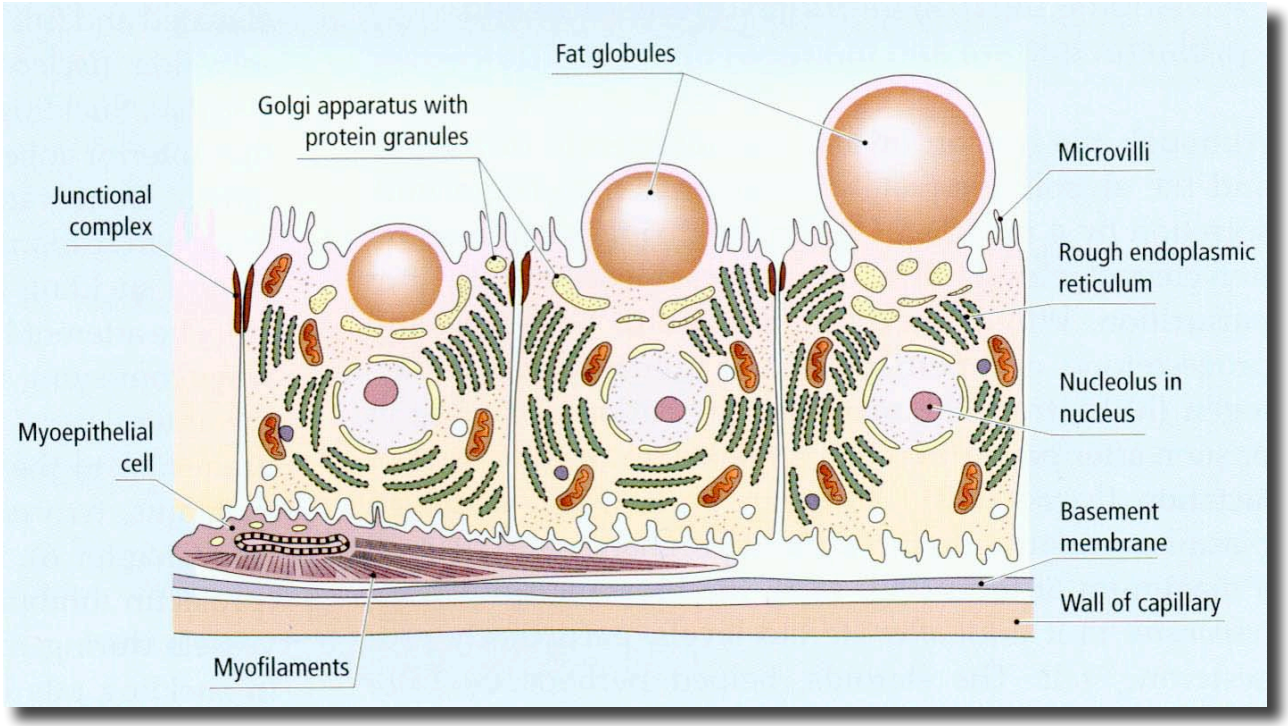
Postpartum Nutrient Provision



Postpartum Nutrient Provision

- Support young until they can obtain their own food
- Maximizes survival
- Speeds postpartum development
- Critical in migratory species

Crop Milk

- Some birds – pigeons
- Crop sac/gland
  - produce crop milk under stimulation of prolactin
  - prolactin released due to brood patch tactile stimulation
  - prolactin stimulates crop and inhibits ovulation

Mammary Glands

- Milk production by process called lactation
- Mammary gland evolved from sweat glands

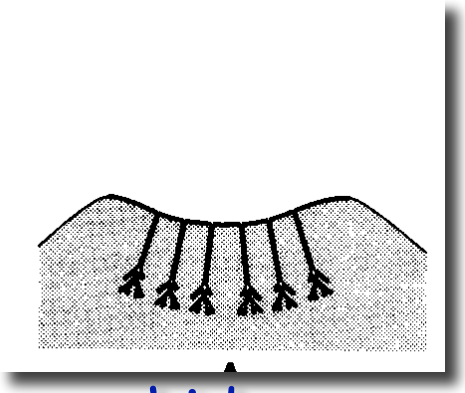
Hypothesis

- Mammal-like reptiles (therapsids)
  - incubated eggs with brood patch or pouch.
  - Moist patch conducive to optimal growth and survival.
- Secretions of salt, proteins and fat
  - serve as a nutrient source
  - maximize growth and survival.
- Localized sweat glands would enlarge for increased synthesis.

