

Reproductive Physiology

Lecture 8

Hormones affecting female breast



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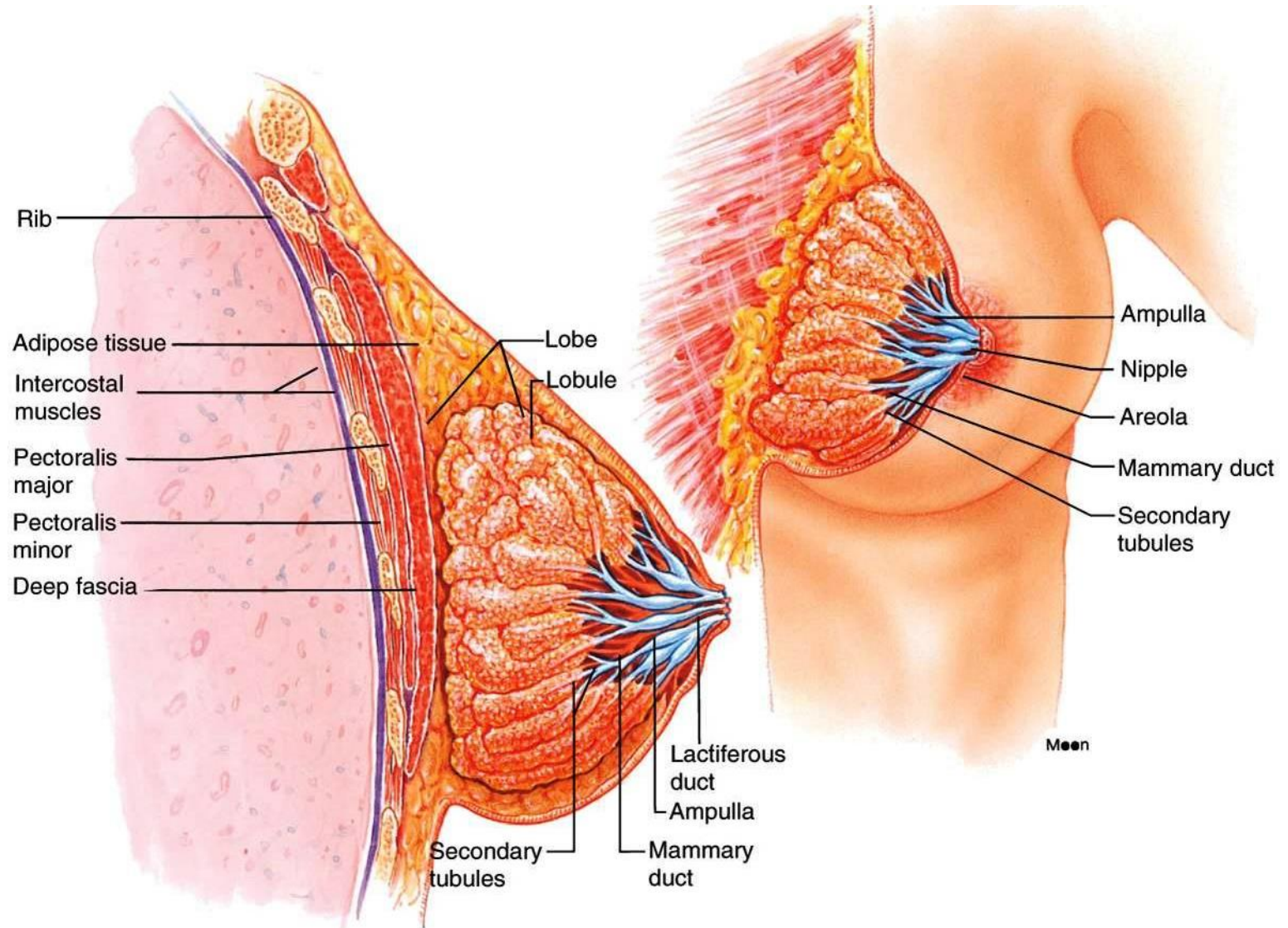
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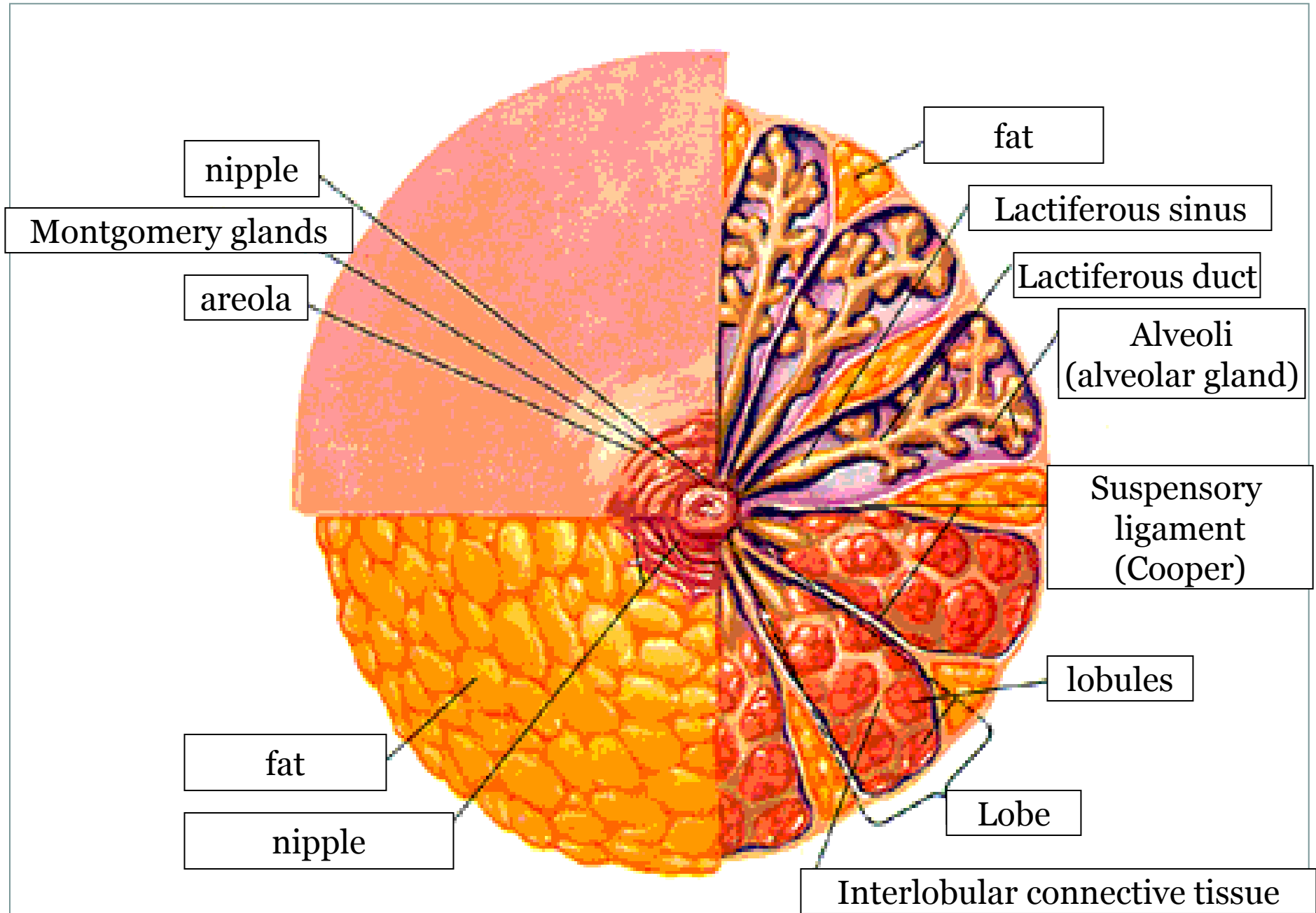
Objectives



- Hormonal requirement for breast development (**Mammogenesis**)
- Hormones involved in the process of lactation (**Lactogenesis**) and their physiological action
- Physiological basis of suckling reflex and its role in lactation
- **Galactopoeisis**
- **Involution** (the termination of milk production).

