

# Reproductive Physiology

## Lecture 8

# Hormones affecting female breast



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# Objectives



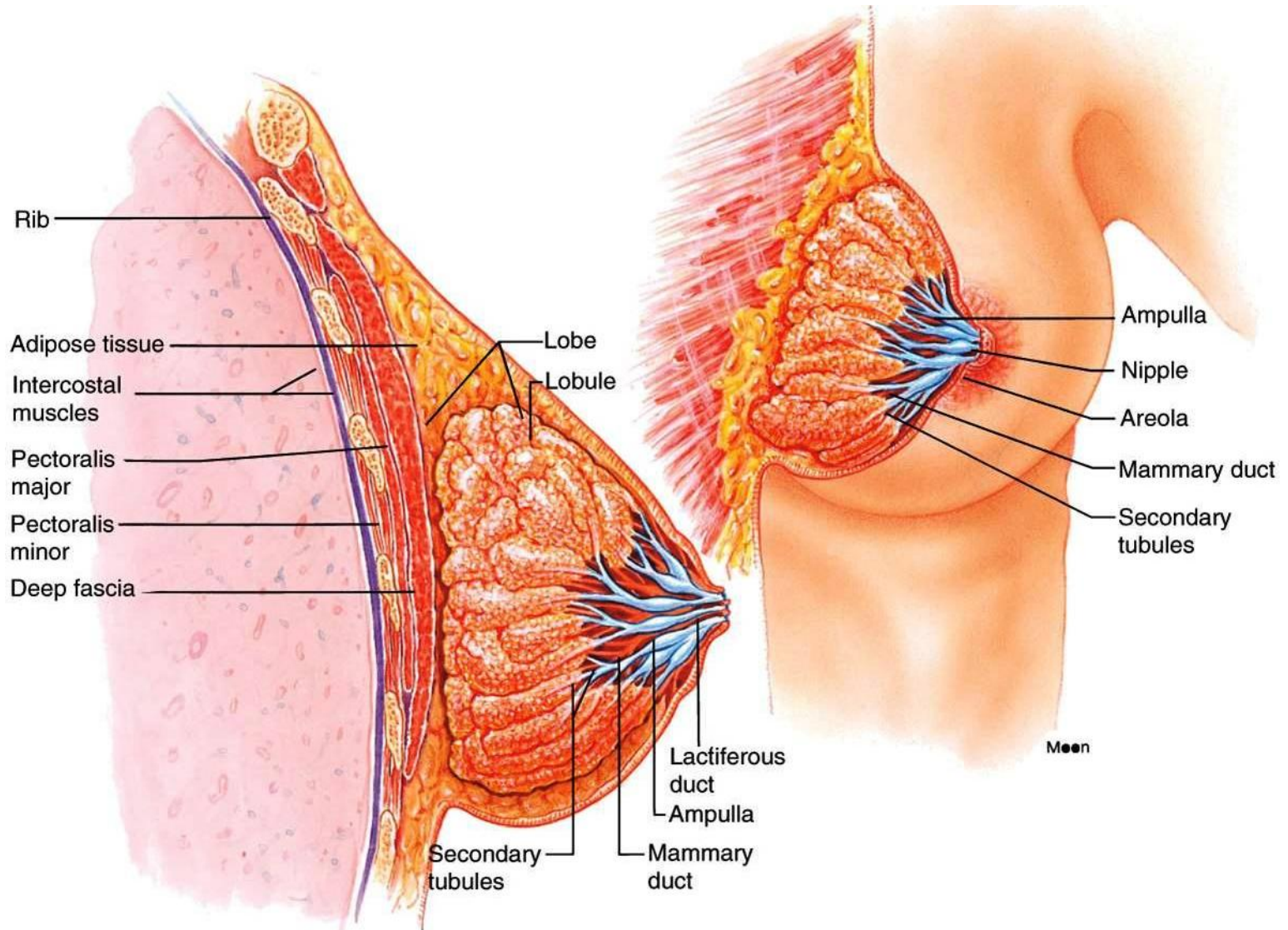
**By the end of this lecture, you should be able to:**

- Know the physiologic anatomy of the breast.
- Describe the physiological changes that occur in the breast during mammogenesis, lactogenesis, and galactopoiesis and the hormones involved.
- Recognize the phases of lactogenesis.
- Describe the endocrine and autocrine control of lactation.
- Explain the physiological basis of suckling reflex and its role in lactation.