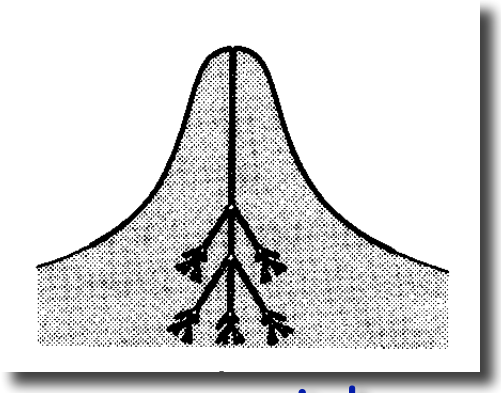
Monotremes

- Numerous small milk-secreting glands
  - open onto two ventrolateral areas of bare skin
  - MILK FIELDS or AREOLAE
- Platypus
  - female lies on back - milk is released onto skin
  - sucked up by young using mammary hairs
- Echidna
  - milk fields in fold of skin - marsupium
  - mechanism similar to that in platypus

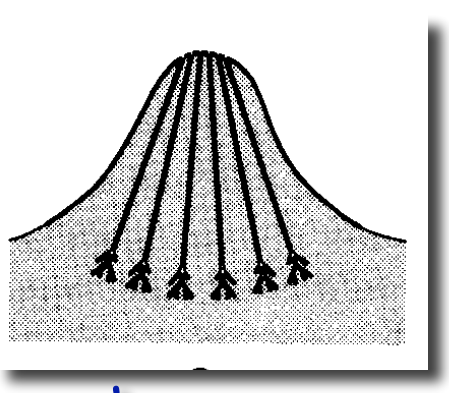
Mammary Organization



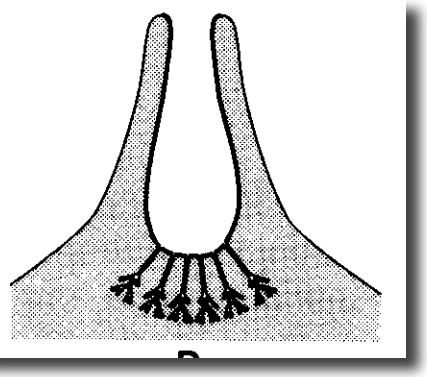
echidna



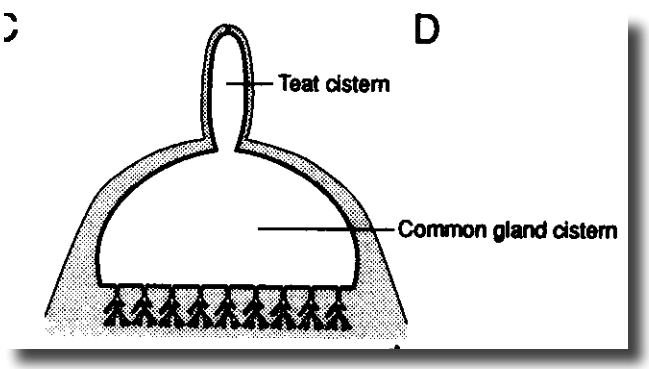
marsupial



human



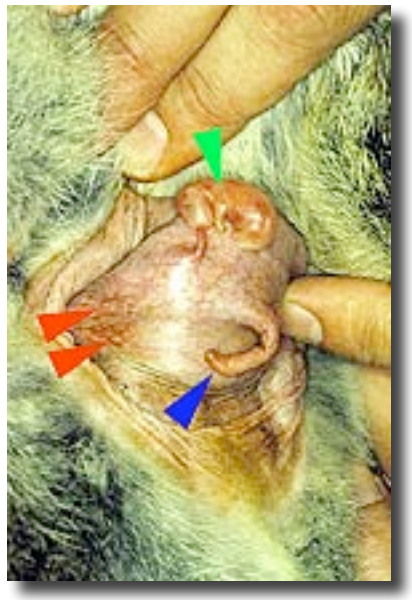
ungulate



cow

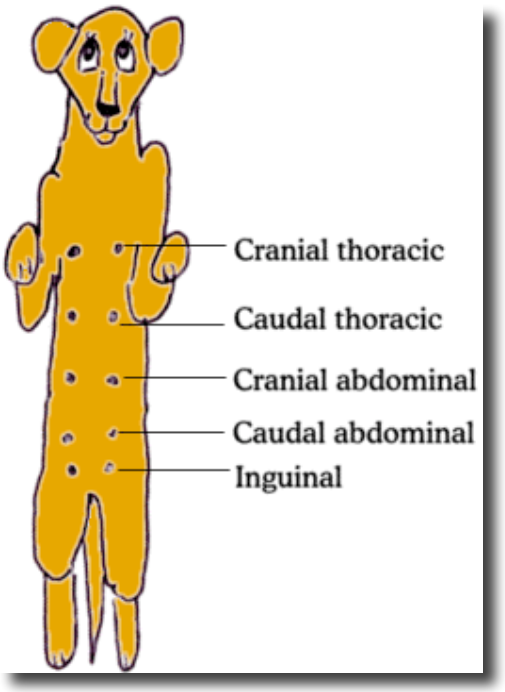
Metatherians

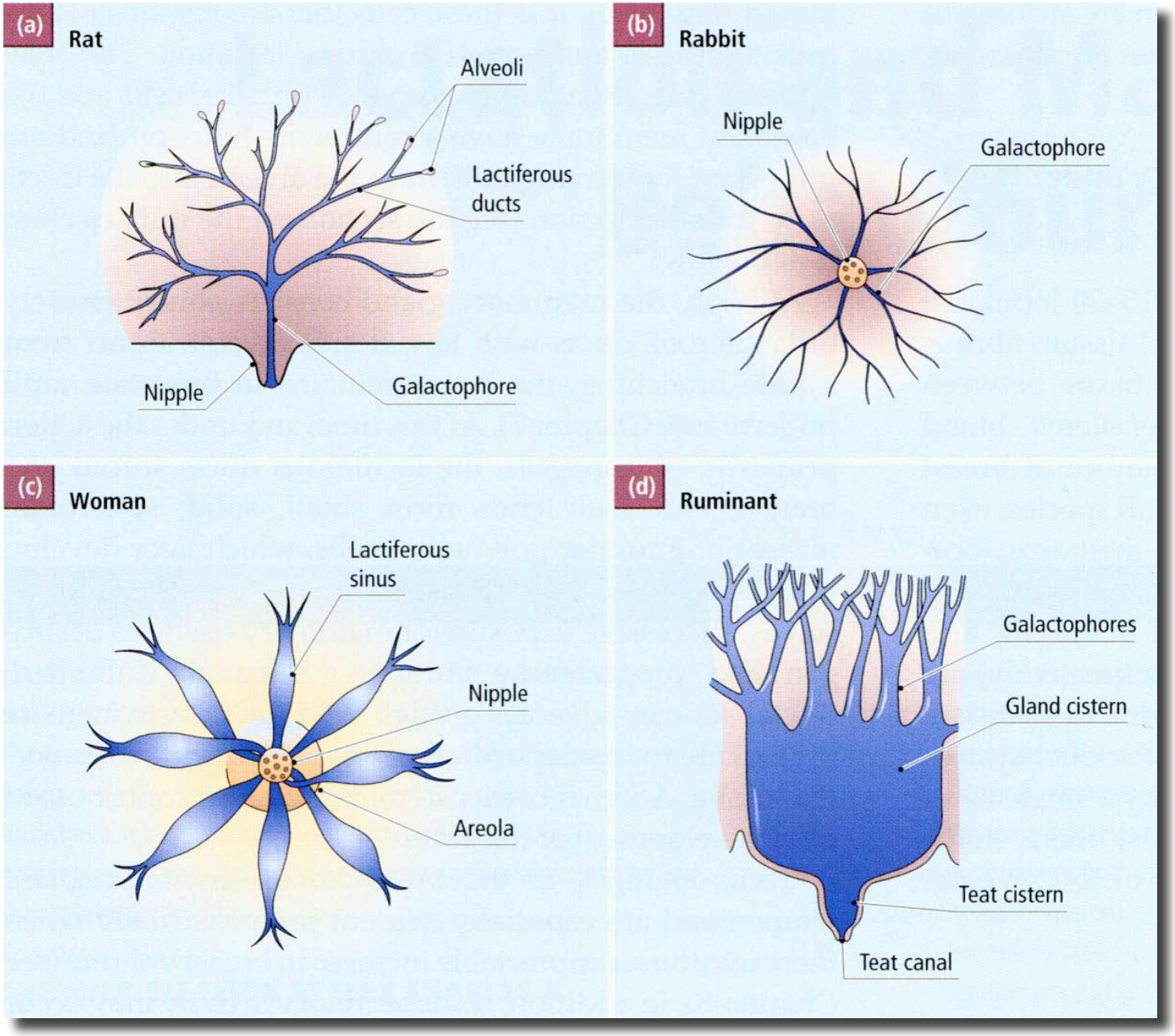
- The ducts of a group of milk secreting glands open at single point - a teat
  - teats are scattered around marsupium or ventral abdomen
- At birth, young marsupial has developed forelimbs, jaw and mouth -
  - crawl into marsupium and attach to teat
- Teat swells-
  - enable a semi-permanent connection
  - milk is ejected without need for suckling



Eutherians

- Mammary gland opens to the outside by one or more ducts at the nipple
- Can also open into cavities or cisterns with a hollow projecting teat (e.g., utter of cow)
- Usually paired with one or multiple pairs
- Located along a ventrolateral line - mammary ridge




(a)
Rat
Alveoli
Lactiferous ducts
Nipple
Galactophore
(b)
Rabbit
Nipple
Galactophore
(c)
Woman
Lactiferous sinus
Nipple
Areola
(d)
Ruminant
Galactophores
Gland cistern
Teat cistern
Teat canal

