

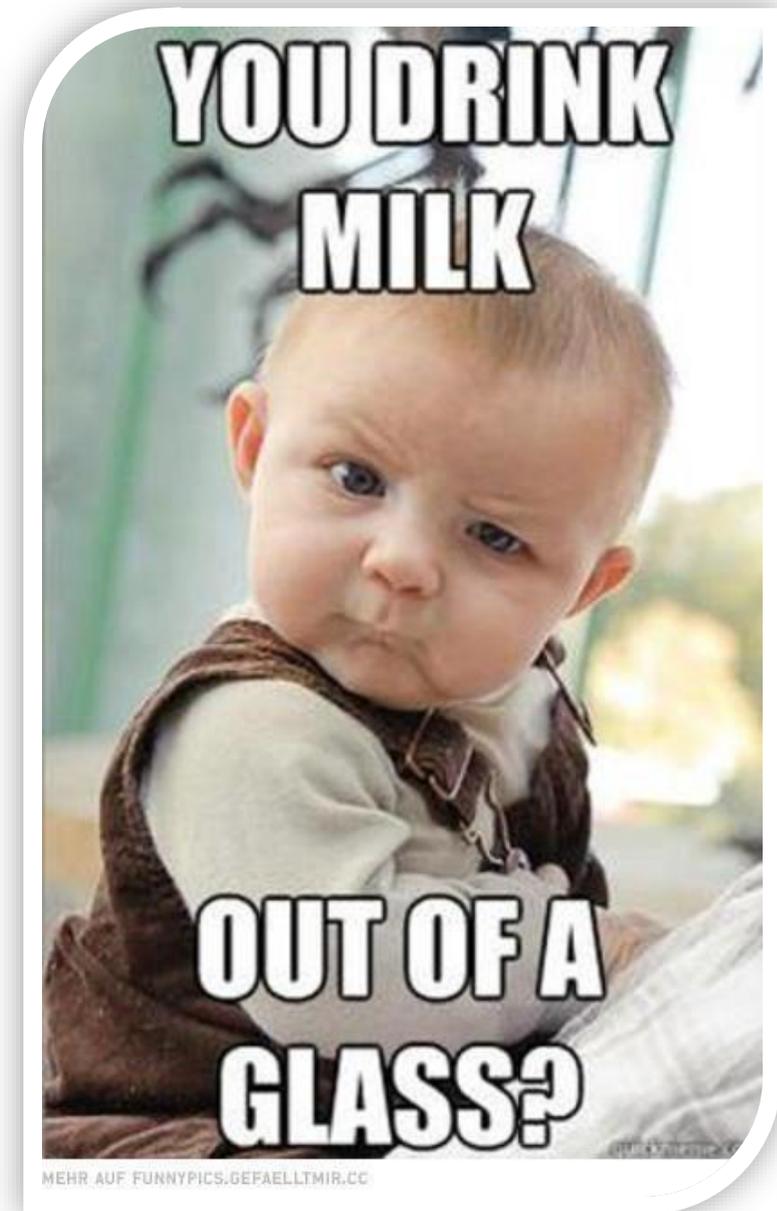


BREASTFEEDING: HOW DOES IT WORK?

Key Components of Breastfeeding

OVERVIEW

- Anatomy of the breast
- Lactation hormones
- Lactogenesis
- Breastmilk composition



ANATOMY OF THE BREAST

- Exocrine Organ
- 3 Major Structures:
 - Skin
 - Corpus mammae
 - Supportive tissues
- Tail of Spence



ANATOMY OF THE BREAST

- Nipple

- Areola

- Pigmented circular area around nipple
- Darkens and enlarges with pregnancy/lactation
- Visual signal to newborns
- Underlying ducts superficial with little underlying fat tissue

ANATOMY OF THE BREAST

- **Montgomery Glands/Tubercles:**
 - Small sebaceous glands around areola
 - Swell during pregnancy/lactation
 - Secrete oily fluid
 - Scent