# What is the structure of breast?



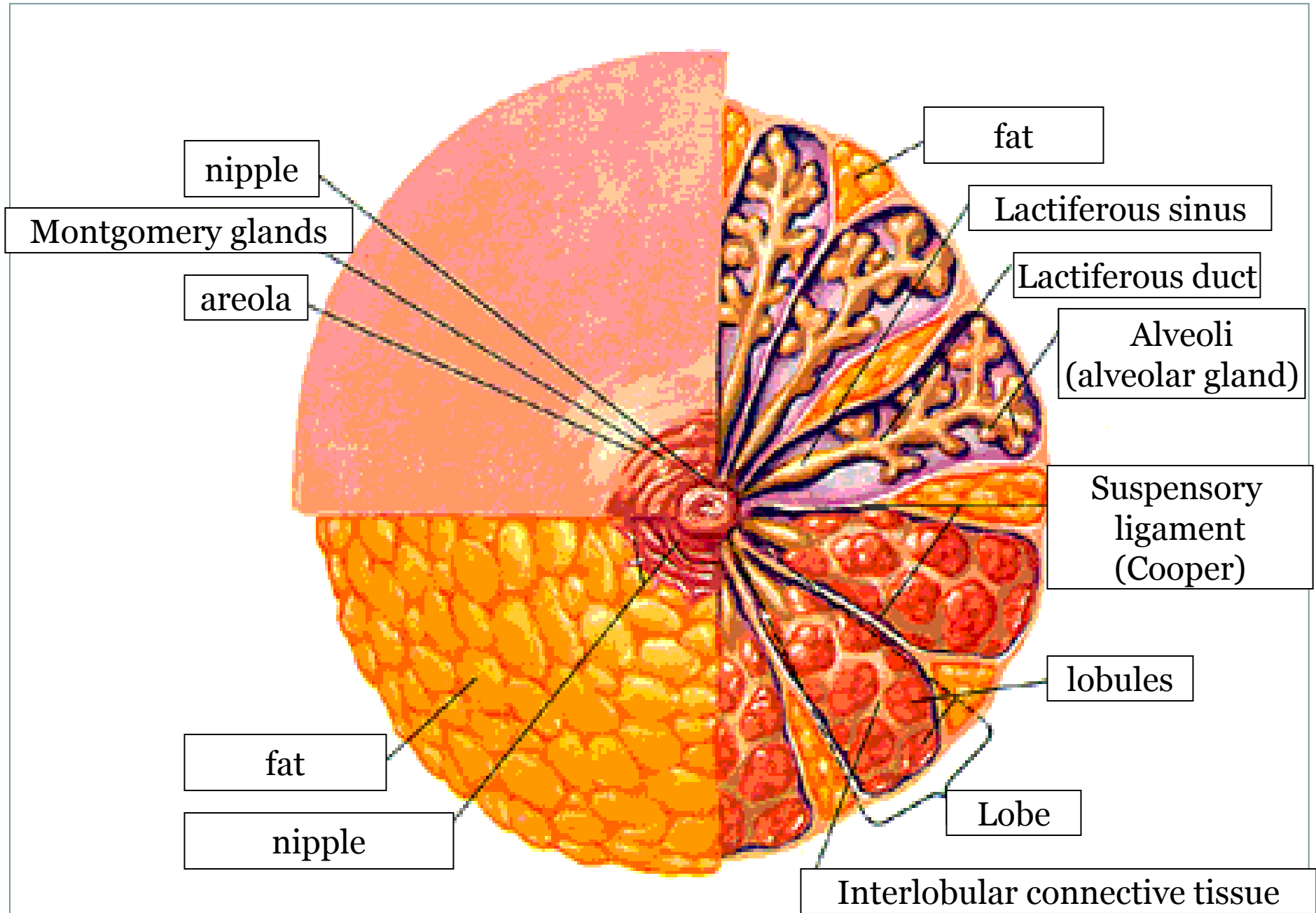
# The structure of the breast and mammary glands



# Structures of the Mammary Gland

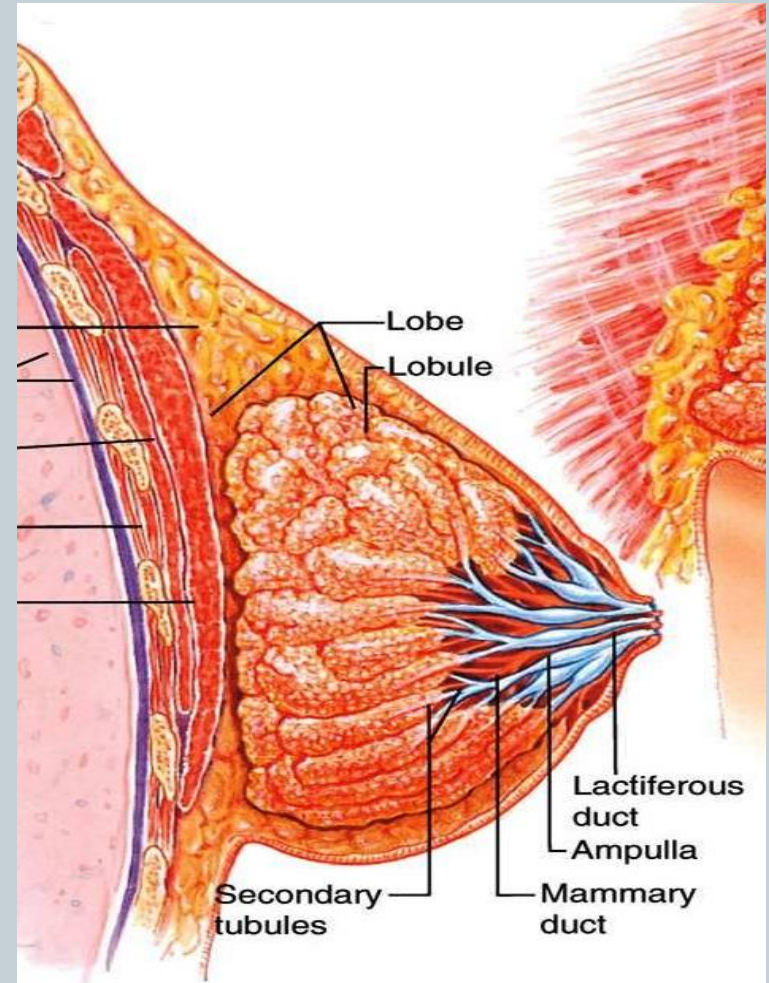


- Each breast consists of ~ 23 lobes of secretory tissue
  - a. Each lobe has one lactiferous duct
  - b. Lobes (and ducts) are arranged radially
  - c. Lobes are composed of lobules
  - d. Lobules are composed of alveoli