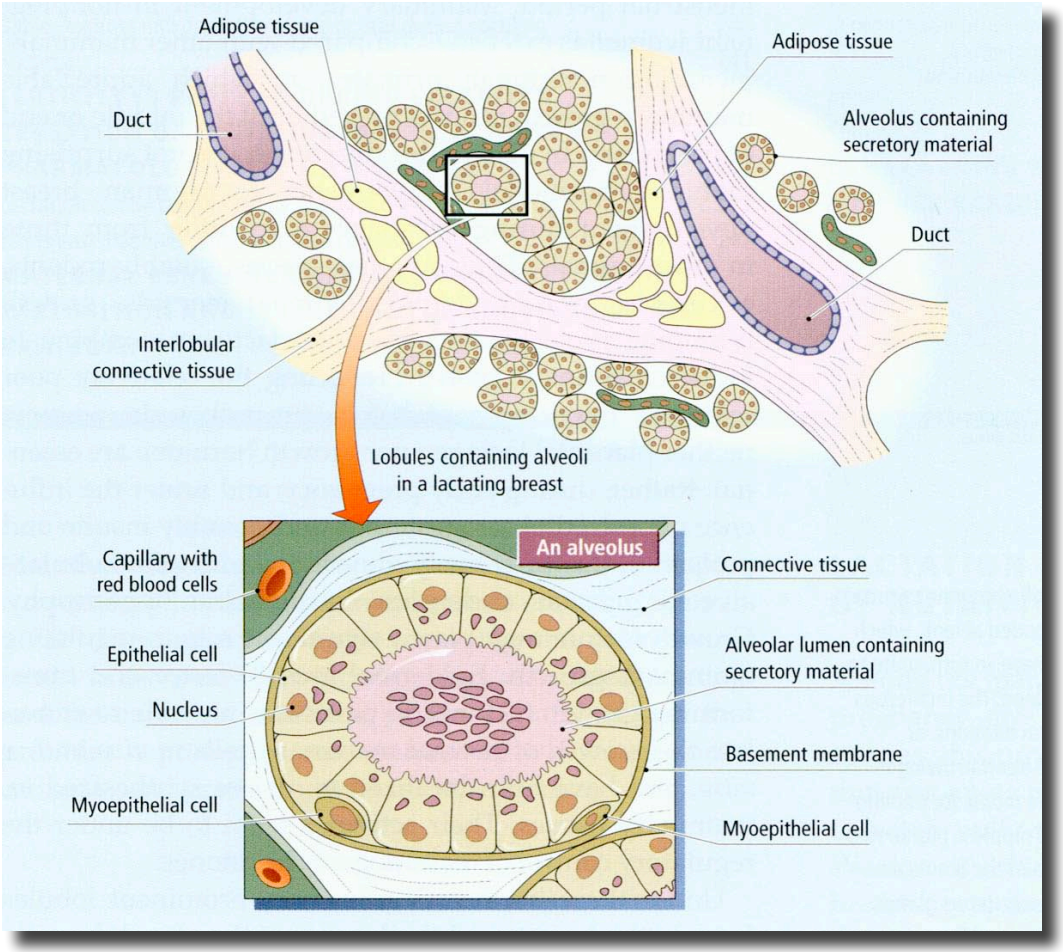
Human Mammary Glands

- Paired organs
  - (but others can be present)
- Variation in size /shape due to fat deposition
  - no major differences in milk synthetic or secretion ability
- Each breast has 15-20 lobes of glandular tissue
  - separated by fat and ligamentous tissue (suspensory ligaments of Cooper)

One of ihe most referred cases of accessory breast tissue from 1827 that involves Therese Ventre of Marseilles. Veiitre had an accessory breast on the lateral aspect of her left thigh that enlarged during puberty and produced milk when she became pregnant. Loukas et al Am Surgeon 73 (2007)

Pregnancy and Lactation

- Late adolescence
  - breast mitotically dormant and undifferentiated
- Mid pregnancy
  - breast matures under stimulation of estrogens and progesterone
  - tip of ducts differentiate into alveolar milk-secreting cells