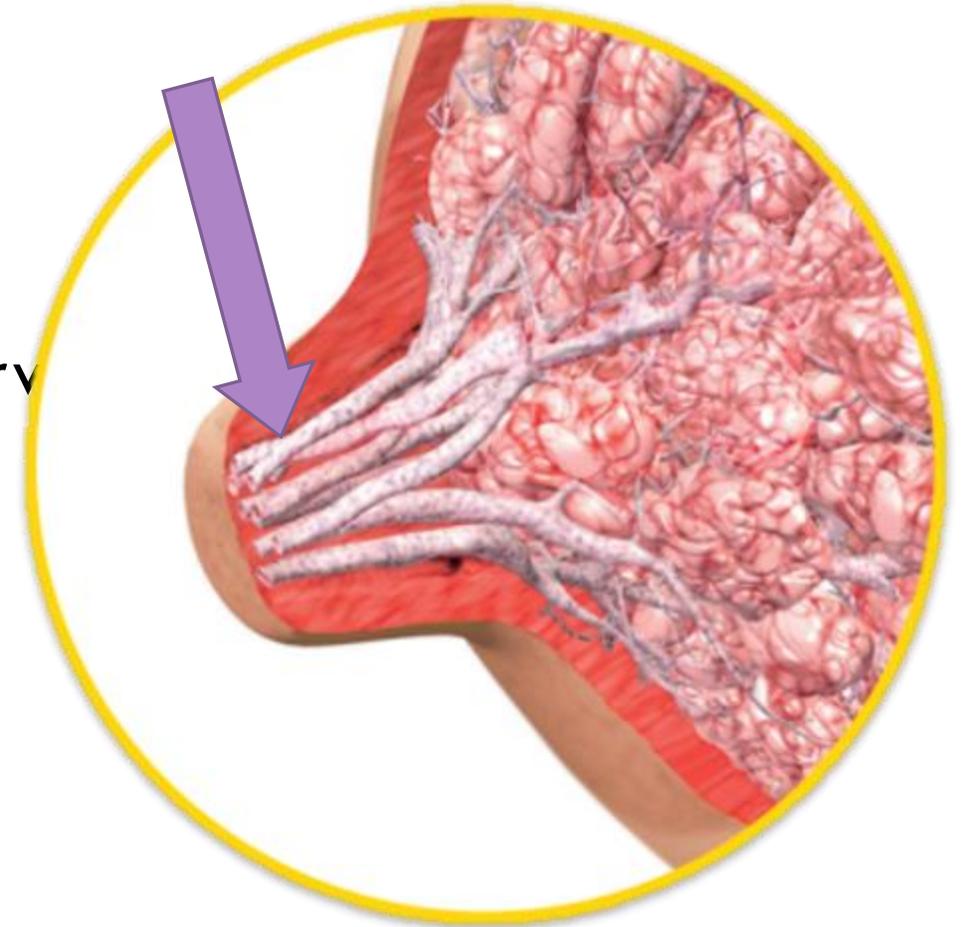
NIPPLE PORES

Nipple:

- Circular smooth muscle fibers, sensory nerve endings & sweat glands
- Erectile tissue

Nipple pores – aka “main ducts”:

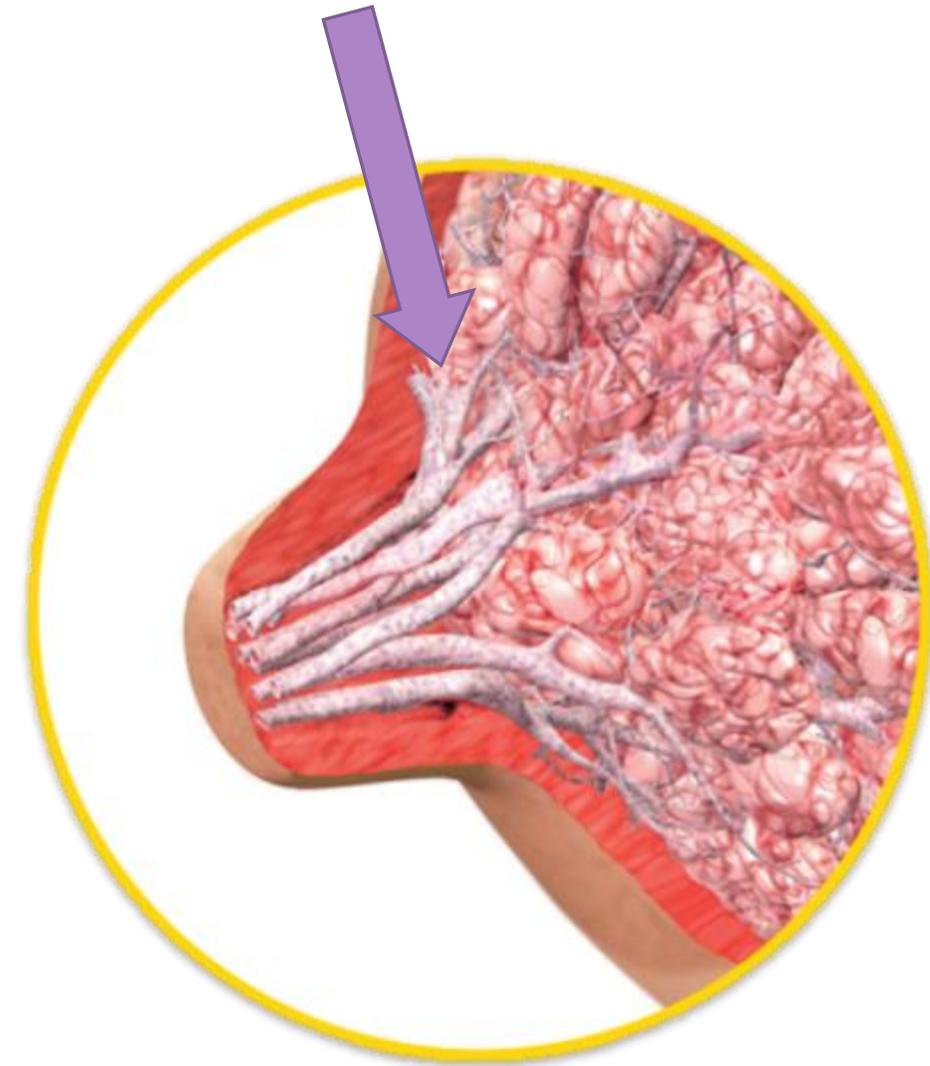
- Ductile openings on the nipple surface
- Average 5-9 (range 1-18)
- Approximately 2mm in diameter



NIPPLE DUCTS

Nipple ducts – “secondary ducts”,
lactiferous ducts:

- Multiple ducts share a few common nipple pores
- Average 23-27 (range 11-48)
- Duct system is random and varies significantly between women
- Main function is transfer of milk
- Ducts widen during milk transfer, then collapse when milk flow ceases



LOBE & LOBULE

Lobe:

- Ducts branch out into lobes
- Average 15-25 in each breast
- Separate compound alveolar gland in which ducts drain into secondary ducts

Lobule:

- Lobes branch into lobules
- Average 20-40 make up each lobe
- Contain clusters of alveoli



ALVEOLI

Alveoli:

- Average of 10-100
- Milk producing cells
- Smallest functioning unit of the breast
- Surrounded by capillaries delivering nutrient rich blood to produce milk