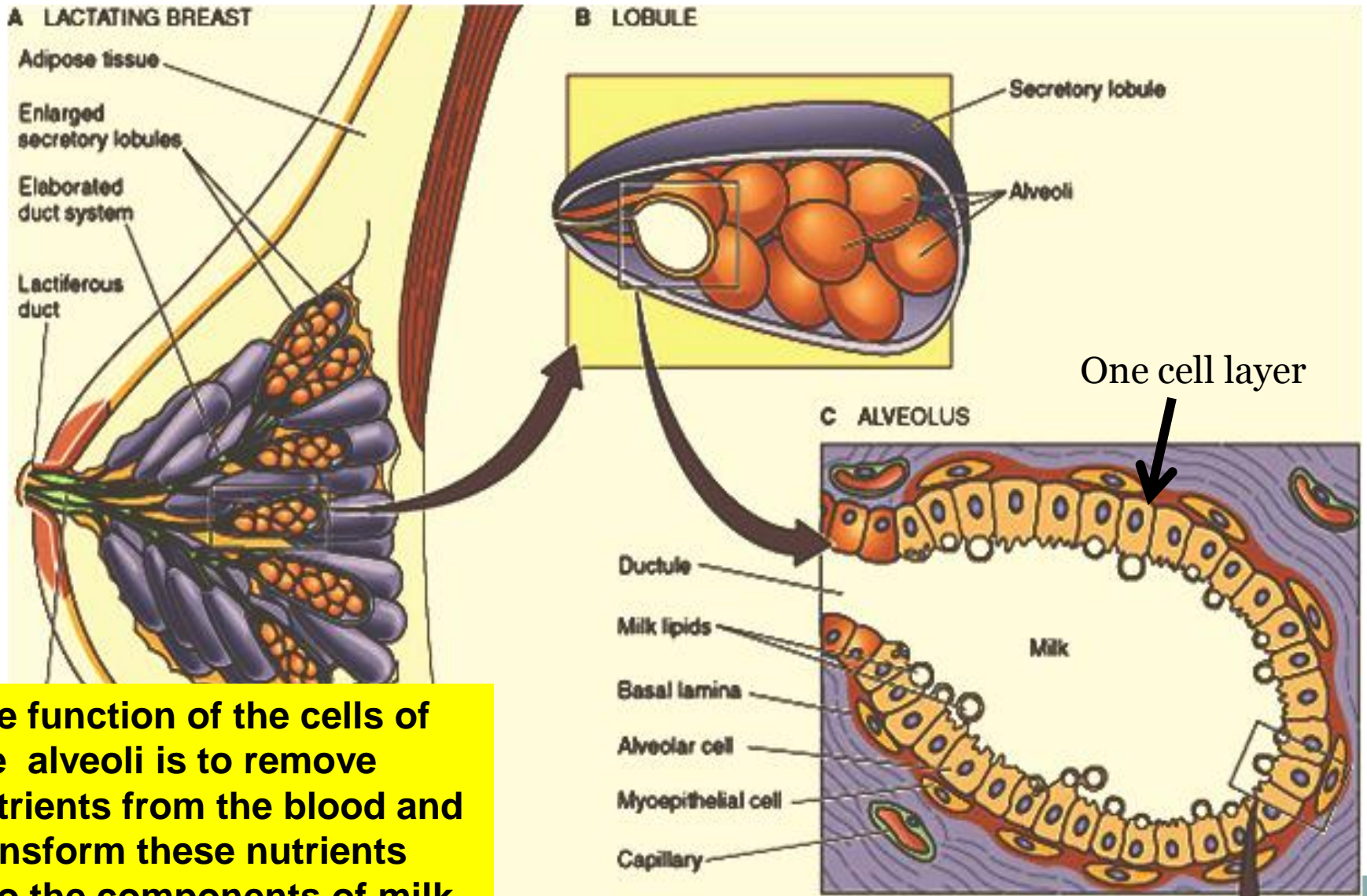


# Ductal System

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



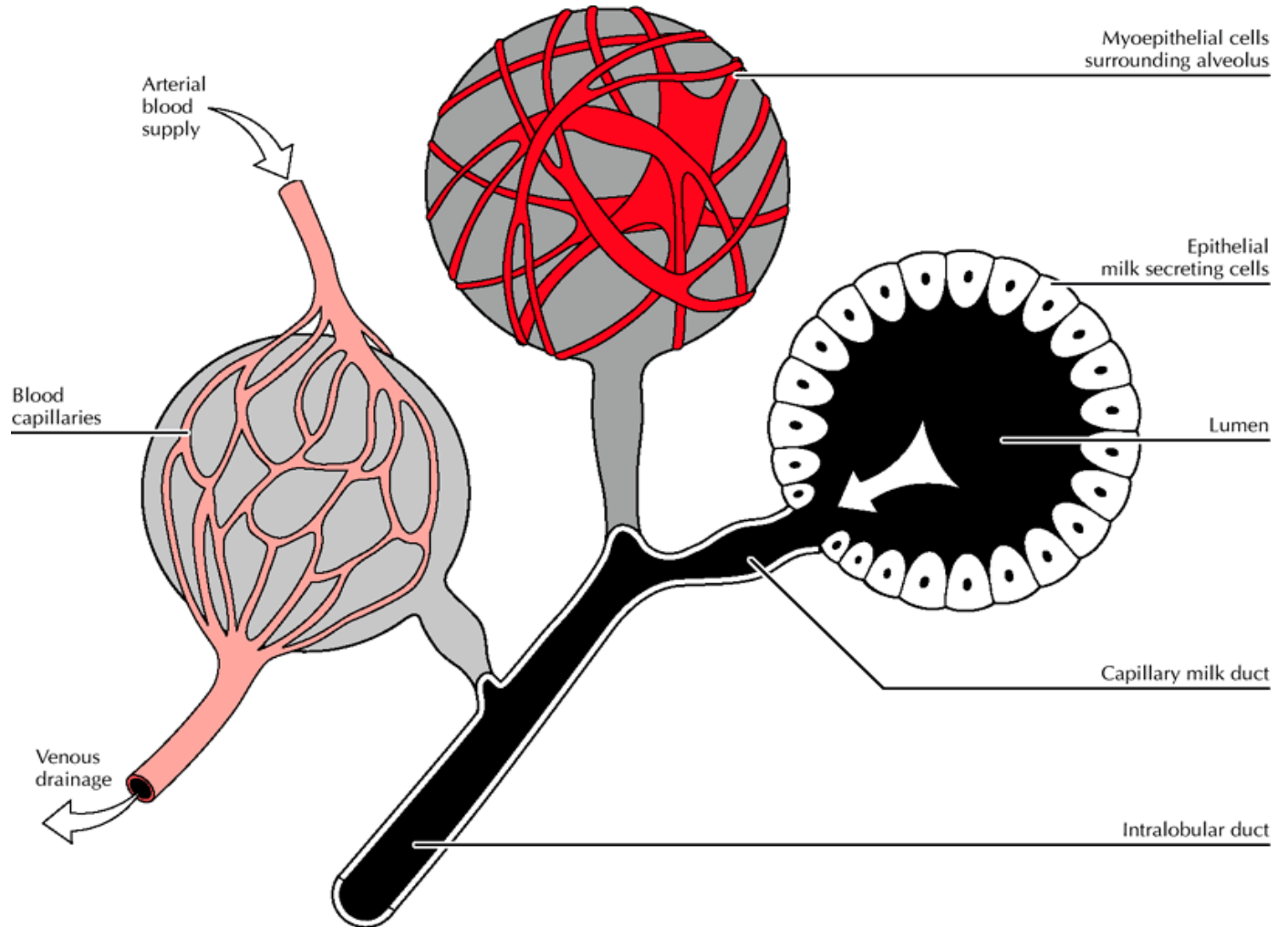
# Lobule-Alveolar System



The function of the cells of the alveoli is to remove nutrients from the blood and transform these nutrients into the components of milk.