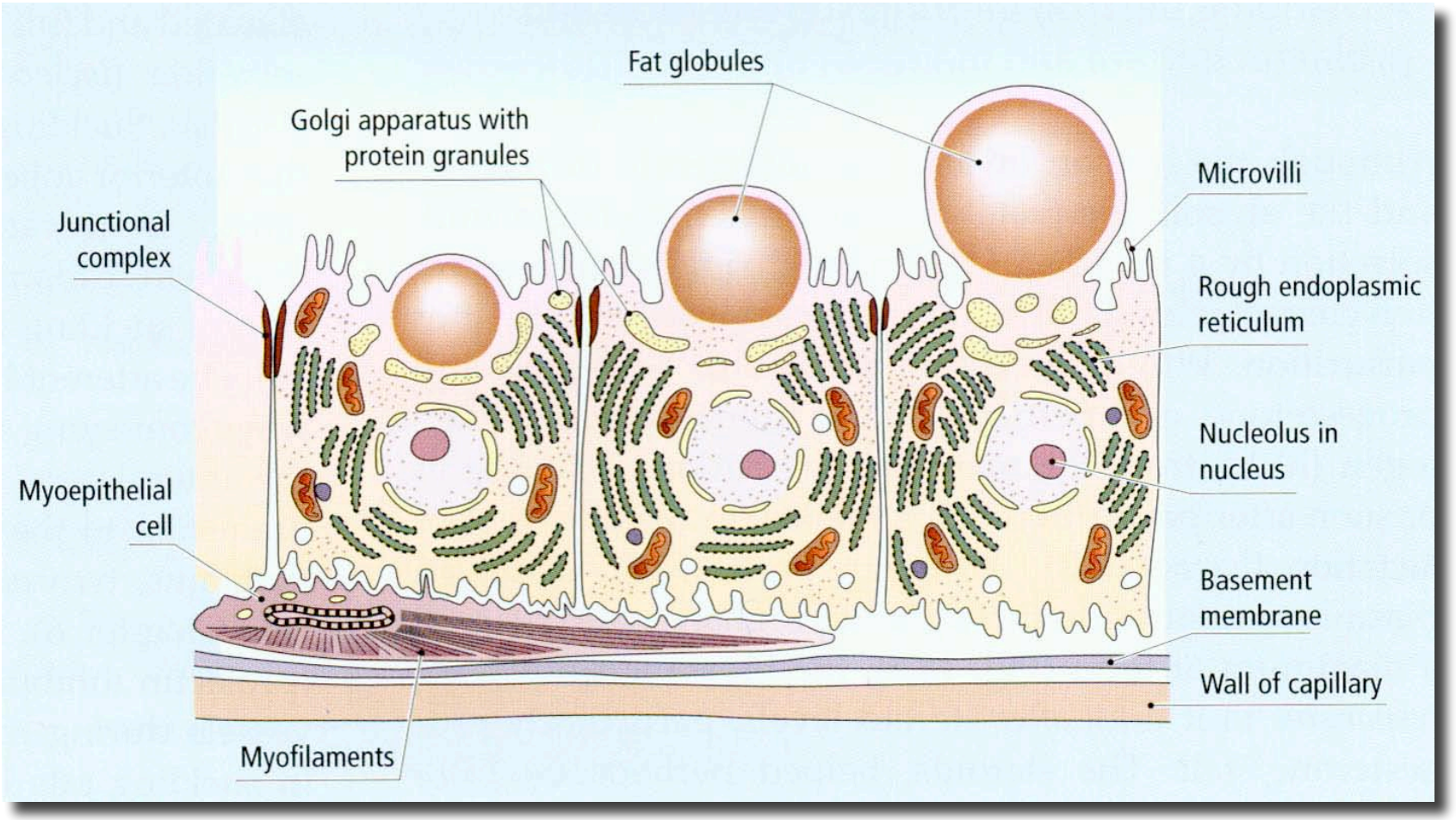


Each lobe contains grape-like clusters of glandular cells - mammary alveoli

Mid-pregnancy

- At mid-pregnancy
  - mammary glands cells have little rER and Golgi
  - casein granules few
  - casein major proteins of milk