The structure of the breast and mammary glands





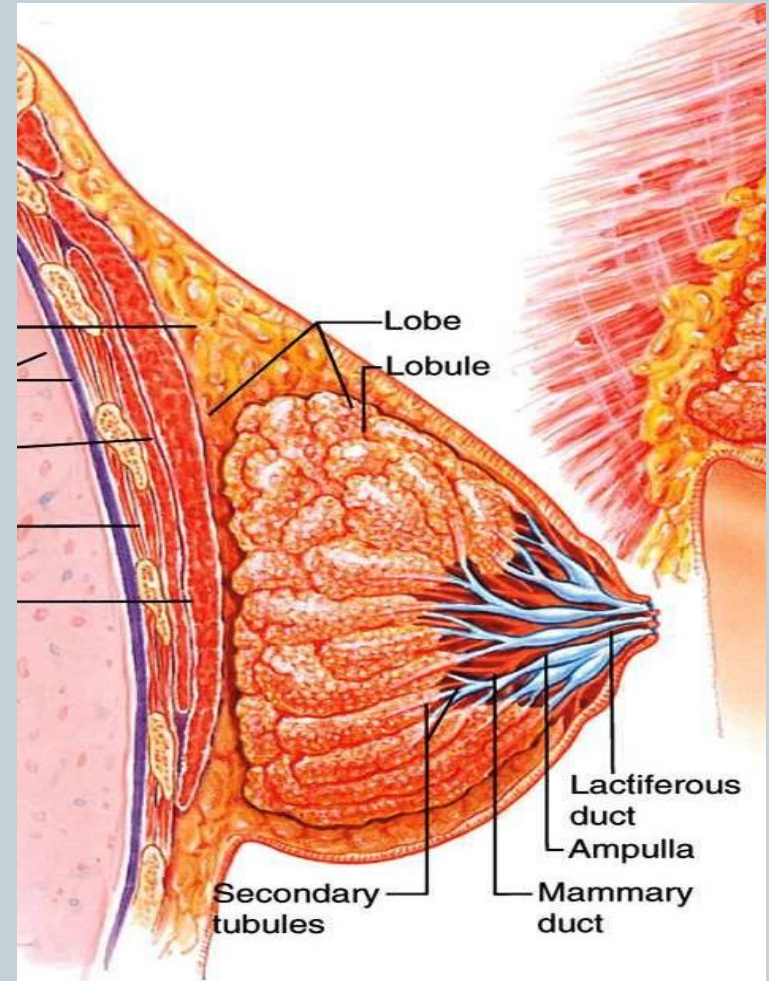
Structures of the Mammary Gland



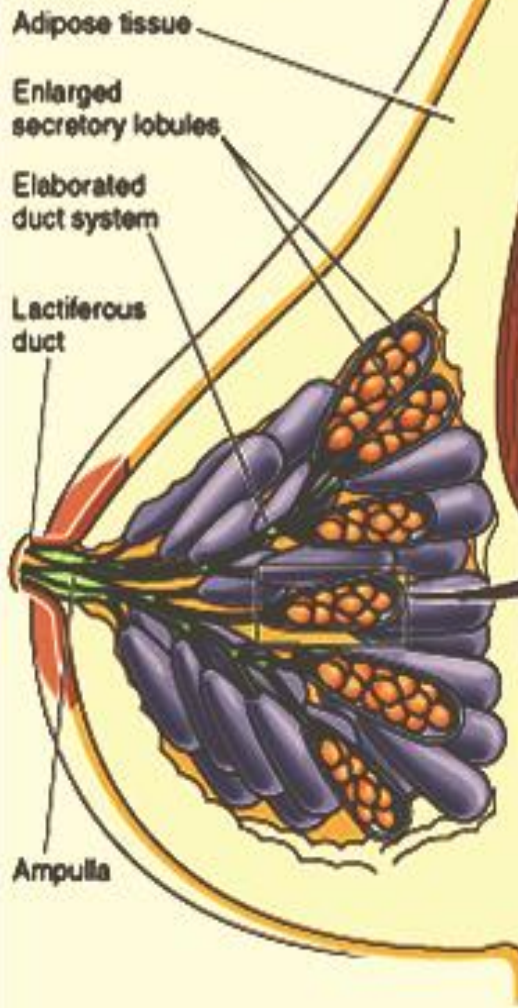
- Each breast consists of ~ 23 lobes of secretory tissue
 - a. Each lobe has one lactiferous duct
 - b. Lobes (and ducts) are arranged radially
 - c. Lobes are composed of lobules
 - d. Lobules are composed of alveoli

Ductal System

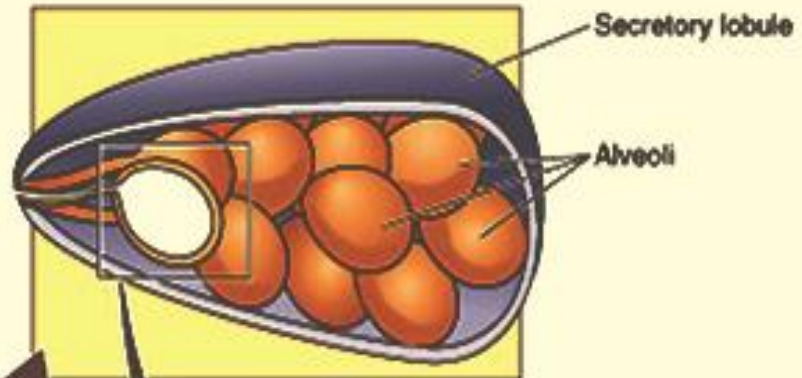
- Alveolar tubule
- Secondary tubule
- Mammary duct
- Ampulla (lactiferous sinus)
- Lactiferous duct



