DEVELOPMENTAL BIOLOGY

TOPIC :VULVA FORATION IN C. ELEGANS

III SEMESTE M.SC ZOOLOGY

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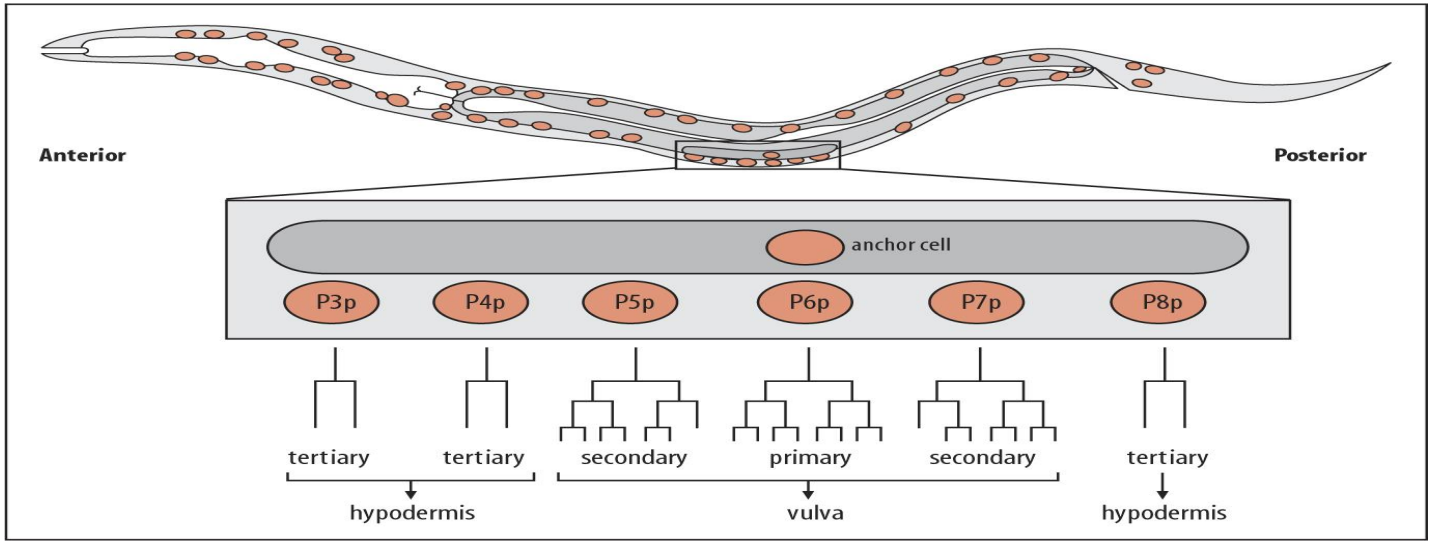
Vulva formation in Caenorhabditis elegans



About C. elegans

- Most C. elegans individuals are **hermaphrodites.** (both male and female sex organs in single body).

- In their early development, they are male, and the gonad produces sperm, which is stored for later use.

- As they grow older, they develop ovaries.

C. elegans

- C. elegans are the **multicellular nematodes.**
- It has **2 sexes**
- 1. hermaphrodite
- 2. male
- Hermaphrodite can be viewed most simply as a female that produce a limited number of sperms, so she can reproduce either by self fertilization by using own sperms.