# Where does milk come from?



# Stages of Development of The Mammary Gland



1) **Mammogenesis** (*mammary gland growth*).

2) **Lactogenesis** (*initiation of milk secretion*):

**Phase 1**

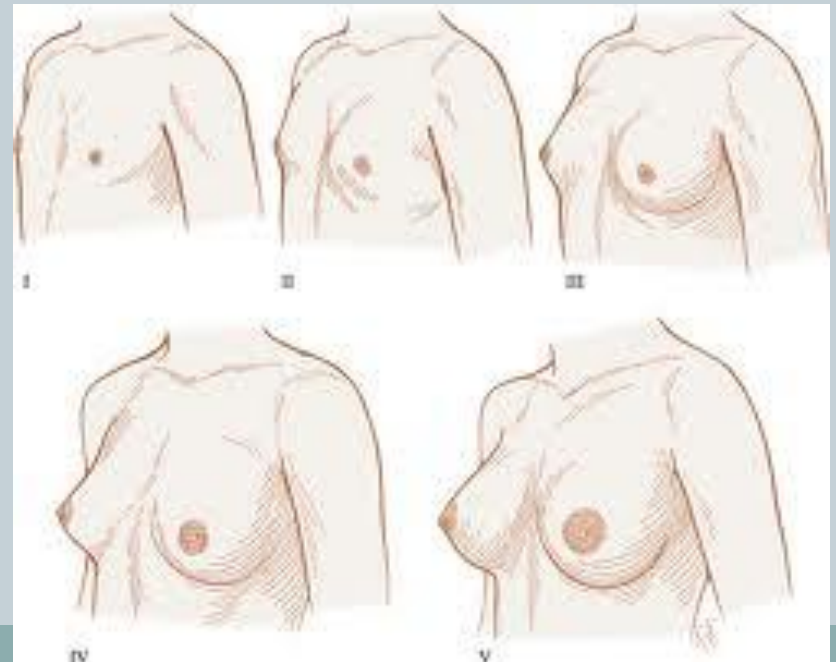
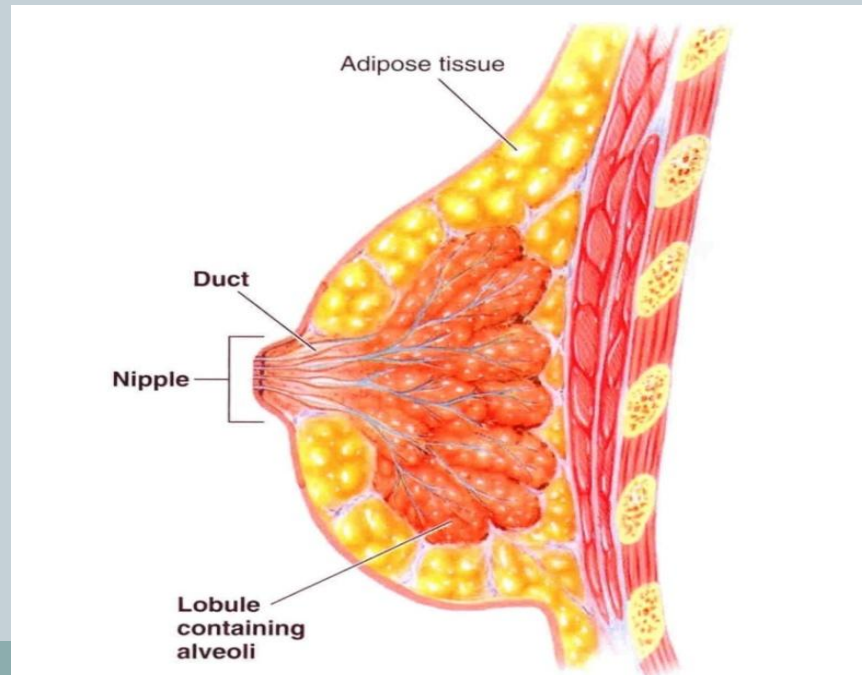
**Phase 2**

3) **Galactopoiesis** (*maintenance of milk secretion in the postpartum period*)

4) **Involution** (*cessation of milk production*)

