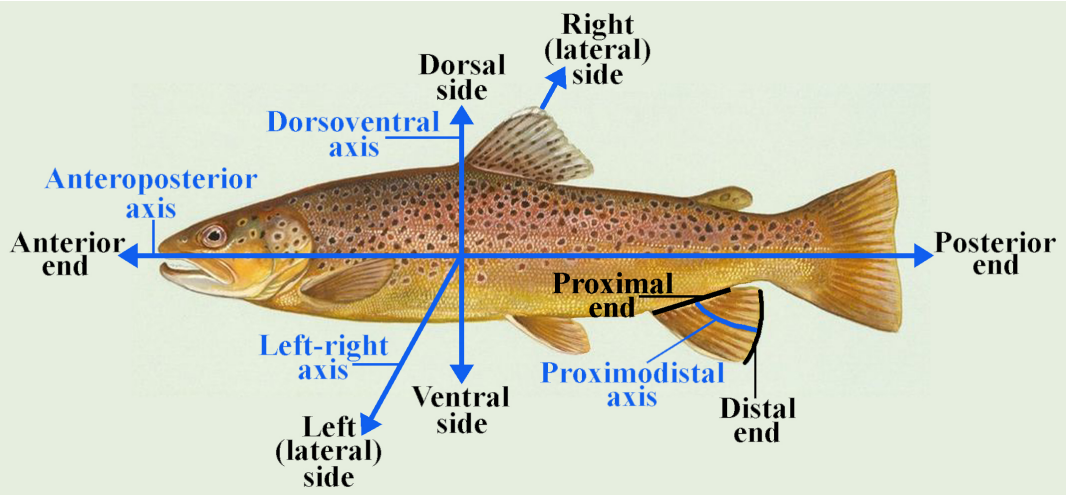
□ The **dorsal** (top) and **ventral** (bottom) are determined second

□ Many different genes determine the positioning (**patterning)** of these locations

- **Maternal effect genes** are maternal genes found within the egg. These genes are active first

- **Zygotic genes** are the embryo's genes that control later development

EXAMPLE:



● **Segmentation genes** control the development of specific _____ of an organism

□ Maternal effect genes control development first

-Highter ***bicoid*** concentrations form anterior

- Higher **nanos** concentrations form posterior

□ **Gap genes** are zygotic genes that divide the embryo into body segments (ex: *giant, krüppel*)

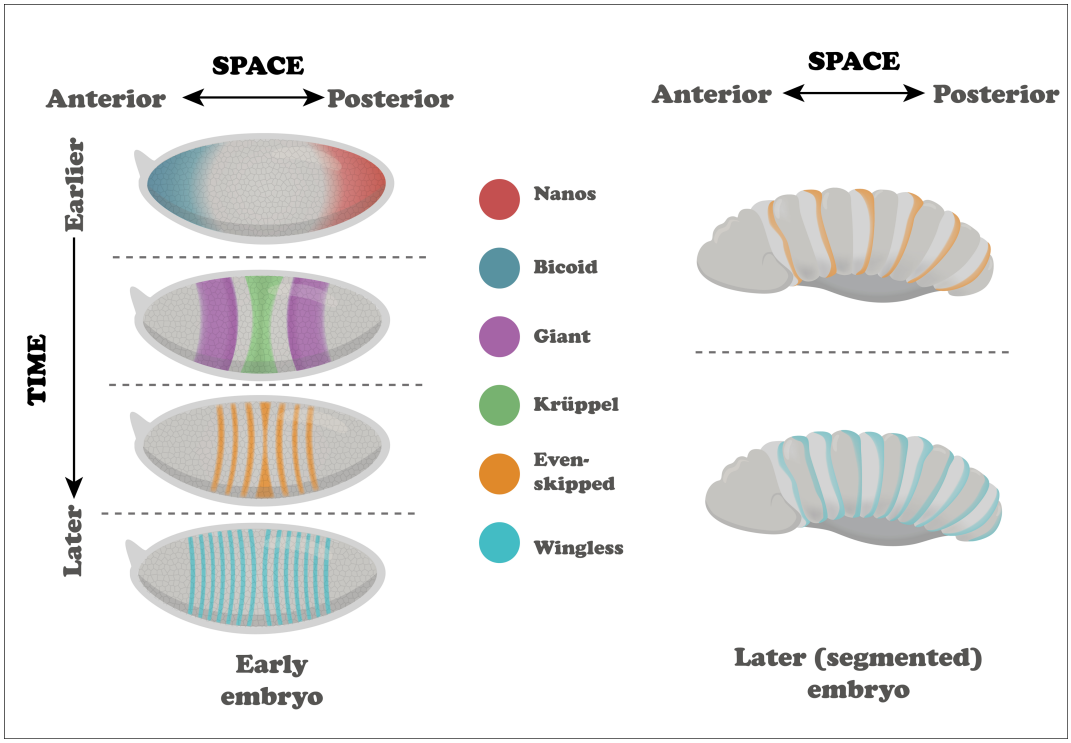
□ **Pair-rule genes** are zygotic genes that result in pairs of segments (ex: *even-skipped*)

□ **Segment-polarity genes** determine the anterior/posterior location in each segment (ex*: wingless)*

□ The concentration of each gene, activates the next set of genes

- *Bicoid* concentration activates gap. Gap activates pair-rule, and pair-rule activates segment-polarity

EXAMPLE:



● **Homeotic genes (HOX)** controls organ development in each previously _____ segment