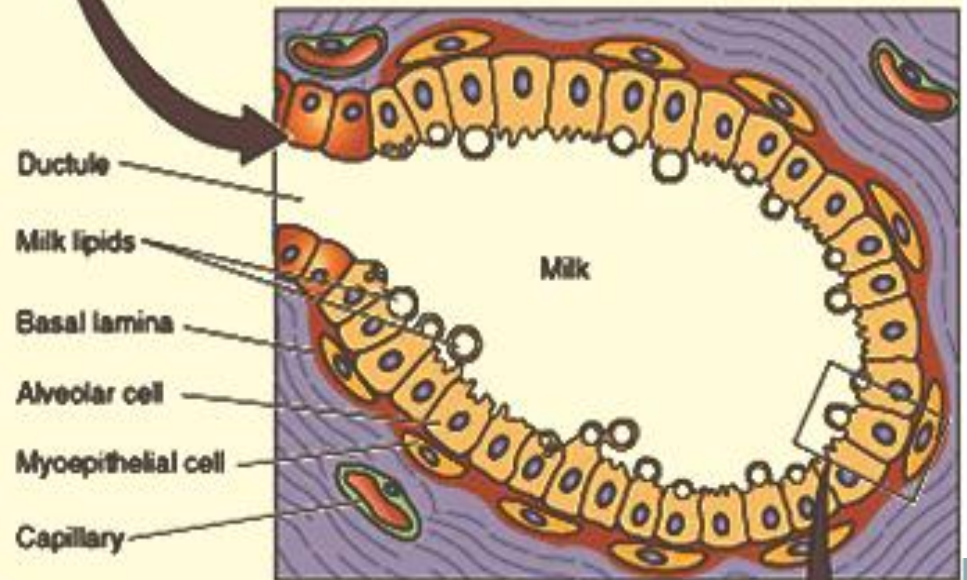
A LACTATING BREAST

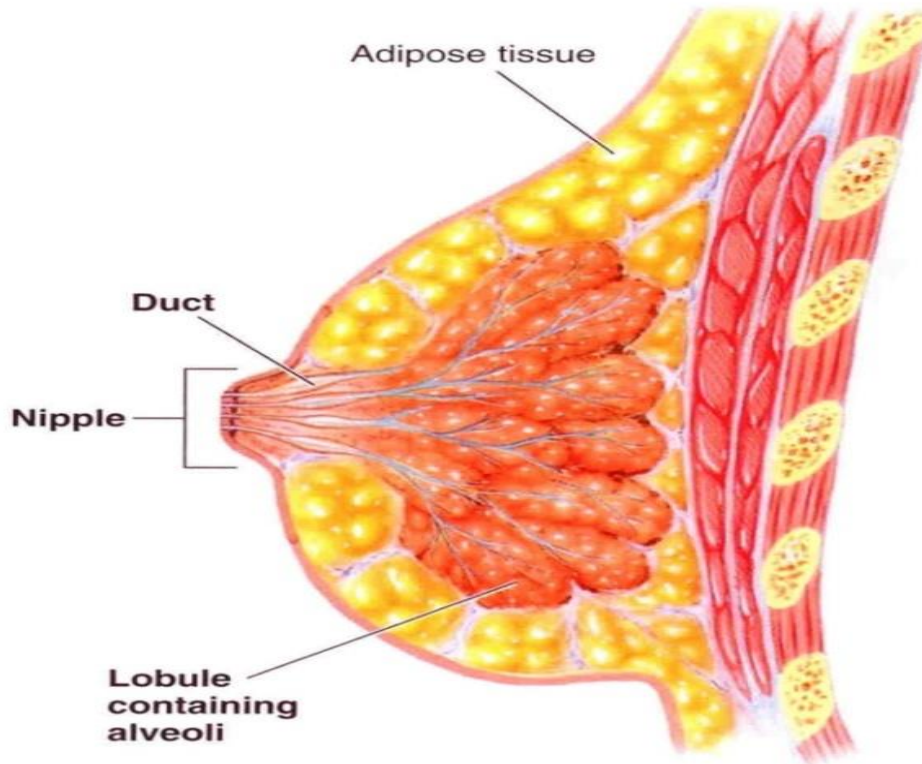


B LOBULE

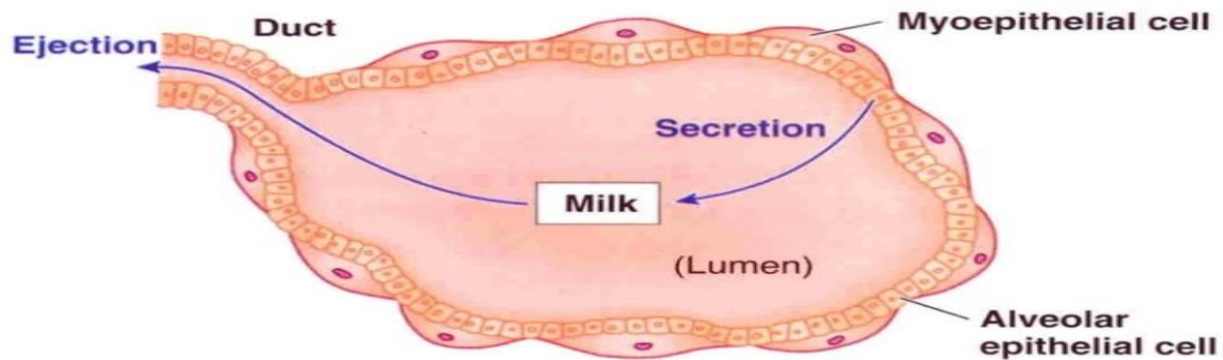


C ALVEOLUS





(a) Internal structure of mammary gland, lateral view



(b) Alveolus within mammary gland

- **FIGURE 20-34 Mammary gland anatomy.** The alveolar epithelial cells secrete milk into the lumen. Contraction of the surrounding myoepithelial cells ejects the secreted milk through the duct.

Breast development



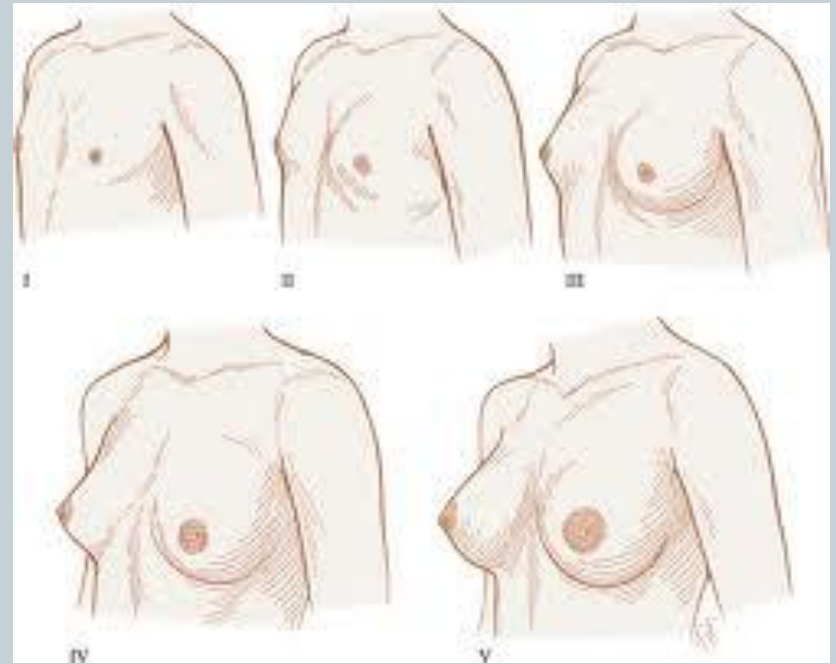
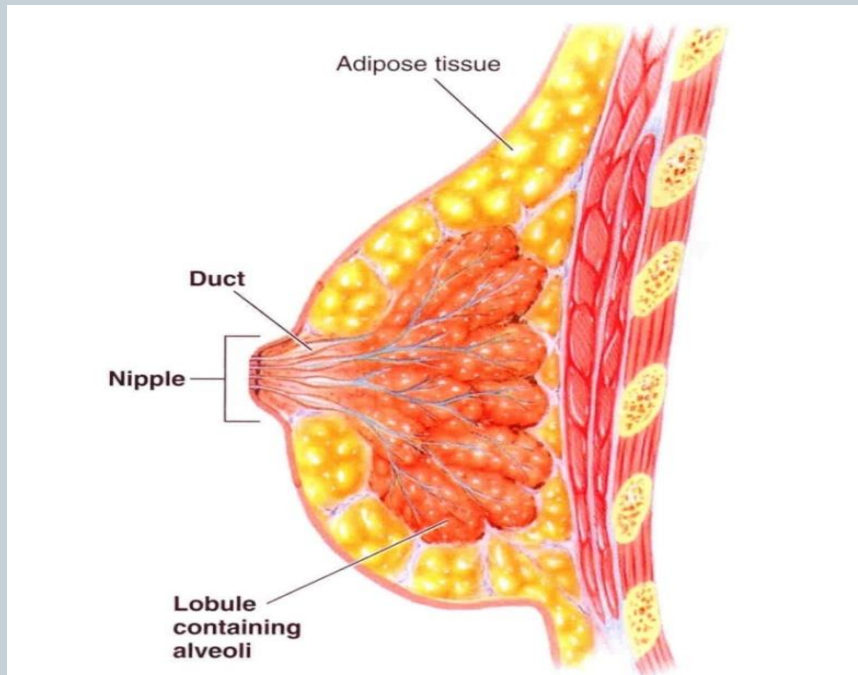
- Endocrine system plays a major role in synchronizing the development (**mammogenesis**) and function (**lactogenesis**) of mammary glands with reproduction
- Three categories of hormones:
 - Reproductive hormones (endocrine)
 - ✦ Estrogen, progesterone, prolactin, oxytocin, and human placental lactogen (hPL).
 - Metabolic hormones (endocrine)
 - ✦ GH, corticosteroids, thyroxine, PTH and insulin
 - Mammary hormones (autocrine)
 - ✦ GH, prolactin, PTHrP and leptin