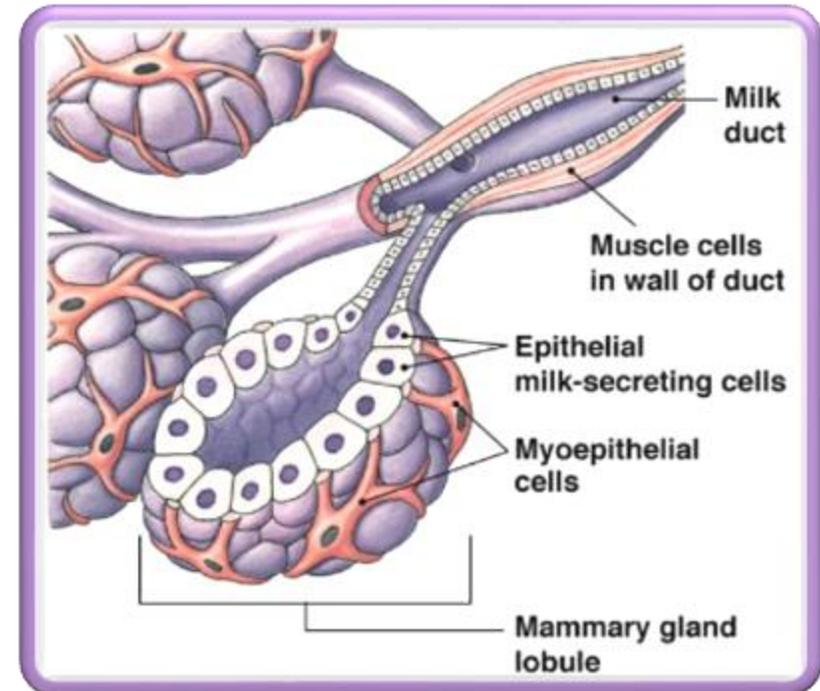
Consist of:

- Secretory epithelial cells (lactocytes)
- Myoepithelial cells



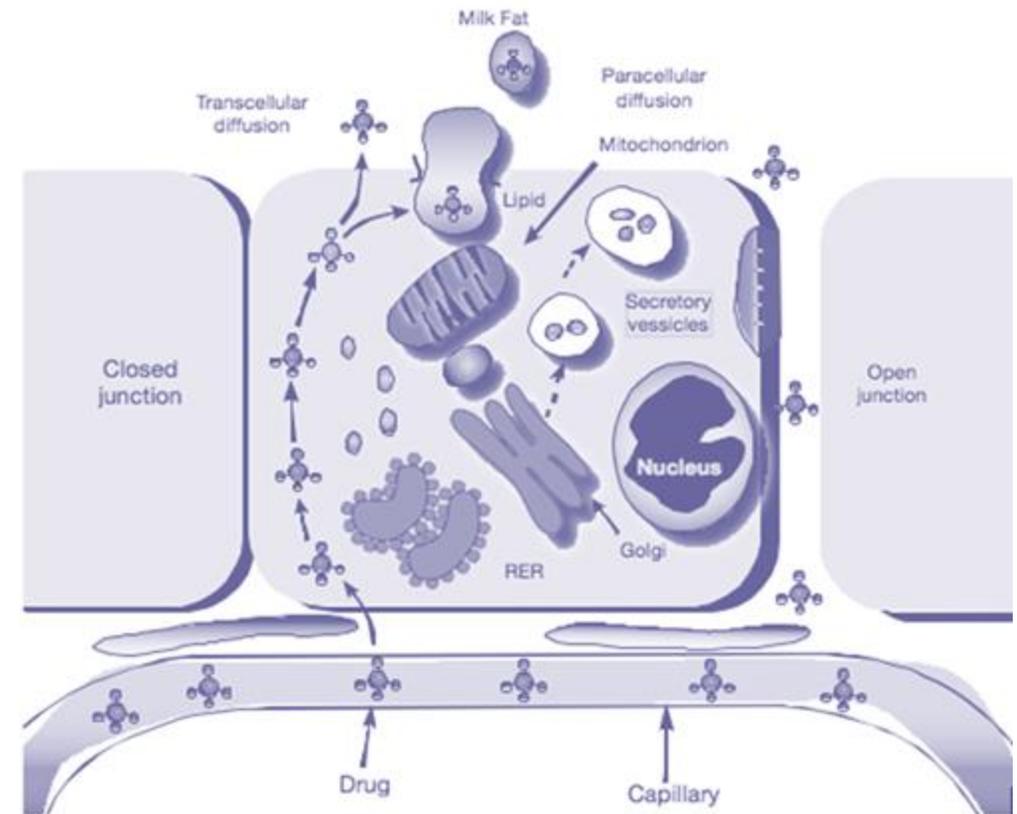
ALVEOLI

- Epithelial cells (Lactocytes)
 - Continuous inner lining of alveoli and ducts
 - Milk *secreting*
- Myoepithelial cells
 - Dense, meshwork of smooth muscle encases lactocytes
 - Milk *moving*
 - Contract from oxytocin stimulation



ALVEOLI

- Large gaps between alveolar cells exist during the first 4-10 days of life
- Soon after the first week, the alveolar cells swell, subsequently closing the intracellular gaps



ANATOMY OF THE BREAST - SUPPORTIVE TISSUES

Nerves:

- *Deep latch* and vigorous sucking stimulate deeper nerves of breast
- Triggers oxytocin release and milk letdown

Fatty Tissue:

- Distributed between lobuli and ducts (except under areola)
- More fatty tissue = larger the breast
- Size is not related to milk producing capability