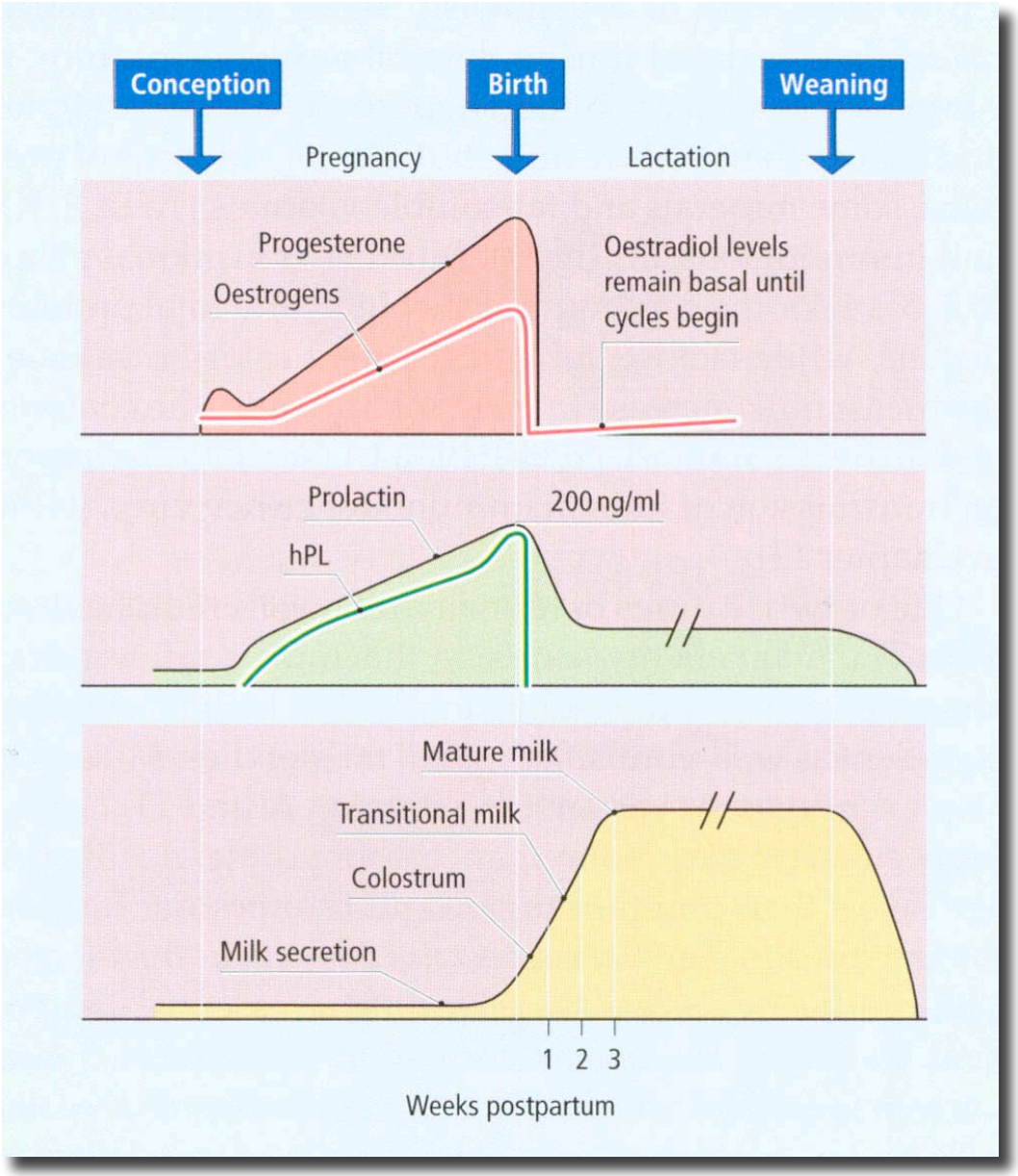
- Under stimulation from
  - placental lactogens and glucocorticoids
  - the alveolar cells increase rER and Golgi
    - allowing casein synthesis
  - (chorionic somatomammotropin in humans)



Milk is synthesized /secreted from each lobe into secondary mammary tubules

At birth

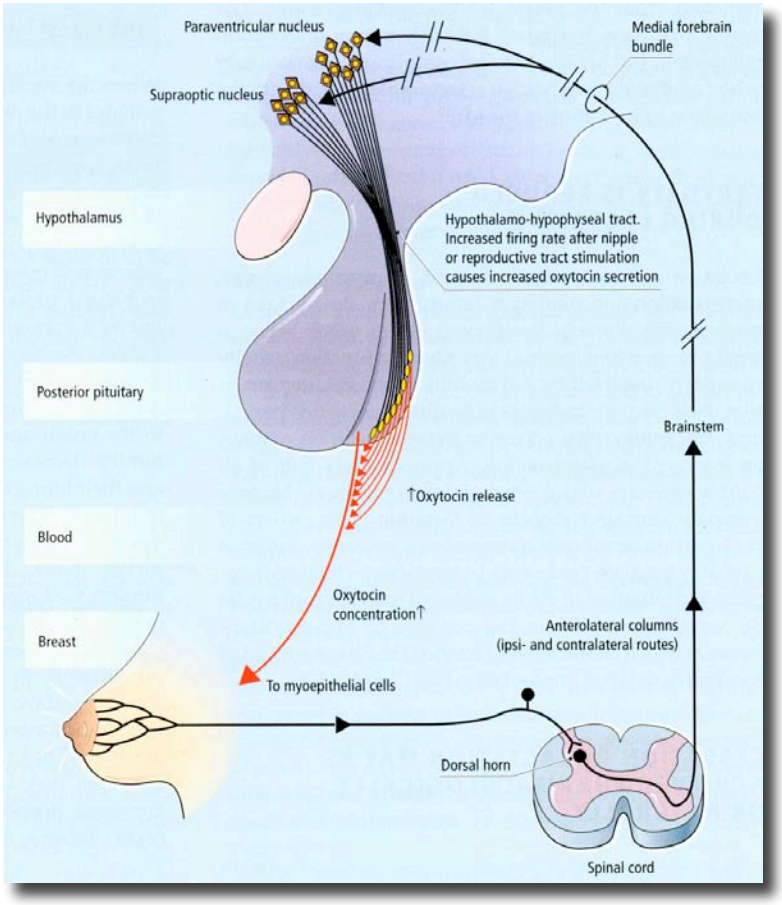
- Prolactin secretion increases
- Prolactin causes
  - casein gene to be transcribed
  - stabilizes the message
- During lactation in mouse
  - can produce 10% body wt in milk/day
  - 80% of proteins in milk caseins
    - β-casein most abundant


Conception
Birth
Weaning
Pregnancy
Lactation
Progesterone
Oestrogens
Oestradiol levels remain basal until cycles begin
Prolactin
200 ng/ml
hPL
Mature milk
Transitional milk
Colostrum
Milk secretion
1 2 3
Weeks postpartum