# Mammogenesis- breast development

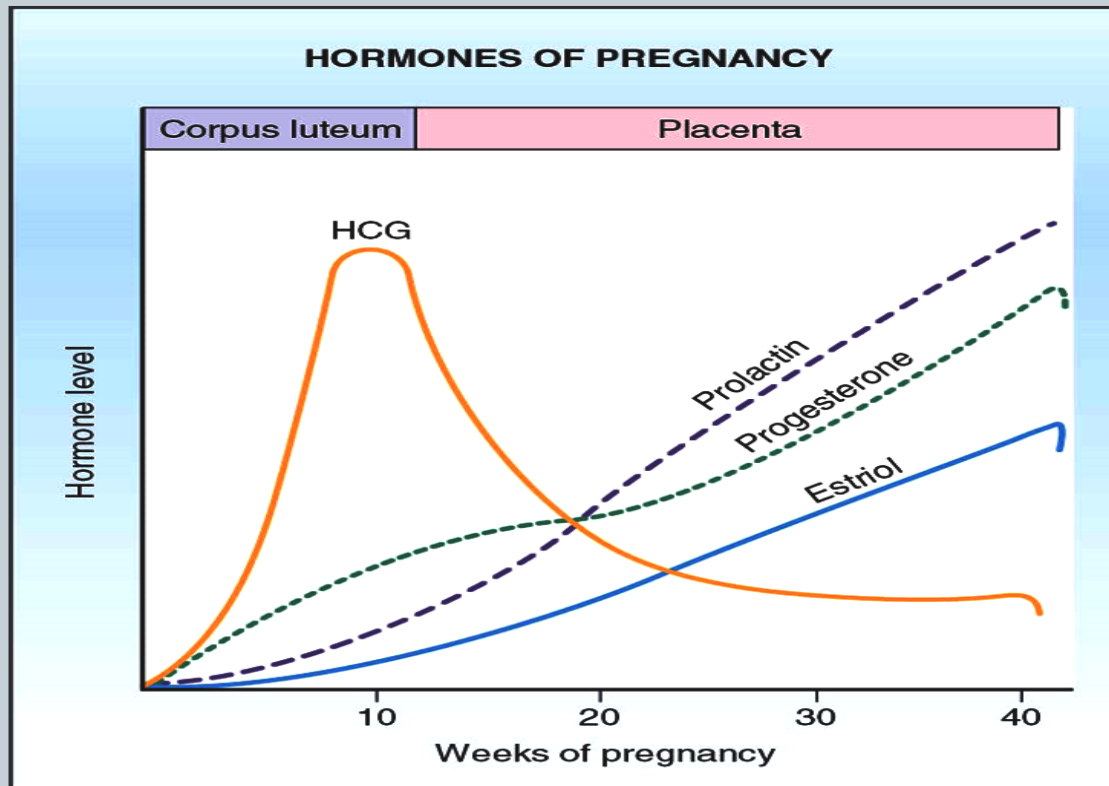
- **During puberty** (Ovarian hormones stimulate mammary growth)
  - **Estrogen** stimulates proliferation of **ducts** and **deposition of fat**.
  - **Progesterone** stimulates development of **lobules**.



# Mammogenesis- breast development



- **During pregnancy**
  - Complete development of mammary glands



# Mammogenesis- breast development



## **Hormones Involved in Mammary Growth**

**Estrogens**

**Progesterone**

**Growth hormone**

**Human placental lactogens (hPL)**

**Prolactin (PL)**

**Glucocorticoids**

**Insulin**

# Mammogenesis- breast development

- **During pregnancy**

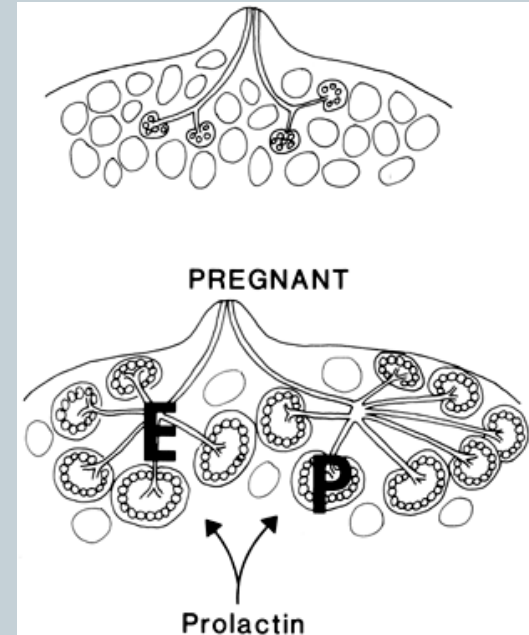
- **Estrogen (placenta)**

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



# Mammogenesis- breast development



- **Prolactin** (anterior pituitary gland)
- Its level rises steadily from the fifth week of pregnancy until birth (10-20 times)
  - It stimulates mammary gland growth, proliferation of alveolar epithelial cells, and gene expression which induce the synthesis of milk components (casein, lactose and lipids)
  - 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 growth of mammary glands
  - supports the prolactin during pregnancy (lactogenic properties)
  - Suppresses the prolactin by stimulating the dopamine.

# Lactogenesis



- **Lactogenesis:** Cellular changes by which *mammary epithelial cell* switches from non-secretory tissue to a secreting tissue (initiation of milk secretion)
- **Involves 2 Phases:**
  - **Lactogenesis 1**
  - **Lactogenesis 2**