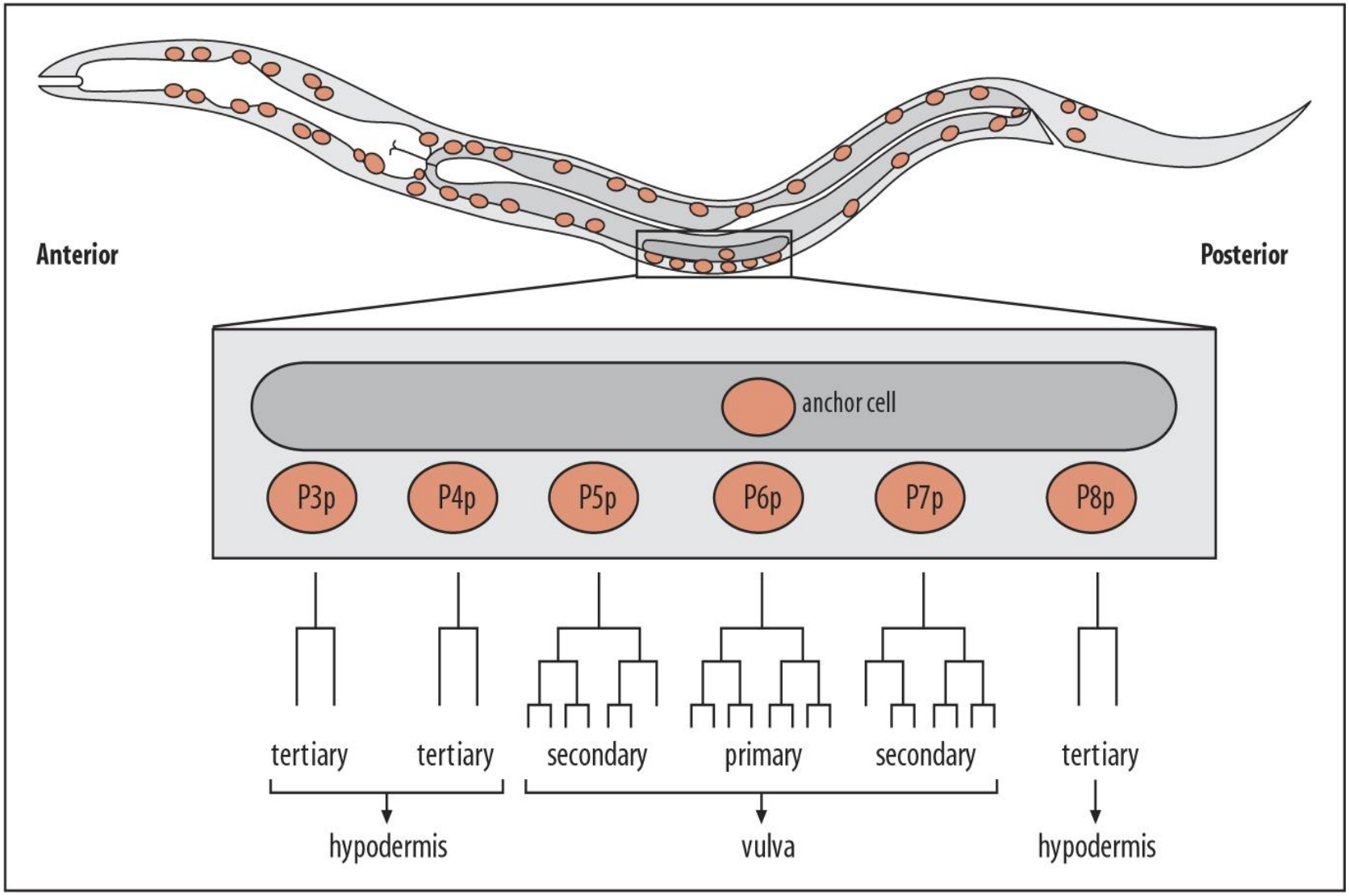
- Or by cross fertilization, after the transfer of male sperm by mating.

- C. elegans known as **round worm** and regarded as model organism.

- The eggs "roll" through the region of sperm storage, are fertilized inside the nematode, and then pass out of the body through the **vulva**.

VULVA

- The vulva is part of female sex organ that consist of 22 cells and serves as a structure through which the sperm enter and fertilized eggs leaves the gonads.


Anterior
Posterior
anchor cell
P3p
P4p
P5p
P6p
P7p
P8p
tertiary
tertiary
secondary
primary
secondary
tertiary
hypodermis
vulva
hypodermis

Life cycle of c.elegans

- **Life cycle is temprature dependent**
- 1. at 16 degree c—2-3 days
- 2. at 20 degree c- 3-4 days
- At 25 degree c—5-6 days

Vulva

- Vulva dvlpmnt in c. elegans involves a network of intercellular signalling, sinalling transduction and transcriptional regulation

- Vulva is necessary for egg laying
- Vulva present at midventrally
- Vulva is a part of female sex apparatus
- Adut vulva has 22 cells

Vulva development

- **Generation of VPCs**

  six vulval precursor cells (VPCs) are specified among the 11 cells, which are located in the ventral epidermis

- **Vulval precursor patterning**

  a signal from the gonad and signalling among the VPCs specify three VPCs to generate vulval cells.

Vulval dvlpmnt…

The vulval lineages are of two types 1degree (primary) and 2 degree (secondary) and