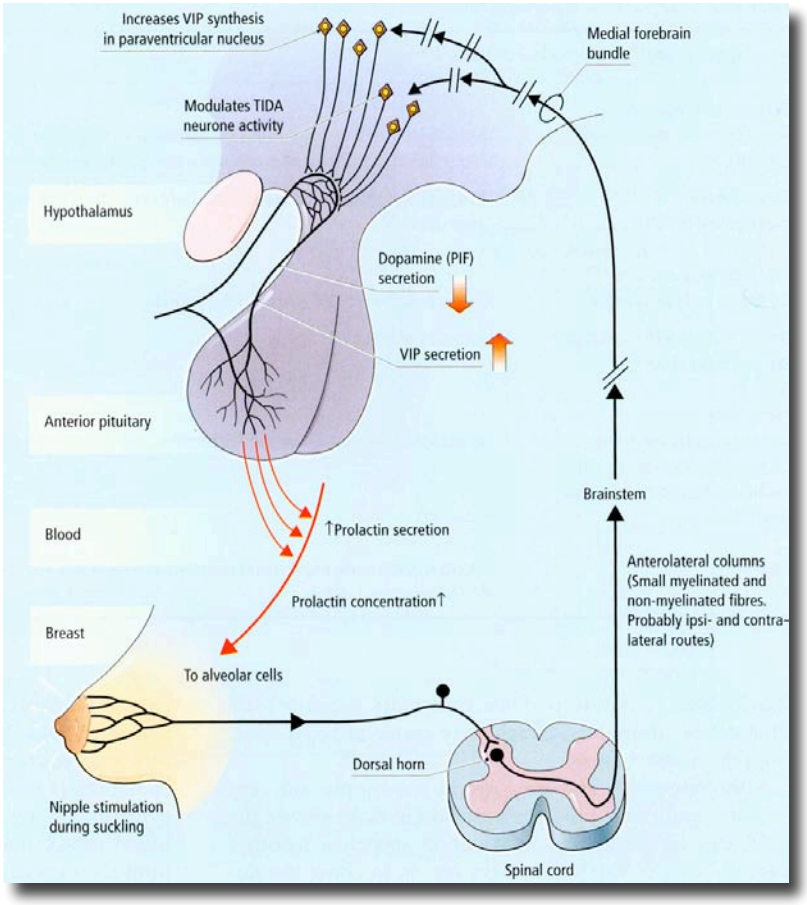
Hormonal Control of Milk Release

- With drop in estrogens and progesterone,
  - prolactin can stimulate alveolar synthesis of milk
- Suckling
  - inhibits FSH and LH release
  - but stimulates PRL release
    - (levels rise 2-20 fold in 30 mins)
- First milk colostrum
- 'Real' milk appearing in 2-3 days