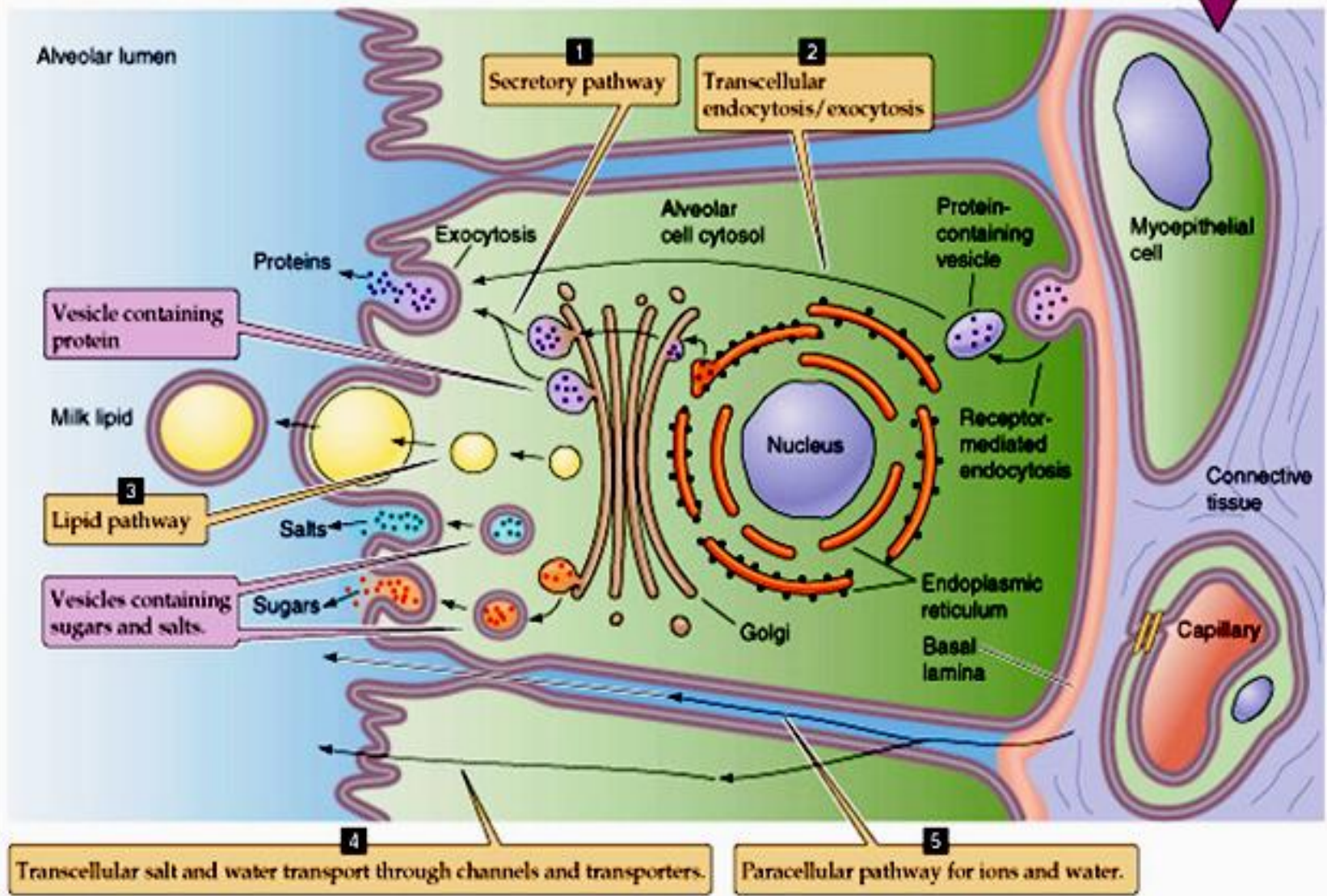


# Lactogenesis



- **Lactogenesis 1:** (Histological and enzymatic differentiation of mammary alveolar cells).
  - Starts in **mid-pregnancy** and characterized by expression of many genes involved in the synthesis of milk components (increases in uptake transport systems for amino acids, glucose, and calcium required for milk synthesis).
  - **ENDOCRINE REGULATION OF LACTOGENESIS :**
    - 1- Progesterone:** blocks epithelial secretion.
    - 2- Prolactin:** growth of mammary gland.
    - 3- Growth hormone:** growth of mammary gland.
    - 4- Glucocorticoids (Cortisol):** induce differentiation of the organelles of the secretory epithelial cell.

D SECRETORY EPITHELIAL CELL



# Lactogenesis



- **Lactogenesis 2:** (Copious secretion of all milk components), **starts 2-3 days postpartum**
- At parturition, withdrawal of **progesterone** + high level of **prolactin** leads to:
  - ✦ Further increase in expression of milk protein genes
  - ✦ Glands absorb large quantities of metabolic substrates from the blood
  - ✦ Movement of cytoplasmic lipid droplets and casein into alveolar lumen
  - ✦ Transfer of immunoglobulins
  - ✦ Secretion of colostrum followed by milk
  - ✦ Suckling stimulates further increase in expression of genes involved in milk secretion with expansion of alveolar epithelium
  - ✦ Lactation is maintained by removal of milk

# Galactopoeisis



- Galactopoeisis is defined as the maintenance of lactation once lactation has been established. **starts 9-15 days postpartum**
- **Galactopoeitic Hormones:**
  - **Prolactin:** the most important galactopoeitic hormones involved in the maintenance of lactation.
  - **Growth Hormone:** supports increase in the synthesis of lactose, protein, and fat in the mammary gland
  - **Glucocorticoids**
  - **Thyroid hormones:** essential for maximal secretion of milk
  - **parathyroid hormones**
  - **Insulin**

## MAMMOGENESIS

Begins in embryo  
Continues through puberty  
Completed during pregnancy

## LACTOGENESIS Stage I & II

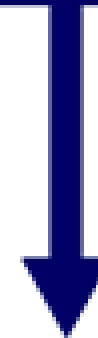
Begins mid pregnancy  
Completed by day 8  
postpartum