Breast development (mammogenesis)



- **During puberty**

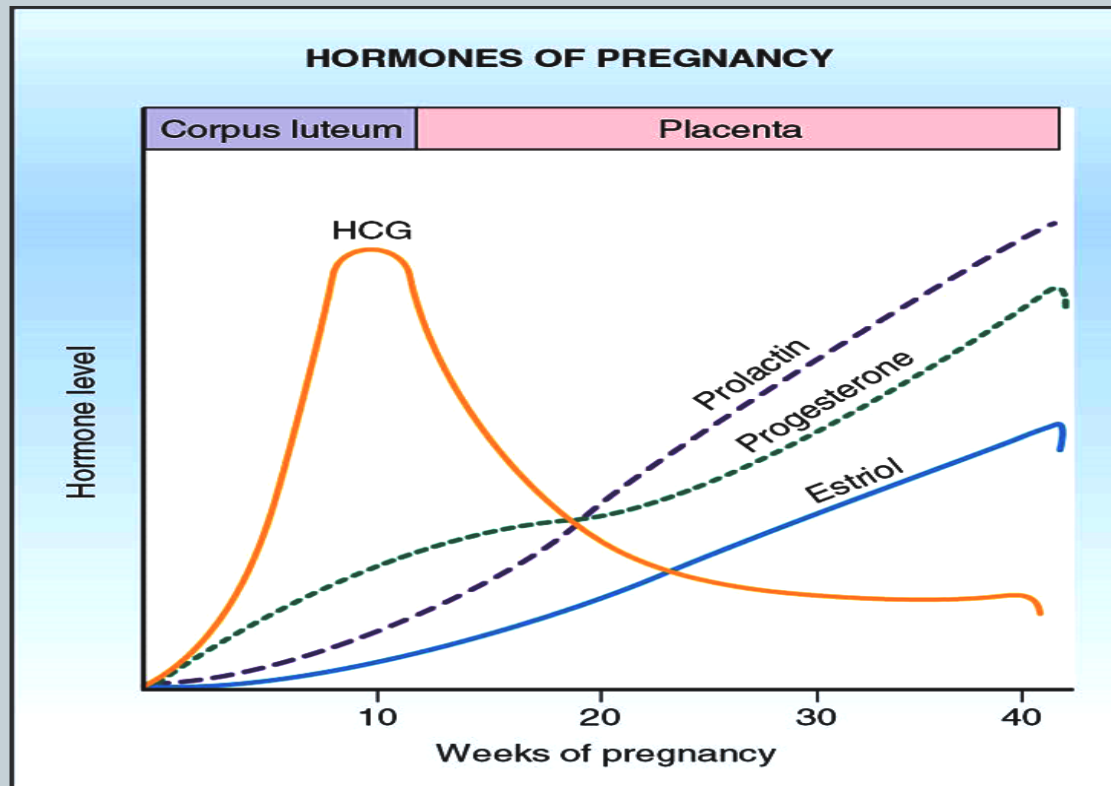
- **Estrogen** stimulates proliferation of ducts and deposition of fat.
- **Progesterone** stimulates development of lobules.



Breast development (mammogenesis)



- **During pregnancy**
 - Complete development of glandular tissue



Breast development

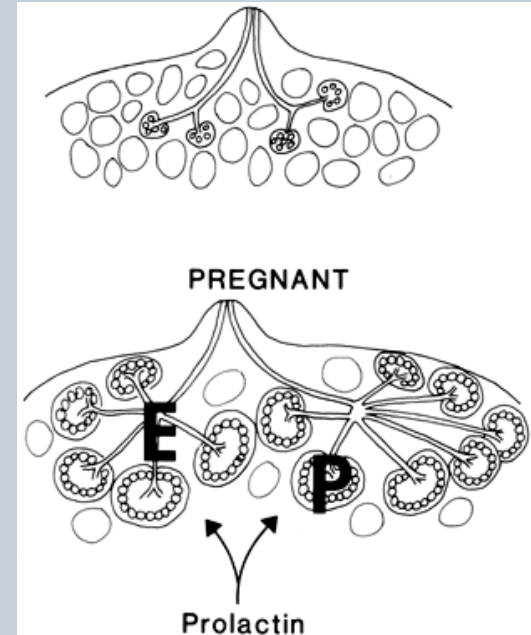
○ Estrogen (placenta)

- ✦ Growth & branching of ductal system (with GH)
- ✦ Fat deposition in the stroma

○ Progesterone (placenta)

- ✦ Growth of lobule-alveolar system (budding of alveoli and secretory changes in epithelial cells)

- Although estrogen and progesterone are essential for physical development of the breasts, they inhibit actual secretion of milk



Breast development



- **Prolactin** (anterior pituitary)
 - Its level increases during pregnancy (10-20 times)
 - It stimulates mammary gland ductal growth and proliferation of alveolar epithelial cells which induce milk protein synthesis
 - Sudden drop in E & P after delivery allows milk production
 - It is controlled mainly by hypothalamic hormone
 - ✦ **PIH (Dopamine)**
- **Human placental lactogen** (human chorionic somatomammotropin, hCS) (placenta)
 - Facilitates mammogenesis
 - Delays milk production

Lactogenesis



- **Lactogenesis:** Cellular changes by which *mammary epithelial cells* are converted from a nonsecretory to a secretory state [**2 stages**]:
 - **Lactogenesis 1**
 - **Lactogenesis 2**

Lactogenesis



- **Lactogenesis 1:** (Cytologic and enzymatic differentiation of alveolar epithelial cells).
 - Starts in mid-pregnancy and characterized by expression of many genes involved in synthesis of milk components (increases in uptake transport systems for amino acids, glucose, and calcium required for milk synthesis).
 - Hormones involved:
 1. Progesterone (suppresses milk secretion)
 2. Prolactin and human placental lactogen
 3. Growth hormone
 4. Glucocorticoids (Cortisol)