□ These genes contain a **homeobox** of 180bp with **homeodomain** that binds DNA (helix-turn-helix)

- Allows for HOX genes to act as transcription factors

□ In *Drosophilia* there are two clusters of HOX genes

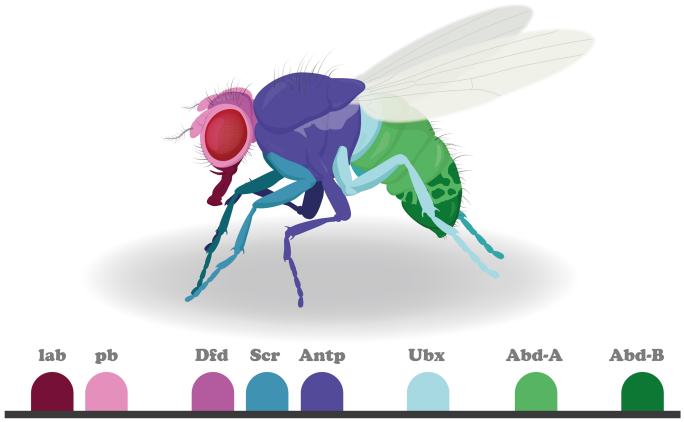
- **Antennapedia (ANT-C)** has five genes which control head and anterior thorax development

- **Bithorax (BX-C)** has three genes for posterior thorax and abdominal development

□ HOX genes are extremely well conserved

- Some animals have more HOX gene clusters than fruit flies (ex: mice have four)

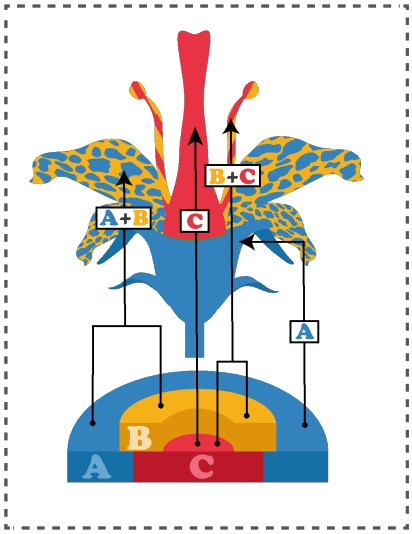
EXAMPLE:

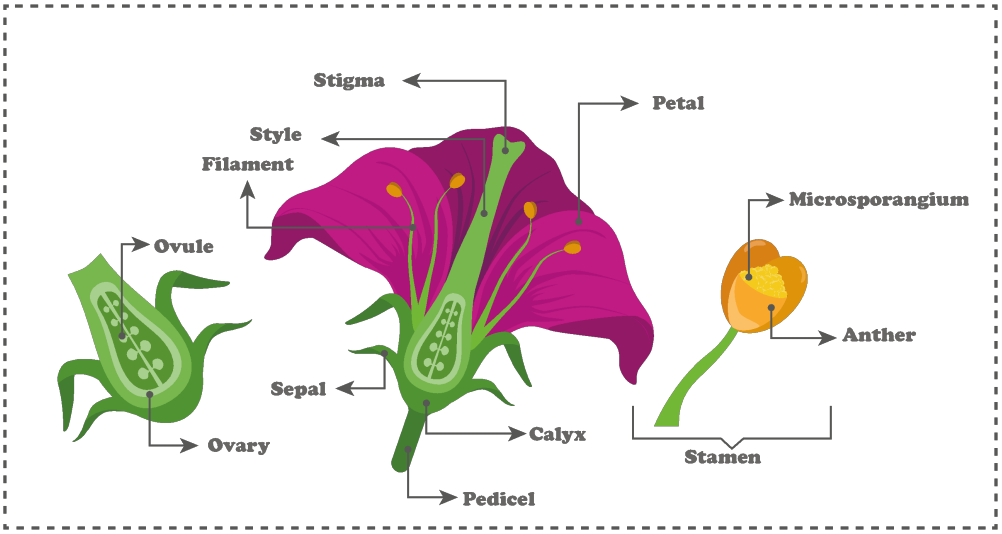


Plant Development

- Plants contain their own _____ of homeotic genes
  - □ In *Arabidopsis* there are three classes of HOX genes called Class A,B,and C
    - Class A forms the *sepals*
    - Class A and B form the *petals*
    - Class B and C form the *stamen*
    - Class C form the *carpels*

EXAMPLE:





PRACTICE:

1. Which genes are the first genes that control patterning of the offspring during early development?
    a. Anterior genes
    b. Maternal effect genes
    c. Zygotic genes
    d. Dorsal genes

2. Areas with higher *bicoid* expression will develop into which body pattern?
    a. Anterior
    b. Posterior
    c. Dorsal
    d. Ventral

3. Activation of the segmentation genes occurs in which of the following orders?
    a. Maternal effect → gap → segment polarity → pair rule
    b. Gap → maternal effect → pair rule → segment polarity
    c. Maternal effect → gap → pair rule → segment polarity
    d. Segment polarity → pair rule → gap → maternal effect

4. Which of the following HOX clusters are responsible for forming the abdominal in *Drosophila* development?
    a. Segment polarity
    b. Antennapedia
    c. Bithorax
    d. Pair rule

5. In *Arabidopsis*, which class of HOX genes are responsible for forming the plant carpels?
    a. Class A
    b. Class B
    c. Class C
    d. Class B and C