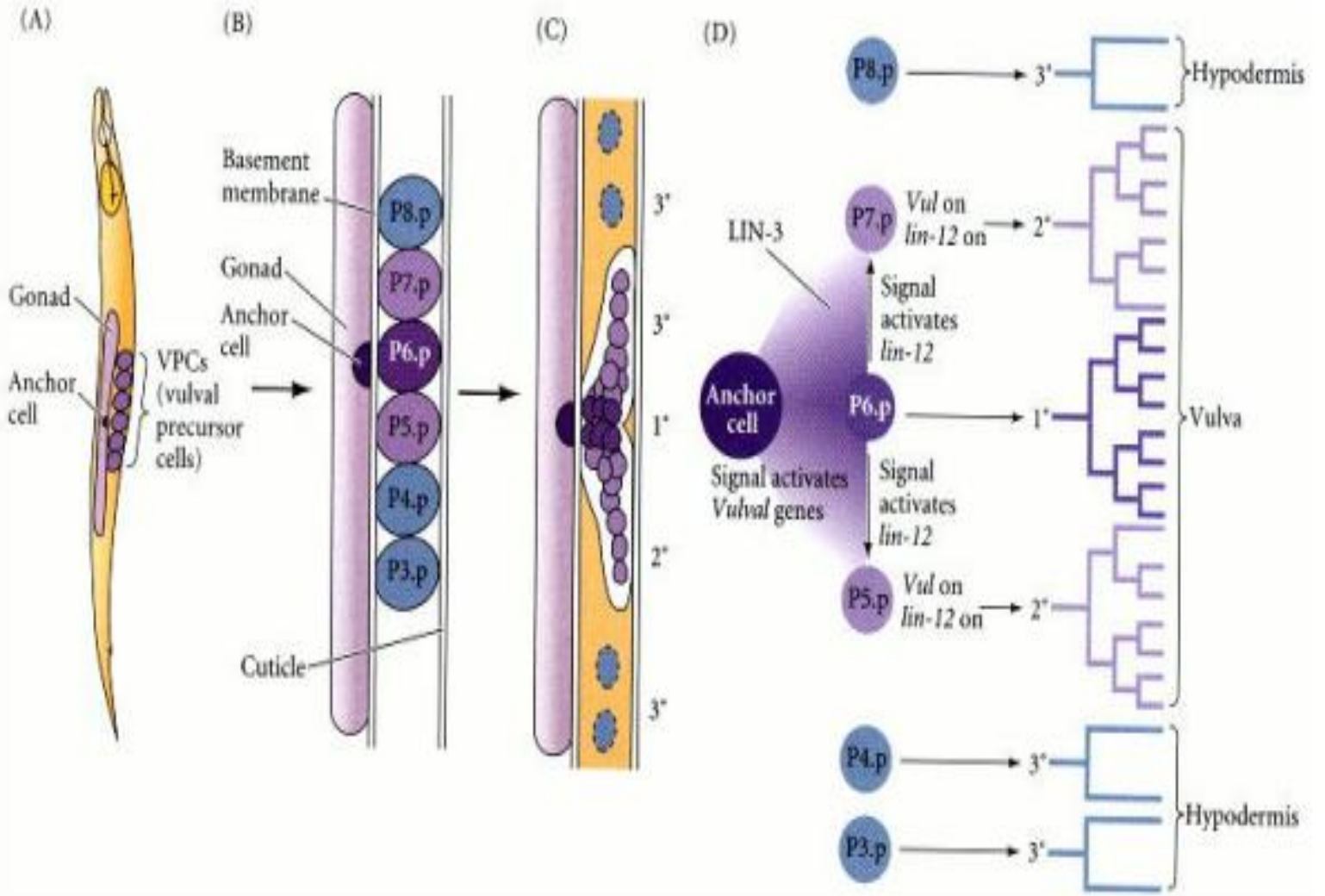
Uninduced VPCs generate 3 degree(tertiary) lineage which make epidermal cells.

- **Generation of the adult cells**

the adult vulva comprise 22 cells

- The vulva of Caenorhabditis elegans represents a case in which **one inductive signal generates a variety of cell types.**
- This organ forms during the larval stage from six cells called the **vulval precursor cells (VPCs).**