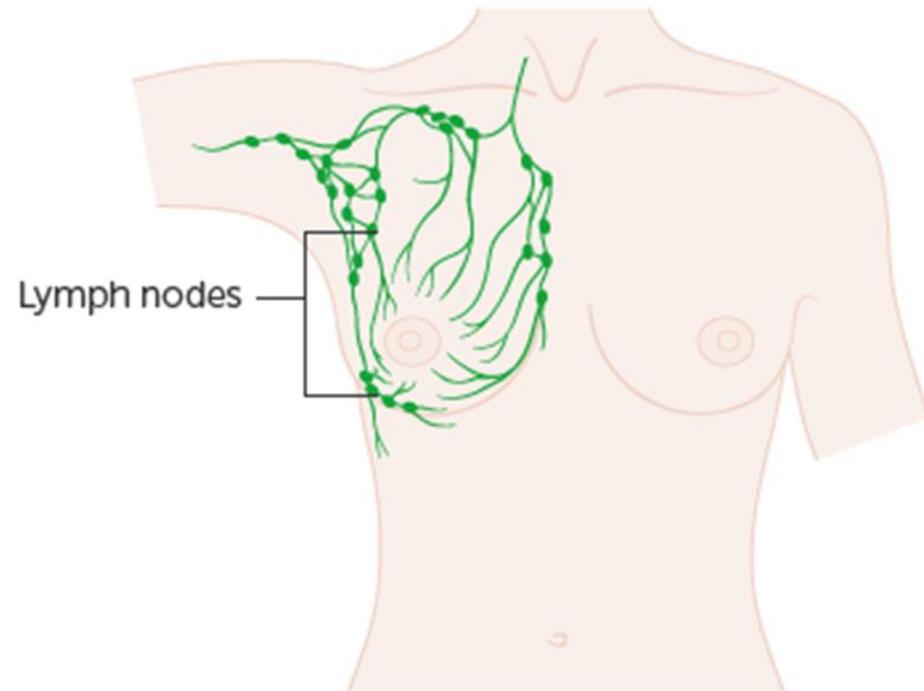
ANATOMY OF THE BREAST - SUPPORTIVE TISSUES

Blood:

- Provides nourishment: proteins, fat, carbohydrates, etc.
- Circulation varies based on body's needs

Lymphatic System

- Drains excess blood fluids from breast
- Lymph nodes trap bacteria
- Most lymph flows into nodes in axilla



NIPPLE VARIATIONS

Common



Short Shank

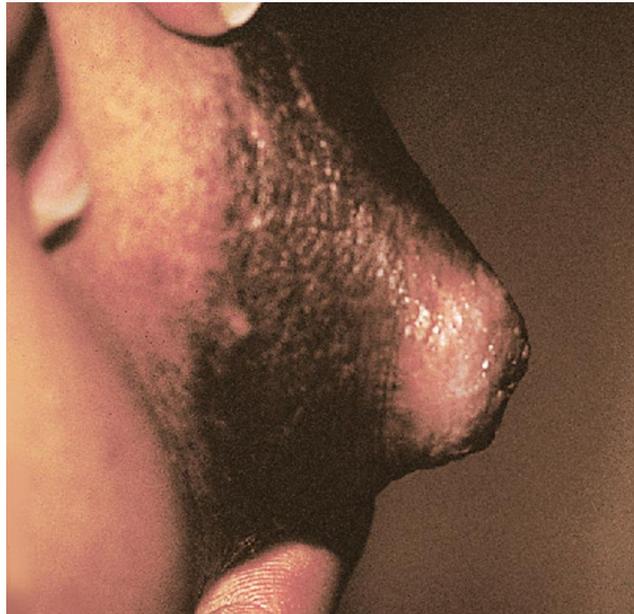


Flat



NIPPLE VARIATIONS

Inverted Appearing vs. True Inverted



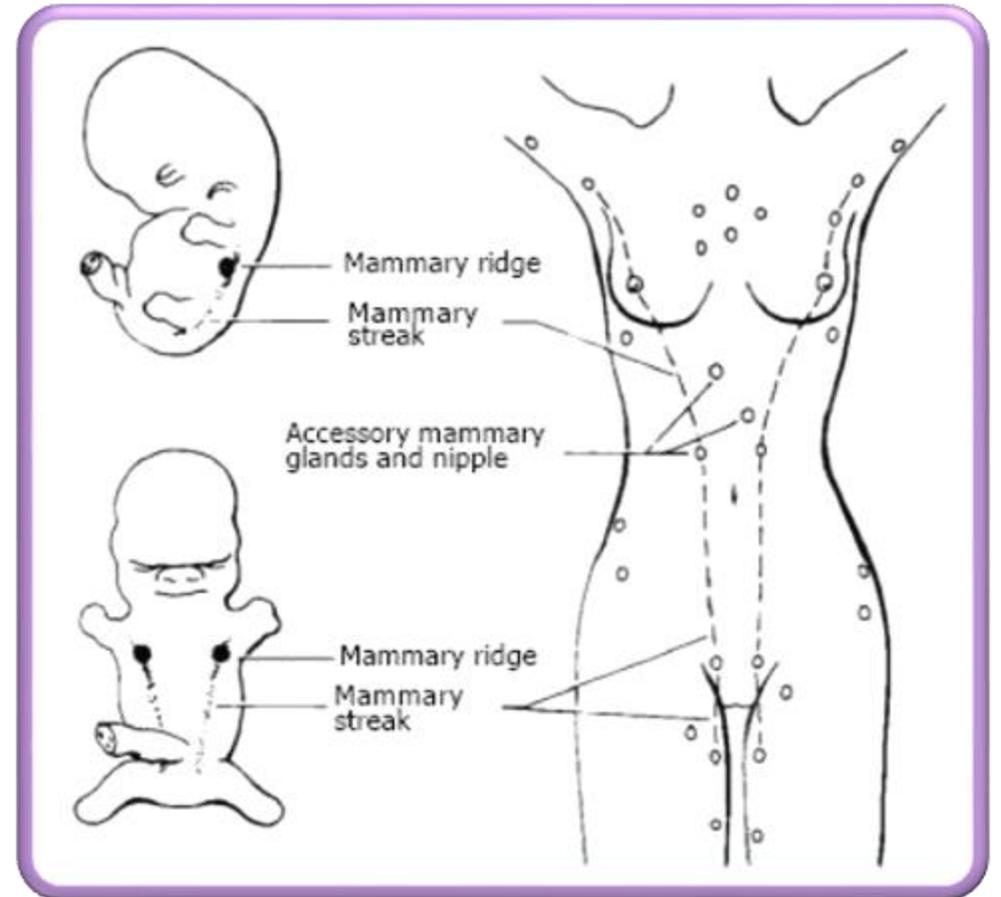
NIPPLE PINCH TEST

- Perform the “nipple pinch test” to determine nipple type
- Mimics what the nipple does when the baby is nursing
- Place hand in C position, thumb and finger around areola, and compress inward toward chest
 - A “normal” nipple moves forward
 - Flat nipple neither inverts or everts
 - Inverted nipple moves further inwards in breast tissue
 - Retracted nipple appears graspable but retracts on stimulation/with pinch test