## INVOLUTION

From commencement of  
weaning

## LACTOGENESIS Stage III

Begins day 9 postpartum  
Continues until weaning  
Also called galactopoiesis



# Endocrine Control of Lactation

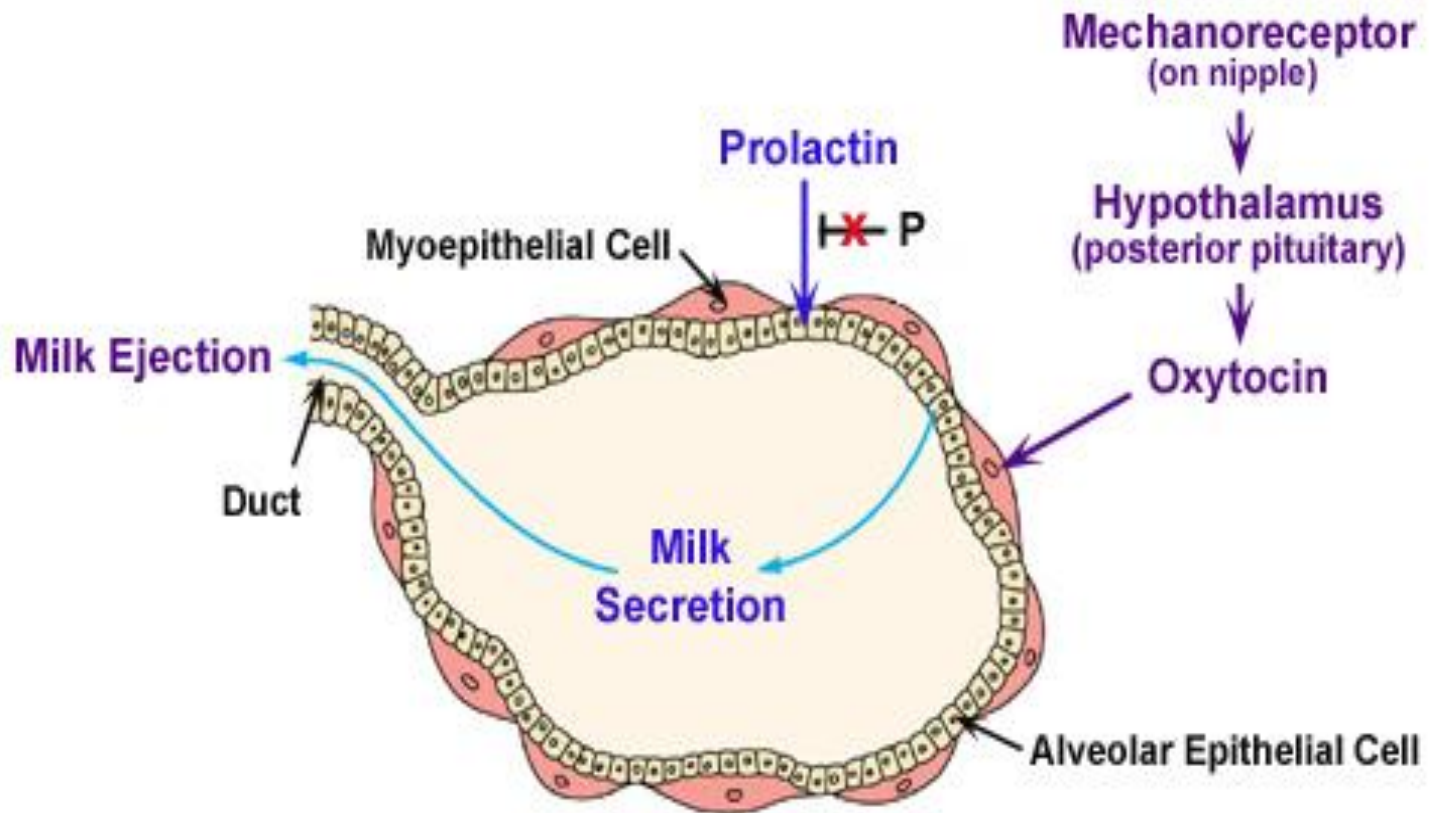


- **Milk Production Reflex:**

***Prolactin*** is a key lactogenic hormone, stimulates initial alveolar milk production, inhibits epithelial cell loss and maintain cellular differentiation.

- **Milk Ejection Reflex:**

***Oxytocin*** contracts the myoepithelial cells, forcing milk from the alveoli into the ducts and sinuses where it is removed by the infant



**Alveolus of Mammary Gland**

# Autocrine Control of Lactation



## Influence of Local Factors Acting on the Breasts

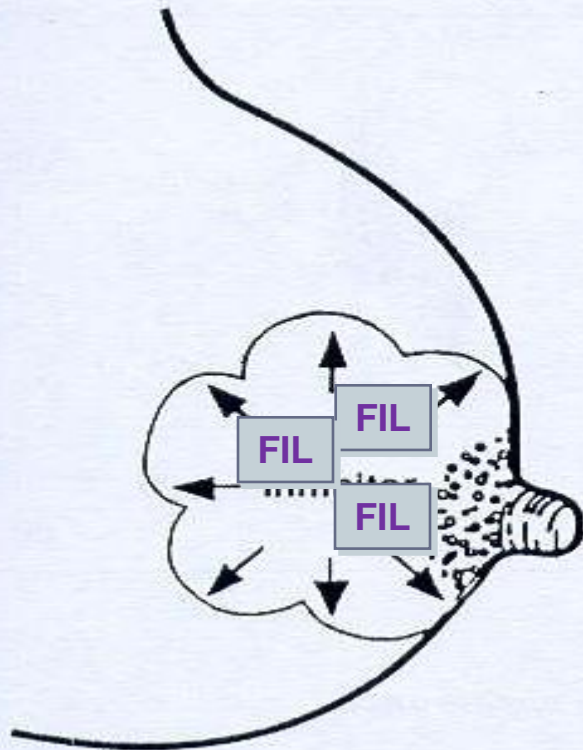
- It is not just the level of maternal hormones, but the efficiency of *milk removal* that governs the volume product in each breast
- A protein factor called *feedback inhibitor of lactation (FIL)* is secreted with other milk components into the alveolar lumen
- *FIL*, insensitive to prolactin → **⬇️ milk production**