Lactogenesis



- **Lactogenesis 2:** (Copious secretion of all milk components)
 - Around parturition, withdrawal of **progesterone** + high level of **prolactin** leads to:
 - ✦ Further increase in expression of milk protein genes
 - ✦ Glands absorb increased quantities of metabolic substrates from the blood.
 - ✦ Movement of cytoplasmic lipid droplets and casein into alveolar lumina
 - ✦ Transfer of immunoglobulins
 - ✦ Secretion of colostrum followed by milk

Lactogenesis



- **Lactogenesis 2:**

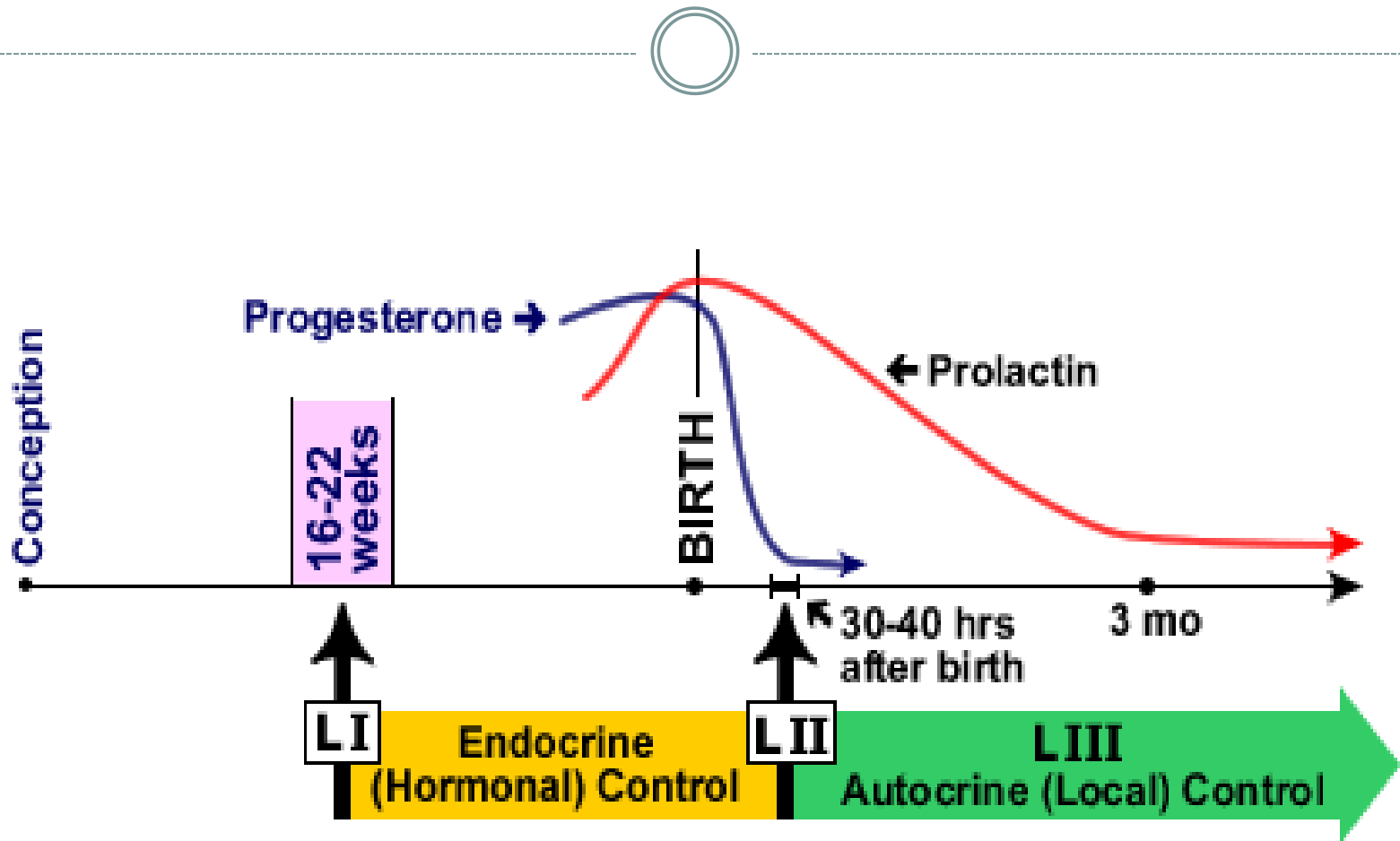
- Suckling stimulates further increase in expression of genes involved in milk secretion with expansion of alveolar epithelium
- Lactation is maintained by removal of milk
- 2 hormones involved
 - ✦ Prolactin (milk production)
 - ✦ Oxytocin (milk let-down)

Galactopoeisis



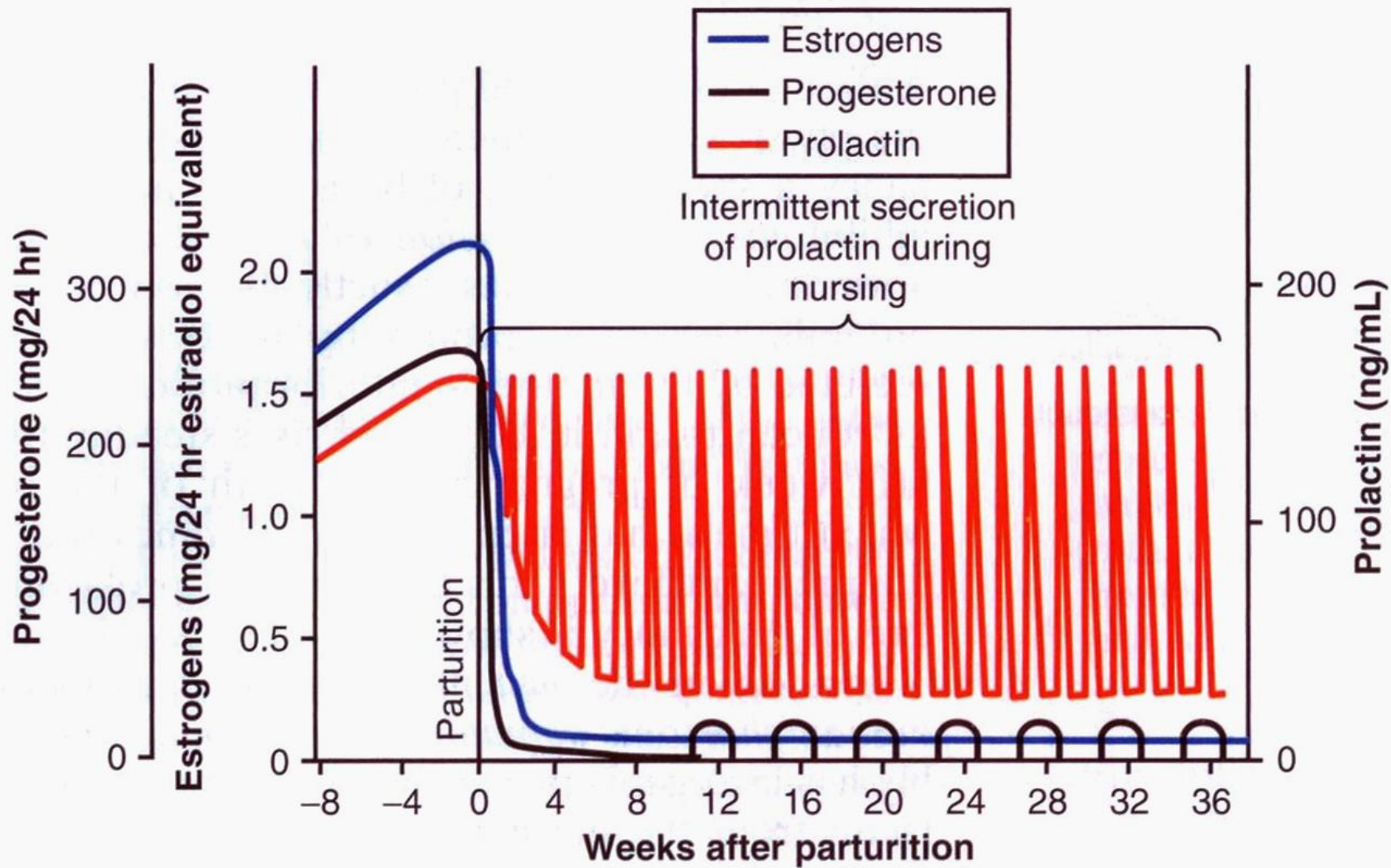
- **Definition:** Galactopoeisis is defined as the maintenance of lactation once lactation has been established.
- **Galactopoeitic Hormones:**
 - **Prolactin:** the most important galactopoeitic hormones involved in maintenance of lactation.
 - **Growth Hormone:** support increase in synthesis of lactose, protein, and fat in the mammary gland
 - **Glucocorticoids**
 - **Thyroid Hormones**
- **Role of ovarian Hormones :**
 - ✦ Estrogen in very low doses is galactopoeitic
 - ✦ Progesterone alone has no effect on galactopoeisis because there are no progesterone receptors in the mammary gland during lactation