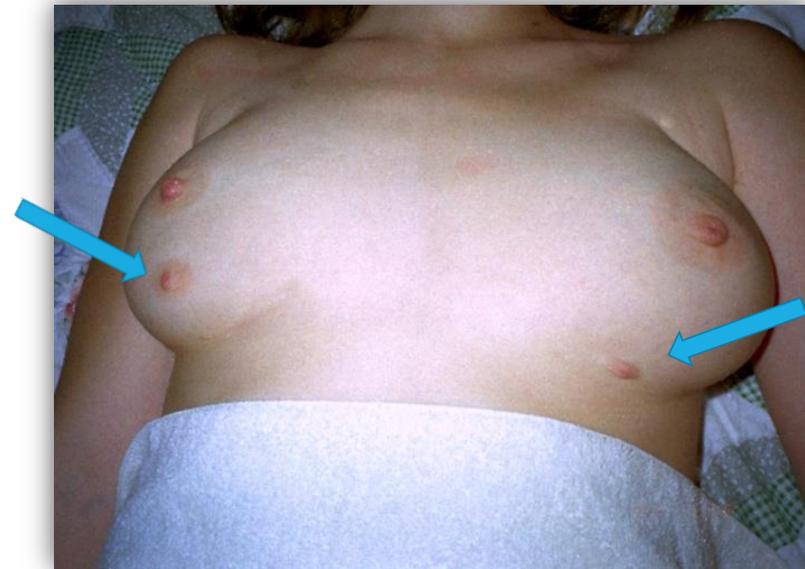
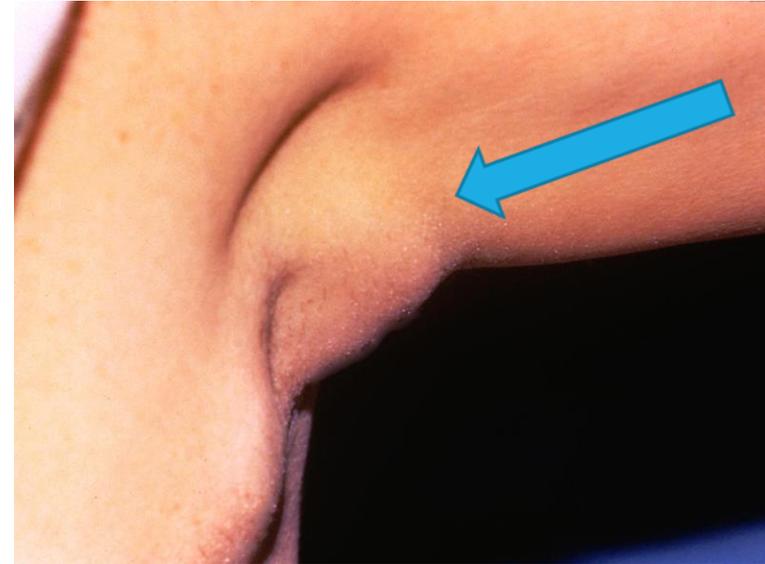


ACCESSORY BREAST TISSUE

- **Milk Line:** breasts develop from a line of glandular tissue found in fetus
- **Accessory breast tissue:** ectopic nipples, areola, or breast tissue



ACCESSORY BREAST TISSUE



PHYSIOLOGY OF LACTATION

Mammogenesis:

- Growth and development of the mammary gland
- Phase 1: onset of puberty
- Phase 2: occurs early in pregnancy

Lactogenesis:

- Establishment of milk synthesis and secretion
- Begins mid to late pregnancy and continues until cessation of breastfeeding
- 3 phases

LACTOGENESIS

Lactogenesis I	Lactogenesis II	Lactogenesis III
<ul style="list-style-type: none">• Initiation of milk synthesis• Secretion begins in the second trimester• Continues for a short time after delivery	<ul style="list-style-type: none">• Copious milk production• Triggered by delivery of placenta/fall in progesterone• Changes begin 30-40 hours after birth lasting through 10 days PP	<ul style="list-style-type: none">• Establishment of mature milk production• Continues through lactation cessation.