# Autocrine Control of Lactation



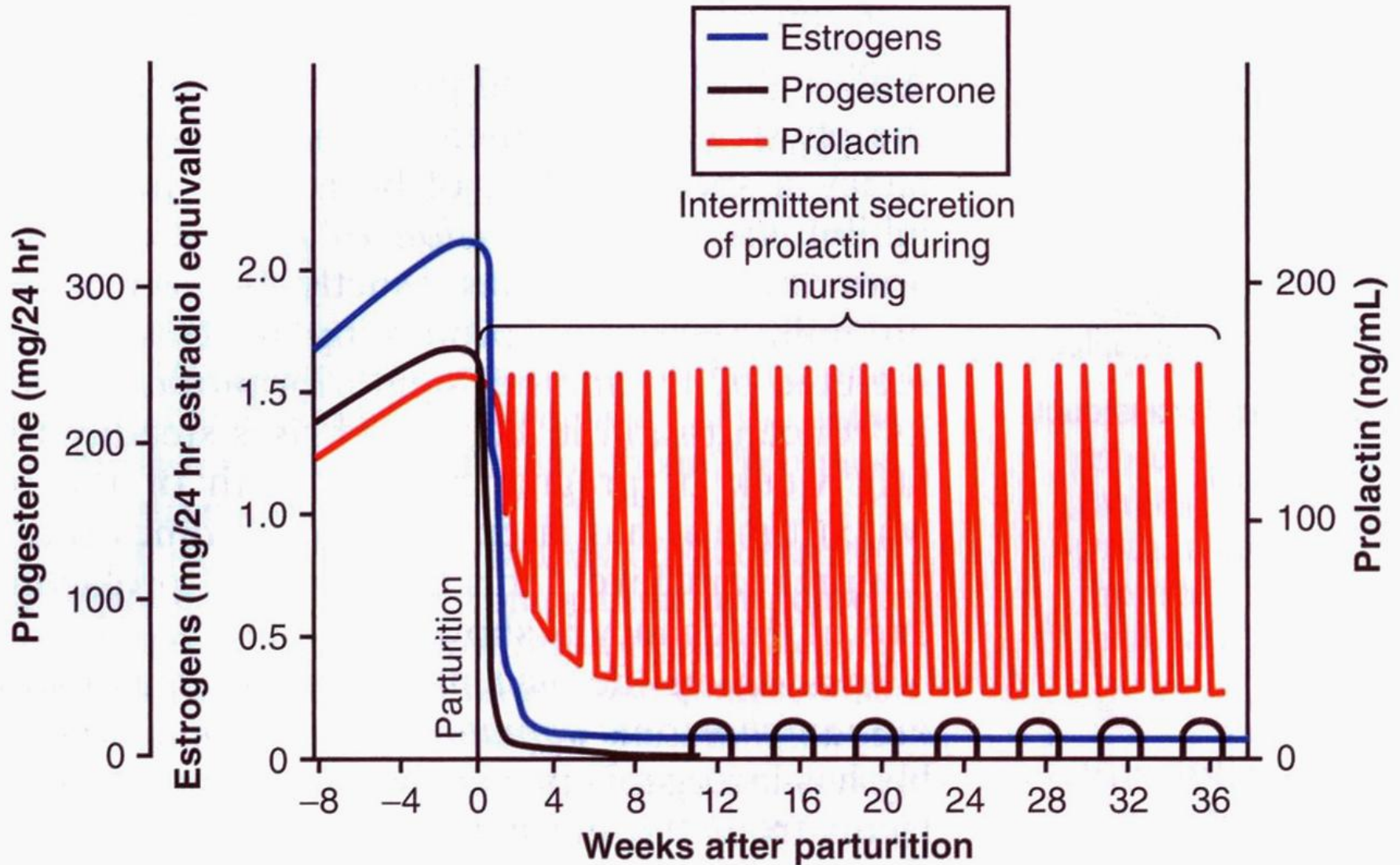
## INHIBITOR IN BREASTMILK



- If breast remains full of milk, secretion stops

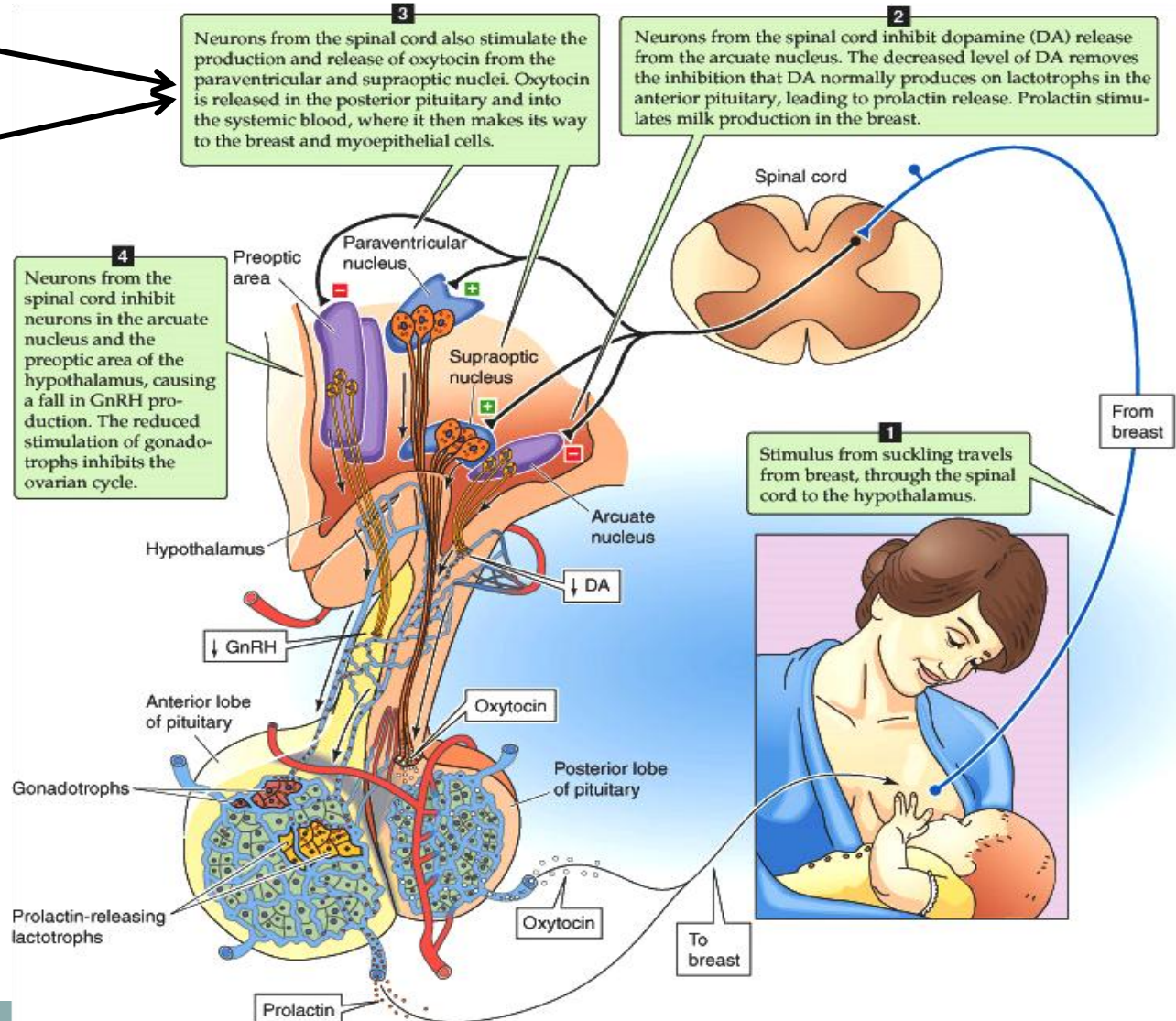
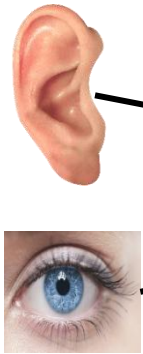
Control of breastmilk production within the breast.

# Suckling and Prolactin Secretion



## Exteroceptive Stimuli

# Suckling reflex



# 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**