Stages of lactogenesis



Mammogenesis and **Lactogenesis**

Galactopoesis



Hormonal regulation of lactogenesis



○ Prolactin

- promotes milk synthesis and production. Secreted by anterior pituitary, starting from 5th wk of pregnancy until birth, then cycles.

○ Oxytocin

- Causes contraction of myoepithelial cells for milk letdown

○ Corticosteroids

- ✦ Increase during pregnancy (fivefold)
- ✦ Involved in breast development (permissive action on milk protein synthesis)

Hormonal regulation of lactogenesis



- **Thyroxine**

- Essential for milk production
- TRH increases leading to stimulation of PRL

- **GH**

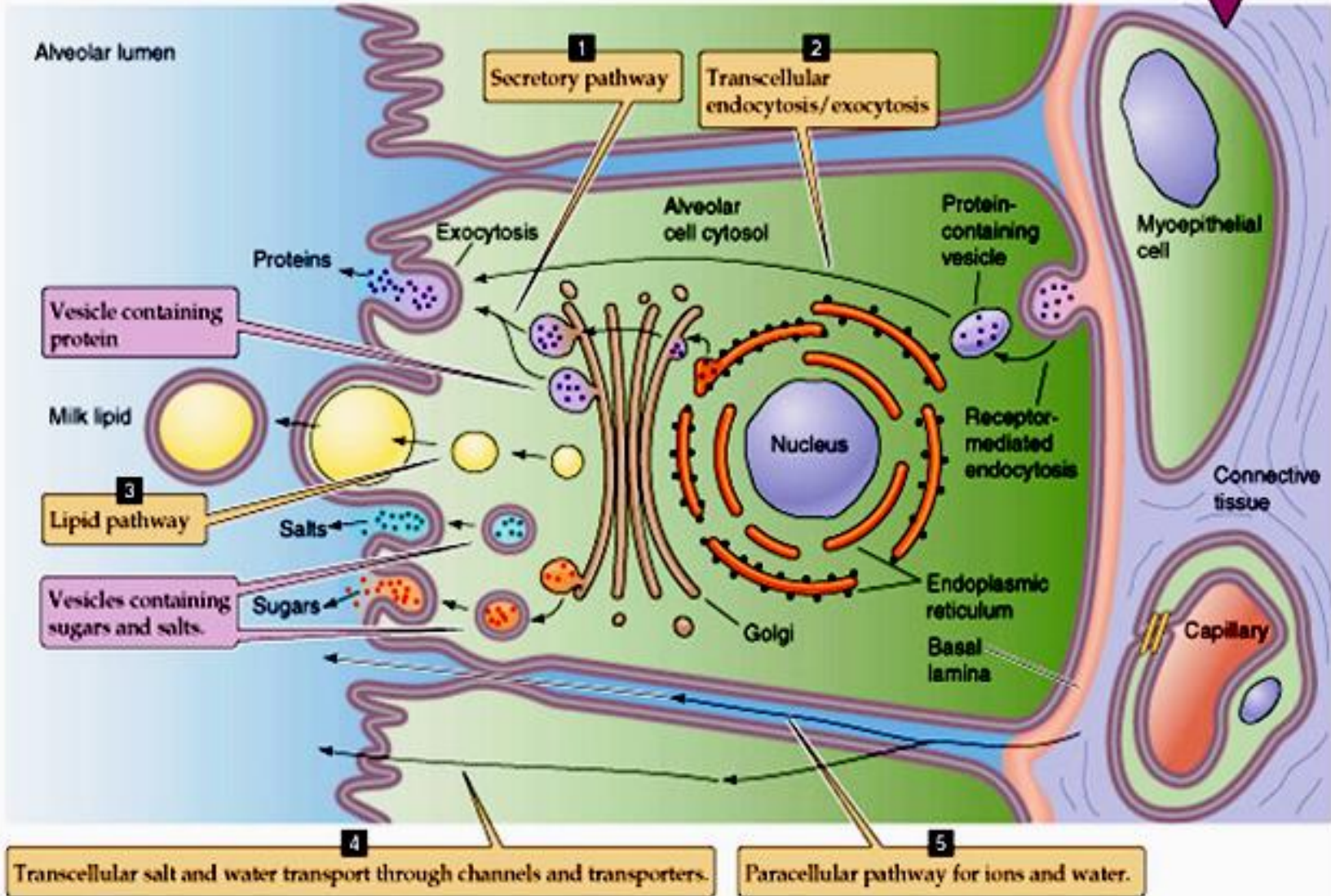
- ✦ Increases production of IGF-1 by the liver
- ✦ Mediates cell survival and ductal growth