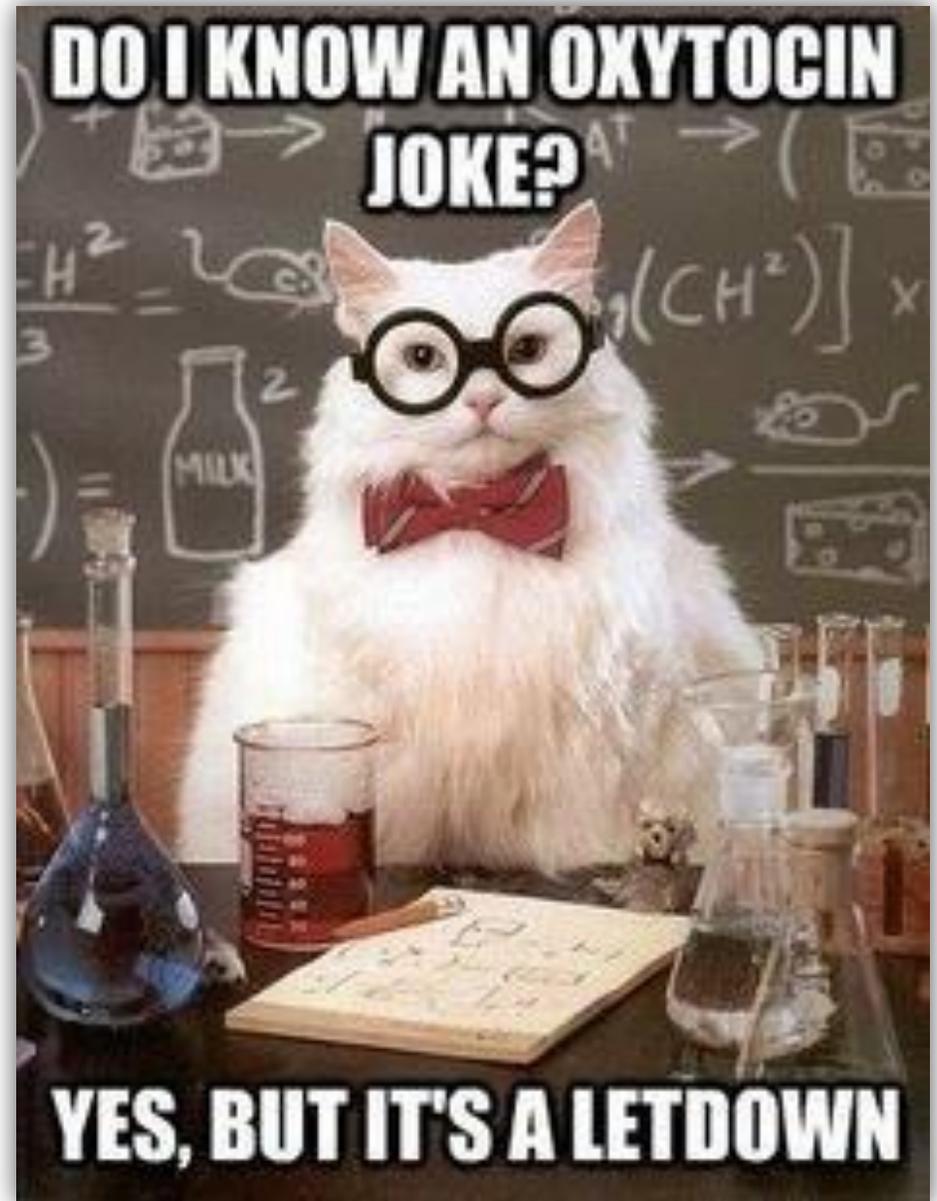
LACTOGENESIS

Delayed Lactogenesis:

- Onset greater than 72 hours after delivery
- Risk factors:
 - Retained placenta or placental fragments
 - C-section delivery
 - Delay in initiation of breastfeeding (>2 hrs after delivery)
 - Endocrine disorders (diabetes, untreated hypothyroidism)
 - Maternal obesity
 - Preterm delivery

HORMONES OF LACTATION

- Progesterone
- Prolactin
- Oxytocin



HORMONES OF LACTATION

Progesterone:

- Produced in the ovaries and placenta
- Assists with active development of milk secreting cells during pregnancy
- Key *inhibiting* hormone for prolactin
- Levels drop after delivery of the placenta
- Initiates lactogenesis II

HORMONES OF LACTATION

Prolactin:

- Produced in the placenta and anterior pituitary
- Stimulates alveolar growth during pregnancy
- Critical for the establishment and maintenance of milk production
- Production triggered by delivery of placenta
- Credited with maternal inducing behavior

HORMONES OF LACTATION

Prolactin:

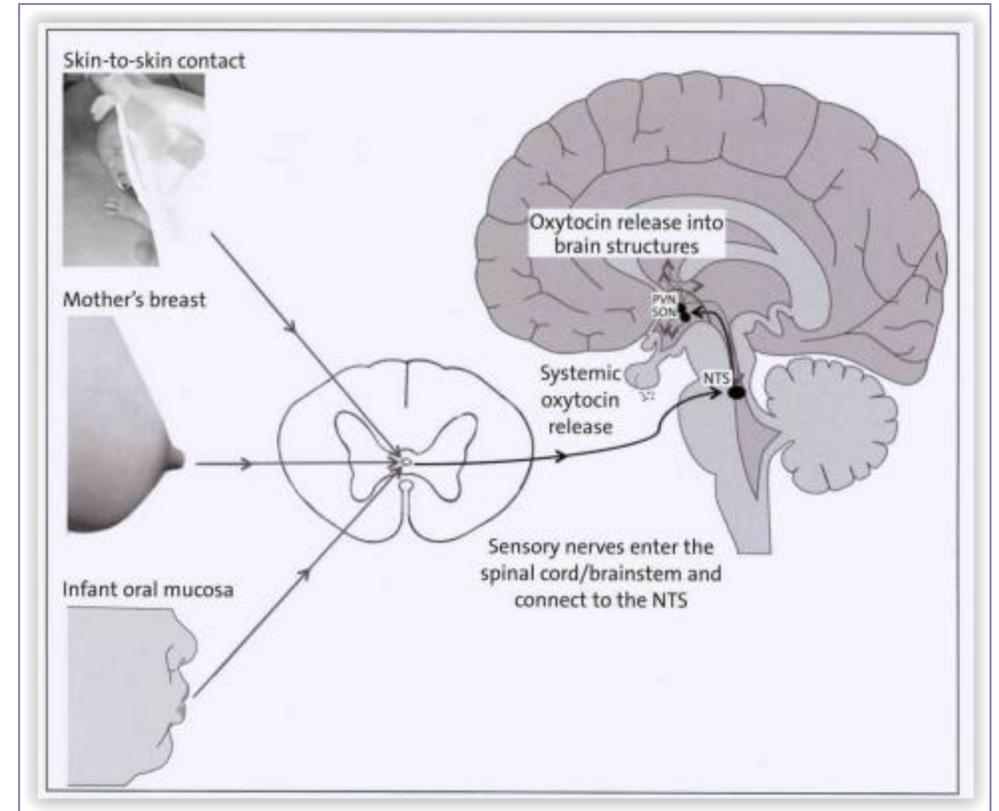
- Release is triggered by tactile stimulus
- Levels are highest at night
- Interventions to maintain high levels of prolactin:
 - Effective latch
 - Avoiding use of artificial nipples
 - Unlimited infant access to breast