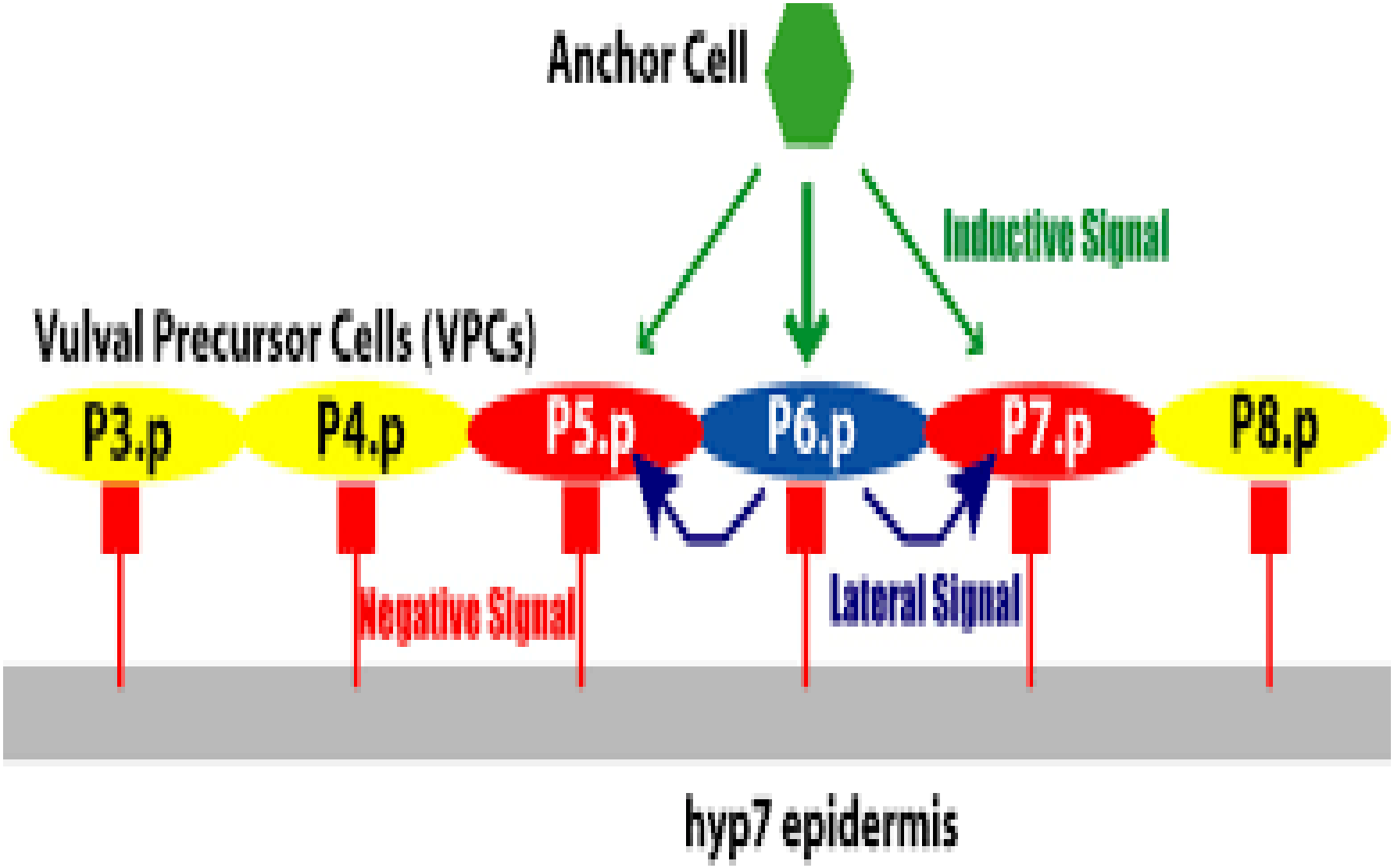
(Figure 6.19D, Katz and Sternberg 1990).



Anchor cell

- The cell connecting the overlying gonad to the vulval precursor cells is called the **anchor cell.**

- The anchor cell secretes the **LIN-3 protein**, a relative of epidermal growth factor (EGF) and the Boss protein (Hill and Sternberg 1992)


Anchor Cell
Inductive Signal
Vulval Precursor Cells (VPCs)
P3.p
P4.p
P5.p
P6.p
P7.p
P8.p
Negative Signal
Lateral Signal
hyp7 epidermis

- If the anchor cell is destroyed (or if the lin-3 gene is mutated), the VPCs will not form a vulva; they will instead become part of the hypodermis (skin) (Kimble 1981).
- The six VPCs influenced by the anchor cell form an equivalence group. Each member of this group is competent to become induced by the anchor cell and can assume any of three fates, depending on its proximity to the anchor cell.

- The cell directly beneath the anchor cell divides to form the **central vulval cells**. The two cells flanking that central cell divide to become the **lateral vulval cells**, while the three cells farther away from the anchor cell generate **hypodermal cells.**

- If the anchor cell is destroyed, all six cells of the equivalence group divide once and contribute to the hypodermal tissue.
- If the three central VPCs are destroyed, the three outer cells, which normally form hypodermal cells, generate vulval cells instead.

- The LIN-3 protein is received by the LET-23 receptor tyrosine kinase on the VPCs, and the signal is transferred to the nucleus through the RTK-Ras pathway. The target of the kinase cascade is the LIN-31 protein.

- 1. The LIN-3 protein forms a concentration gradient. Here, the VPC closest to the anchor cell (i.e., the P6.p cell) receives the highest concentration of LIN-3 protein and generates the central vulval cells.

- The two VPCs adjacent to it (P5.p and P7.p) receive a lower amount of LIN-3 and become the lateral vulval cells.
- The VPCs farther away from the anchor cell do not receive enough LIN-3 to have an effect, so they become hypodermis.

- 2. In addition to forming the central vulval lineage, the VPC closest to the anchor cell also signals laterally to the two adjacent cells and instructs them to generate the lateral vulval lineages.

- These lateral cells do not instruct the peripheral VPCs to do anything, so they become **hypodermis.**

- This **lateral inhibition** of the "secondary" vulval precursor cells by the "primary" VPC is accomplished through the **LIN-12 proteins**.