- **Insulin**

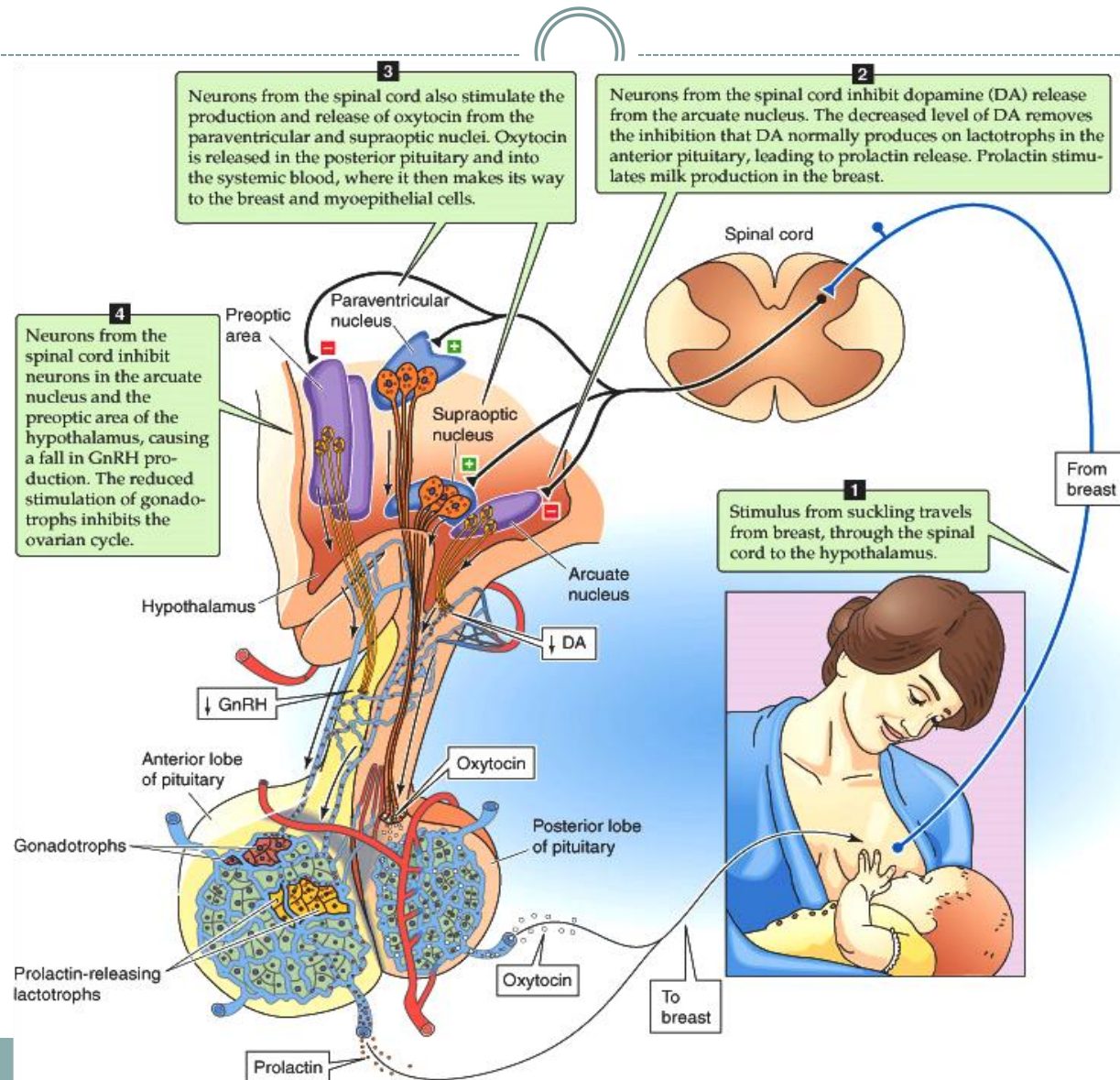
- Involved in glucose up take which is critical for lactose biosynthesis
- Involved in expression of milk protein genes