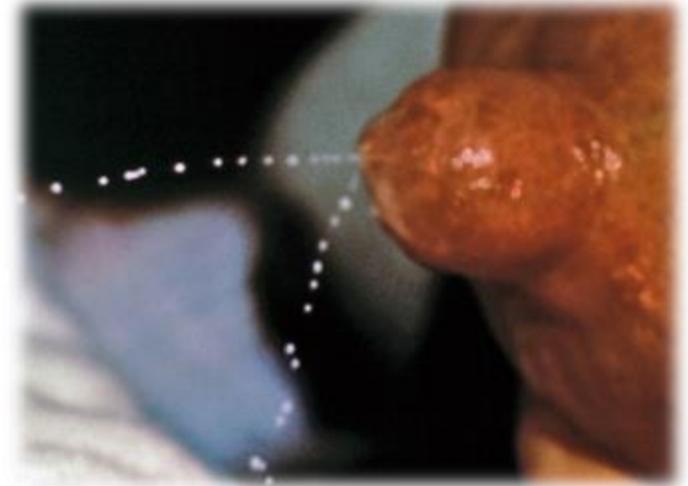
HORMONES OF LACTATION

Oxytocin:

- Produced in the hypothalamus and stored in posterior pituitary
- “Mothering hormone”
- Maternal/Infant effects:
 - Increased social interaction & synchronized responses to one another
 - Calming effect (decreased infant crying)
 - Increased pain threshold
 - Decreased cortisol levels
 - Skin temperature increases



HORMONES OF LACTATION



Oxytocin:

- Responsible for the Milk Ejection Reflex (MER)
- Several minutes of stimulus is needed to produce high enough levels of oxytocin to stimulate milk letdown.
- Release continues in pulse-like manner throughout feeding
- Stimuli of other senses (sight, sound, smell, thought) may also trigger release
- May be inhibited by physiologic, psychologic, and pharmacologic factors

BREASTMILK COMPOSITION

Components:

- Changes throughout lactation
- Fat, proteins, lactose, carbohydrates, fatty acids, hormones, enzymes, peptides, growth factors, vitamins, minerals
- List is continually increasing

Calories:

- The caloric content of breast milk ideal for infant
- Colostrum ≈ 18.76 kcal/oz
- Around two weeks breast milk ≈ 20 kcal/oz
- Around 4 months increase to ≈ 26 kcal/oz

COLOSTRUM

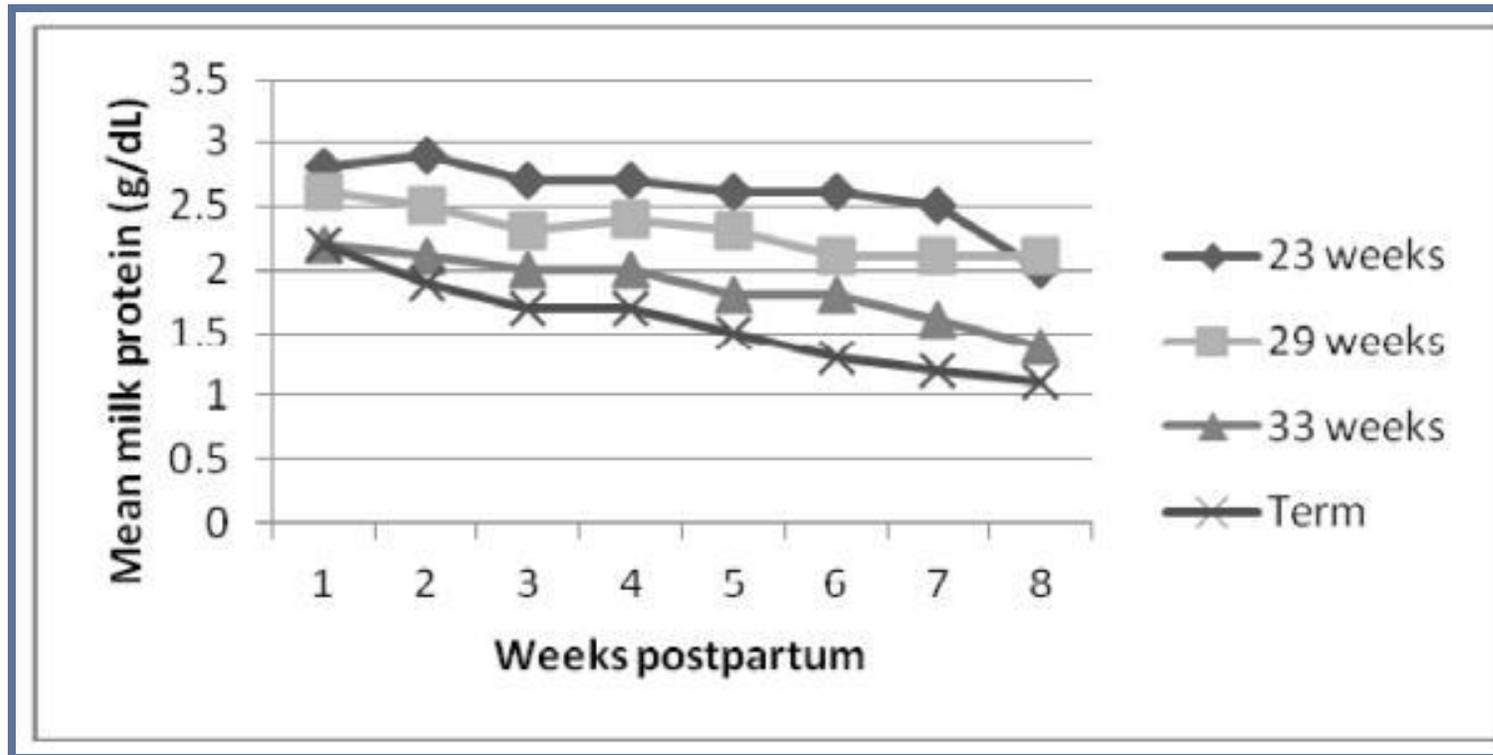
- Production begins around 120 days gestation
- Secreted first 2-3 days after delivery
- Thick, concentrated form of nourishment
- Laxative effect
- Aids in rapid gut closure
- Intake can range from 3-32 mL/kg in first 24 hours