Milk Ejection Reflex

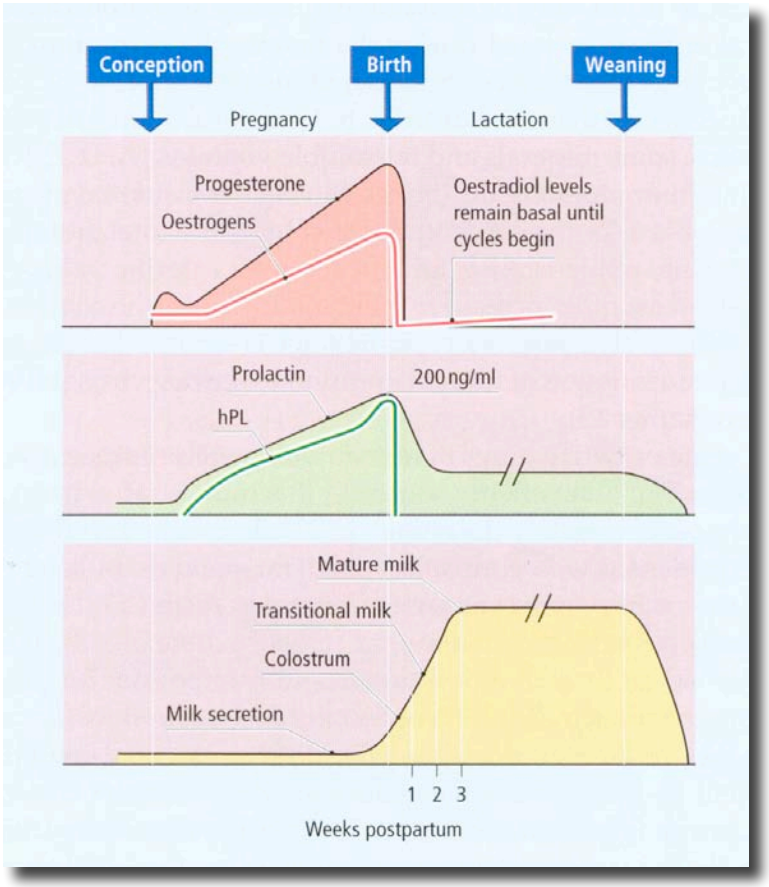


Oxytocin



Prolactin

Colostrum



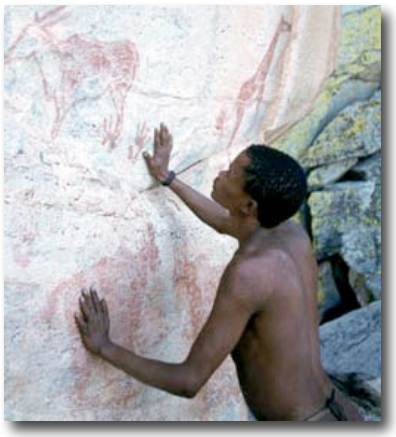
- Secreted during first week
- Contains:
  - Higher minerals, fat soluble vitamins (A,D,E,K), and immunoglobulins (IgGs)
- **Transitional milk**- lower protein and IgGs
- **Mature milk**- increase in lactose, fat, and total calories

Can nursing be contraceptive?

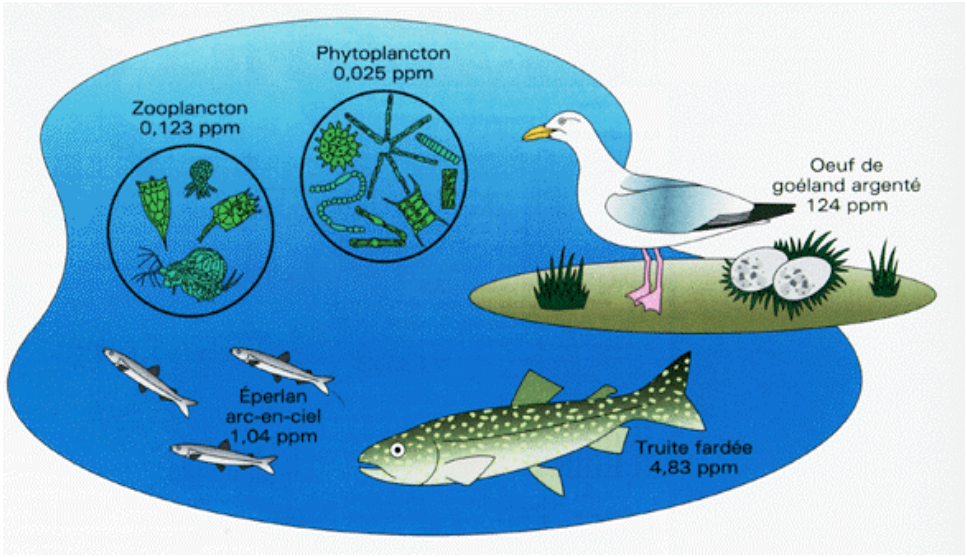
- No - high failure rate
- Nursing blocks ovulation 6-9 mo
- Non-nursing women ovulate 1 - 4 mo after birth
- After 6-9 months regular menstrual cycle begins whether nursing or not
- First post-partum ovulation occurs BEFORE menstruation!

!Kung hunter-gathers

- Very long birth interval - 44.1 months
- Women nurse and have coitus frequently
  - use no contraceptives
- BUT - they nurse briefly but frequently
  - every 13 mins during day for 1 min or so
- Frequent nursing and weaning at 3.5 years
  - blocks FSH/LH due to high prolactin levels

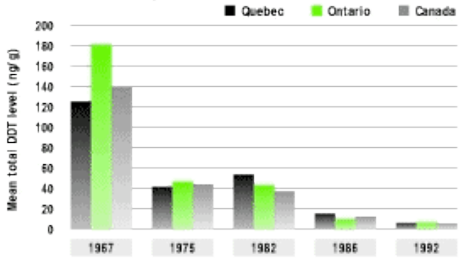


Bioamplification of fat soluble chemicals

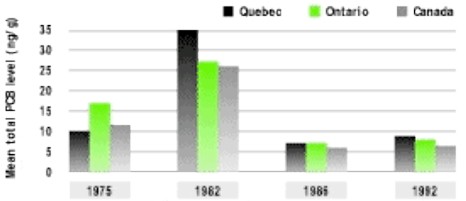


5.7 DDT and PCBs in human breast milk, Quebec, Ontario and Canada, selected years, 1967 to 1992

A. Levels of DDT in human breast milk: Quebec, Ontario and Canada, selected years, 1967 to 1992



B. Levels of PCBs in human breast milk: Quebec, Ontario and Canada, selected years, 1975 to 1992



Source: Government of Canada (1996). *The State of Canada's Environment — 1996*. Ottawa: available from Environment Canada, p. 6-49. Reproduced with the permission of the Minister of Public Works and Government Services, 1998.

Dramatic increase in levels of fire retardants in Swedish women's bodies, 1972 to 1997