- **Parathyroid hormone** - regulates blood calcium

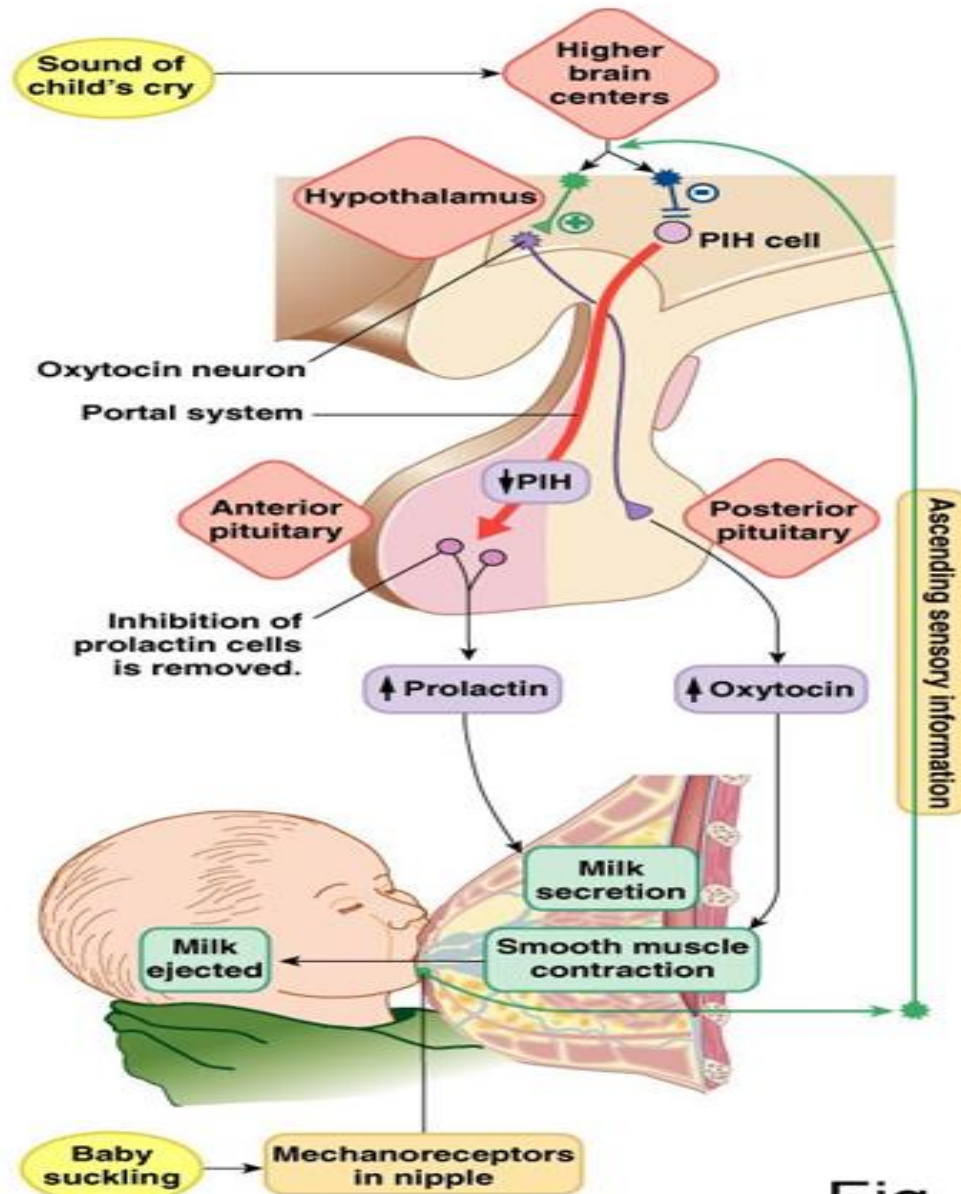
D SECRETORY EPITHELIAL CELL



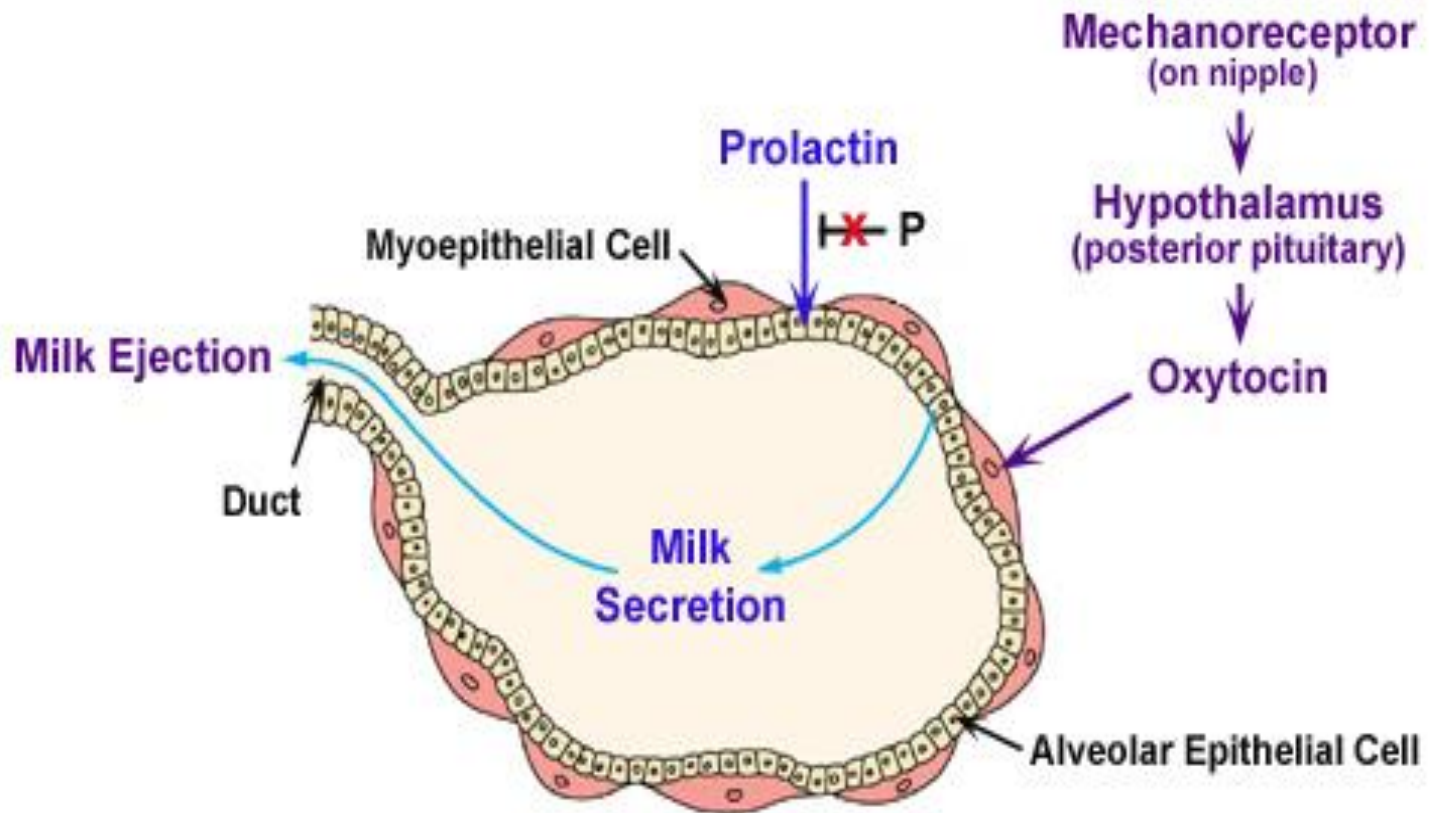
Suckling reflex



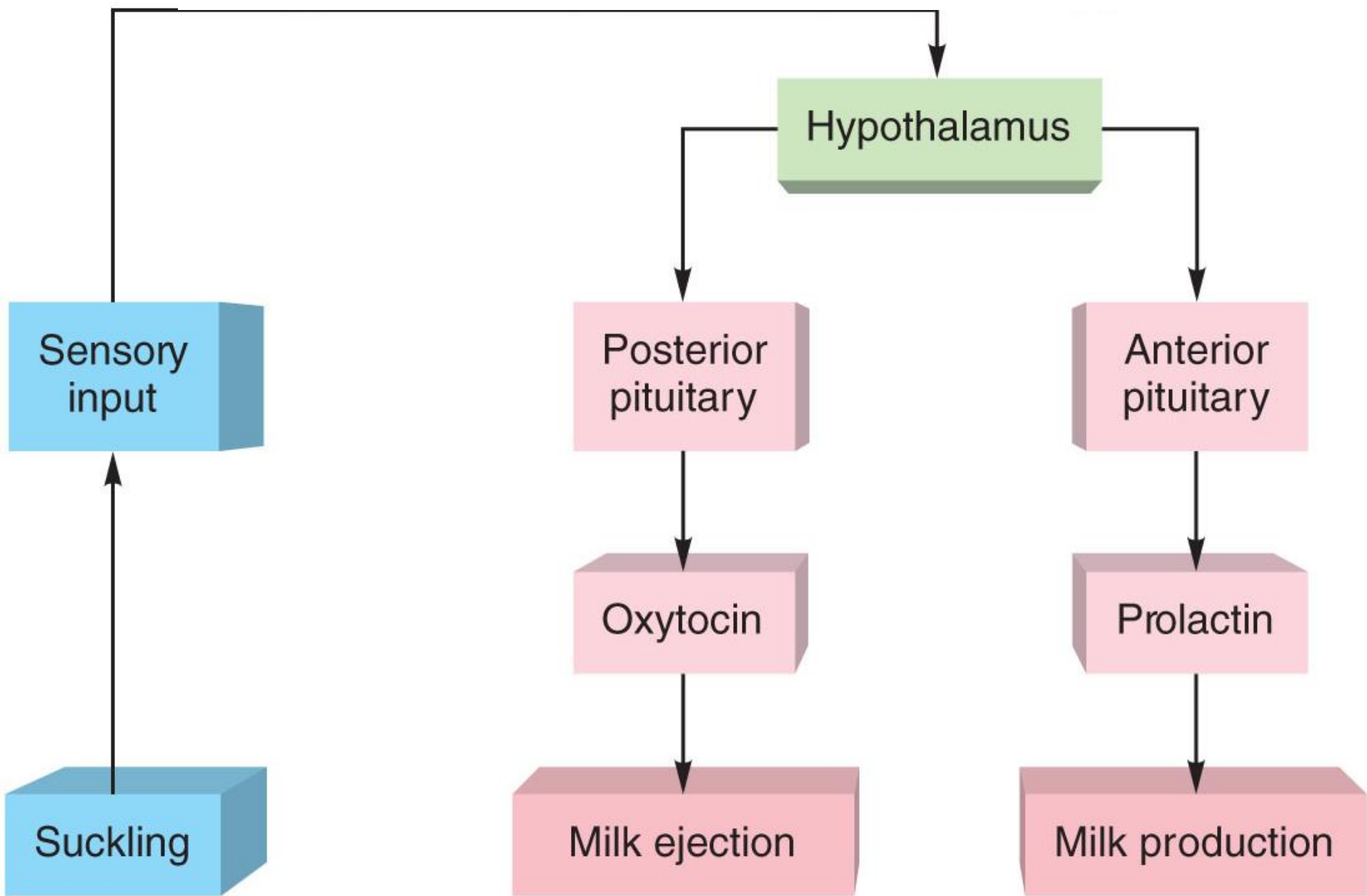
Neural reflex arc



Fig



Alveolus of Mammary Gland



Stimulus

Responses

Milk production



- Milk production is a "use it or lose it" process. The more often and effectively the baby nurses, the more milk will be produced.
- Milk production <math>< 100\text{ ml/day}</math> in day 1 postpartum.
- Milk production by day 3 reaches 500 ml/day.
- **Involution:** This is when the breasts stop producing milk completely after weaning

AAP Recommendations

- Exclusive breastfeeding for the first six months of life
- Continued breastfeeding for at least one year, 'As long as is desired by mother and child'



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The End

Thank You