COLOSTRUM

- High in antibodies
- Rich in white cells and antibodies
- High in protein
- Contains a high percentage of protein, minerals, and fat-soluble vitamins A, E, and K
- Yellow color derived from vitamin A content

PRETERM MILK

Higher in fat, protein and total energy composition



TRANSITIONAL MILK

- Changes within 4 days after birth
- Lasts up to 2 week postpartum
- Decrease in immunoglobulins and total proteins
- Increase in lactose, fat, and total caloric content
- 24 hour volume increases to 556-705 mL

MATURE MILK

- Gradually changes within 2-3 weeks
- Contains all the nutrients needed by an infant in the first 6 months of life
- Largest component is water
- Second largest component is lipids

MATURE MILK - LIPIDS

- Fat concentration varies
- Fats provide one half of the energy content
- Cholesterol concentrations remain consistent regardless of maternal diet

MATURE MILK - PROTEINS

- Proteins include whey and casein (among other components)
- Comparison ratio of whey proteins to casein:
 - Breastmilk = 1.5, meaning 40% casein & 60% whey
 - Formula = 0.25, meaning 80% casein & 20% whey

MATURE MILK - CARBOHYDRATES

- Main carbohydrate is lactose
- Carbohydrates have bifidus factor activity
- Lactose is essential for calcium and iron absorption and CNS development
- Levels are relatively constant, despite maternal diet

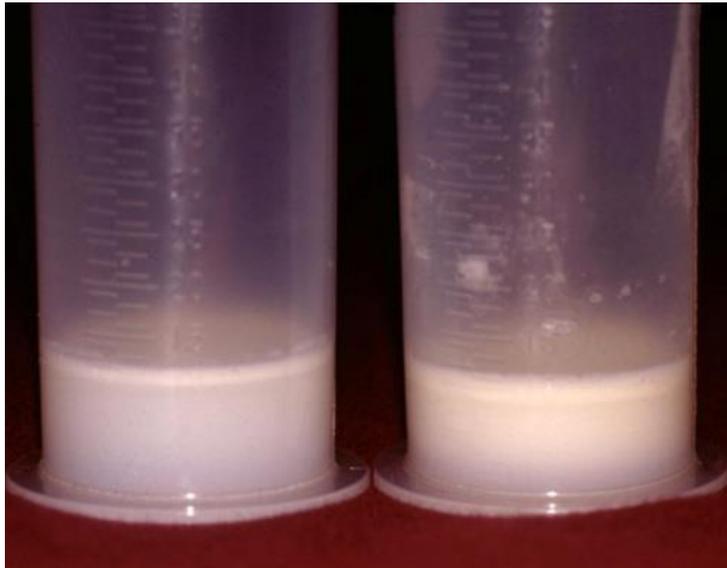
MATURE MILK - ENZYMES

- More than 20 active human milk enzymes
- Three categories by function:
 - Mammary gland function
 - Compensatory digestive enzymes
 - Milk enzymes

BREASTMILK COMPOSITION

Foremilk:

- Available first minutes of feeding



Hindmilk:

- Comprises 2/3 of total feeding volume
- Higher in fat content
- Limiting time at the breast may decrease baby's hindmilk intake

BREASTMILK COMPOSITION

	Protein	Fat	Immune Factors	Vitamins/ Minerals	Carbohydrates	Whey/Casein ratios
Colostrum (C)	Higher than M; Lactoferrin highest	Lower than M	IgA higher than M; Lysozyme high	High fat soluble vitamins (A, E, K)	Lower than M	90:10
Preterm (P)	Higher than term C	Higher than term M	IgA higher in C than term; M is similar to term		Similar to term	
Mature (M)	Lower than C	Higher than C	Decreased levels of IgA	Fat soluble lower than C; Water soluble varies with maternal diet	Higher than colostrum	60:40
>12 months/ Regression (R)	Overall increase; Similar to C	No significant change	IgA levels high; similar to C	Zinc and calcium decreased	No significant change	50:50

REFERENCES

Ballard, O. & Morrow, A. L. (2013). Human milk composition: Nutrients and bioactive factors. *Pediatric Clinics of North America*, 60(1), 49-74. doi: 10.1016/j.pcl.2012.10.002

Cripe J., Eskander R., & Tewari K. (2015). Sentinel lymph node mapping of a breast cancer of the vulva: Case report and literature review. *World Journal Clinical Oncology*, 6(2), 16-21. Retrieved from <https://www.wjnet.com/2218-4333/full/v6/i2/WJCO-6-16-g001.htm>

Lauwers, J. & Swisher, A. (2021). *Counseling the nursing mother: A lactation consultant's guide* (6th ed.). Burlington, MA: Jones & Bartlett Learning.

Lawrence, R. A. & Lawrence, R. M. (2021). *Breastfeeding: A guide for the medical profession* (8th ed.). Philadelphia, PA: Elsevier.

Medela (2009). Anatomy of the lactating breast. Retrieved from <https://www.medela.com/breastfeeding-professionals/research/breast-anatomy>

Moberg, K. U. & Prime, D. K. (2013). Oxytocin effects in mothers and infants during breastfeeding. *Infant*, 9(6), 201-206. Retrieved from <http://content.ebscohost.com/ContentServer.asp?T=P&P=AN&K=107941463&S=R&D=ccm&EbscoContent=dGJyMNL80SeqK84yOvsOLCmr1Cep7BSr6e4SrCWxWXS&ContentCustomer=dGJyMPGrTVGyr7VQuePfgeyx44Dt6fIA>

Wilson-Clay, B. & Hoover, K. (2005). *Breastfeeding atlas* (3rd ed.) images. Manchaca, TX: Lactnews Press.