Mammals, Mammary Glands and Milk:
It's All About Lactation

Walt Hurley

Week 1

Coursera.org Search for Lactation Biology

Overall learning objective:

To start us thinking like a lactation biologist

[It's not just about milk]

Today's learning objectives:

Identify appropriate questions about the biology of lactation

Contrast interspecies nursing with intraspecies nursing

Describe the macrostructure of the mammary gland

Distinguish between simple vs complex types of mammary glands

Lactation is the combined processes of

milk secretion	AND	milk removal
Synthesis of milk components by the mammary epithelial cells and passage of the components from the interior of the cell into the alveolar lumen		Passive removal of mammary secretions from the cisterns or large ducts and physical ejection from the alveolar lumen
Alveolus: considered the basic unit of milk synthesis; lined with milk-secreting epithelial cells that surround the lumen of the alveolus		Milk ejection or milk letdown: process of physically ejecting milk from the mammary gland

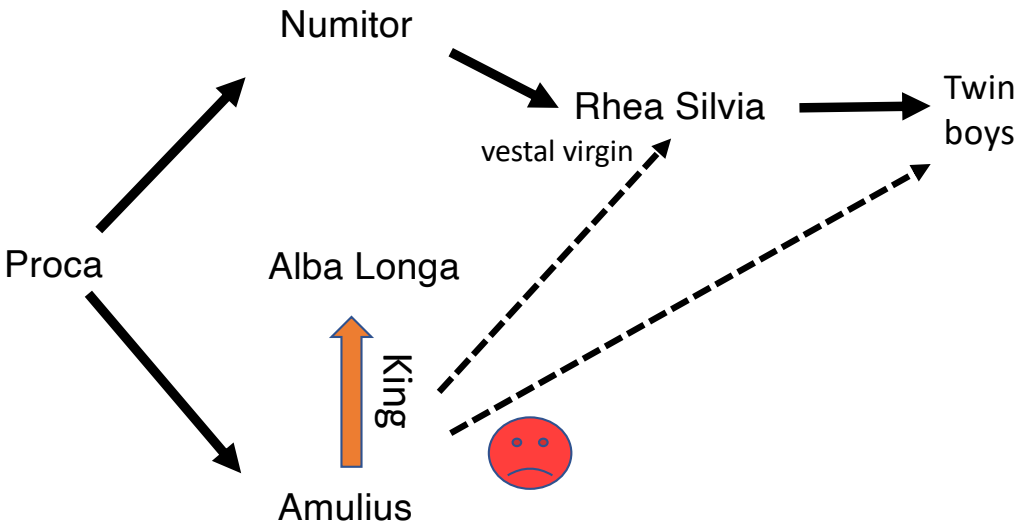
Lactation

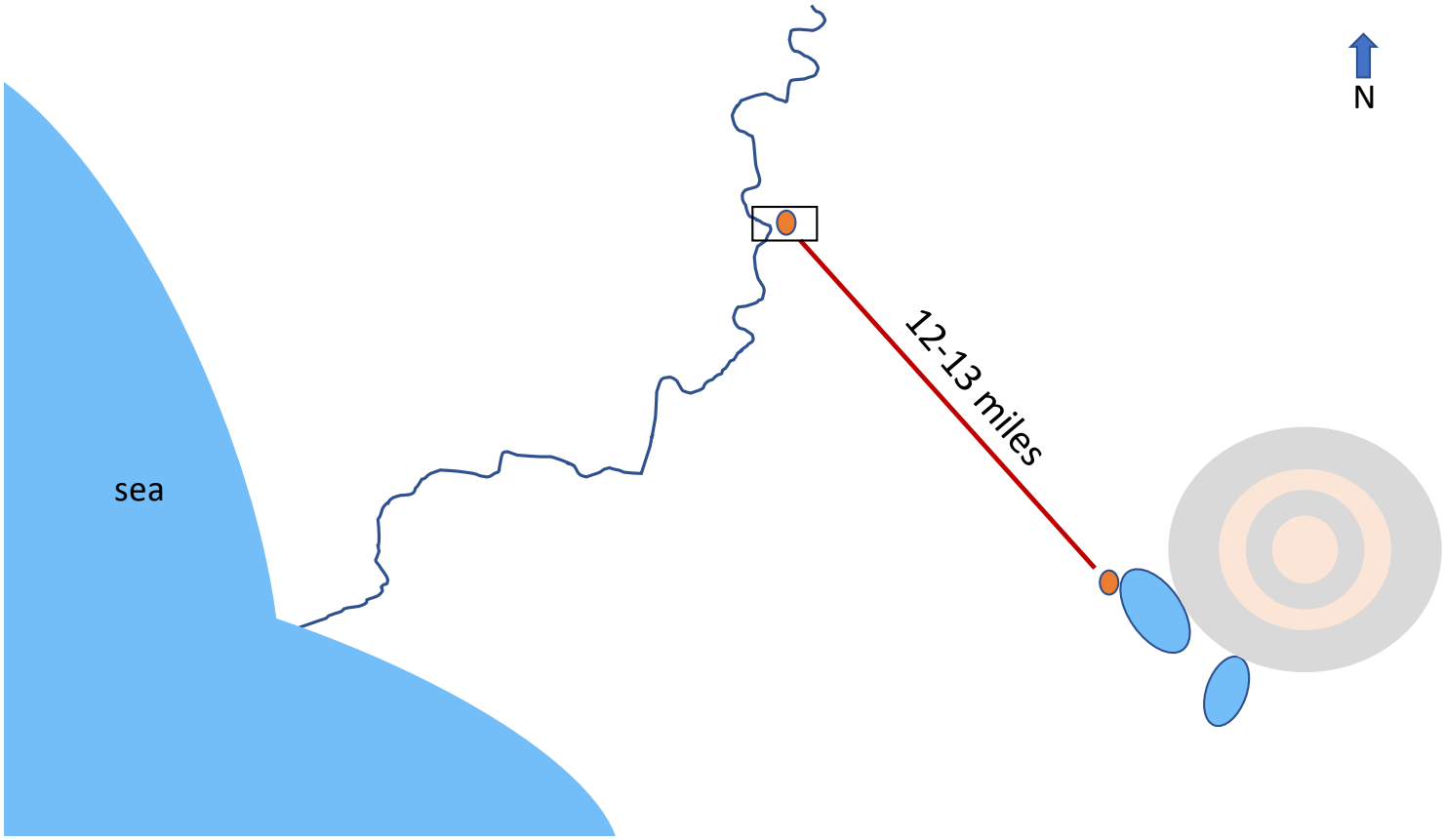
Question	Answer (?)	
Who lactates?	female, mammal	?
What lactates?	mammary glands	√
What is produced?	milk	?
Where does lactation happen?	ventral surface	?
When does lactation happen?	at birth of the offspring	?
Why does lactation happen?	provide for the neonate	?
How does lactation happen?	stay tuned	

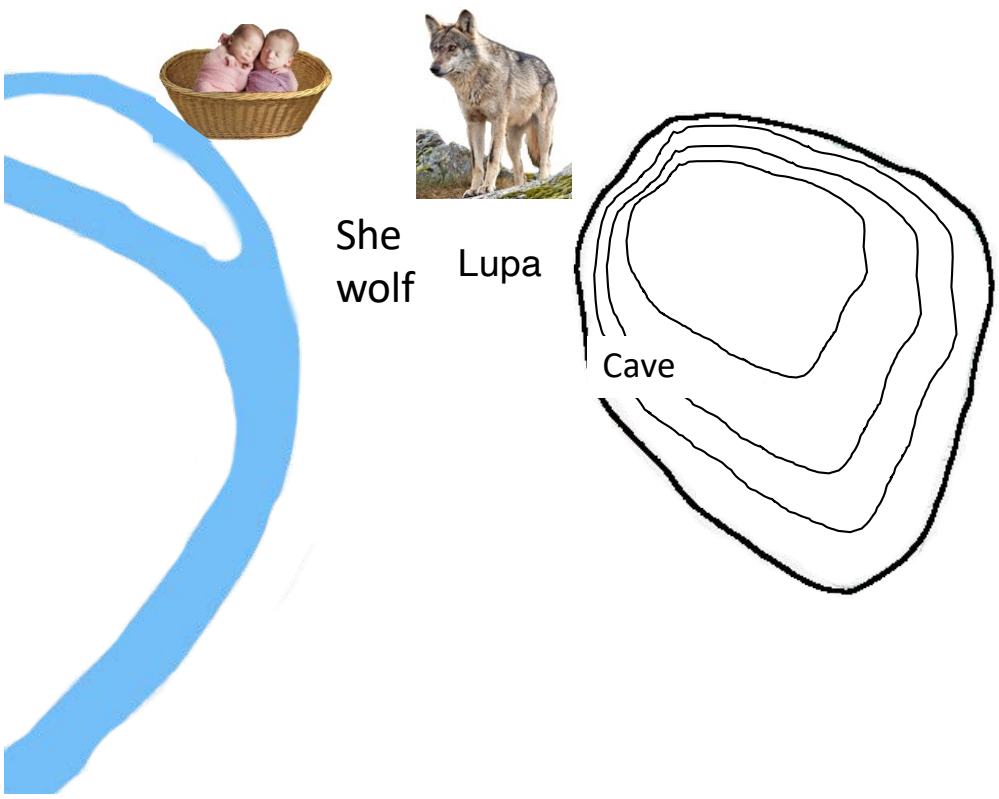
A Story

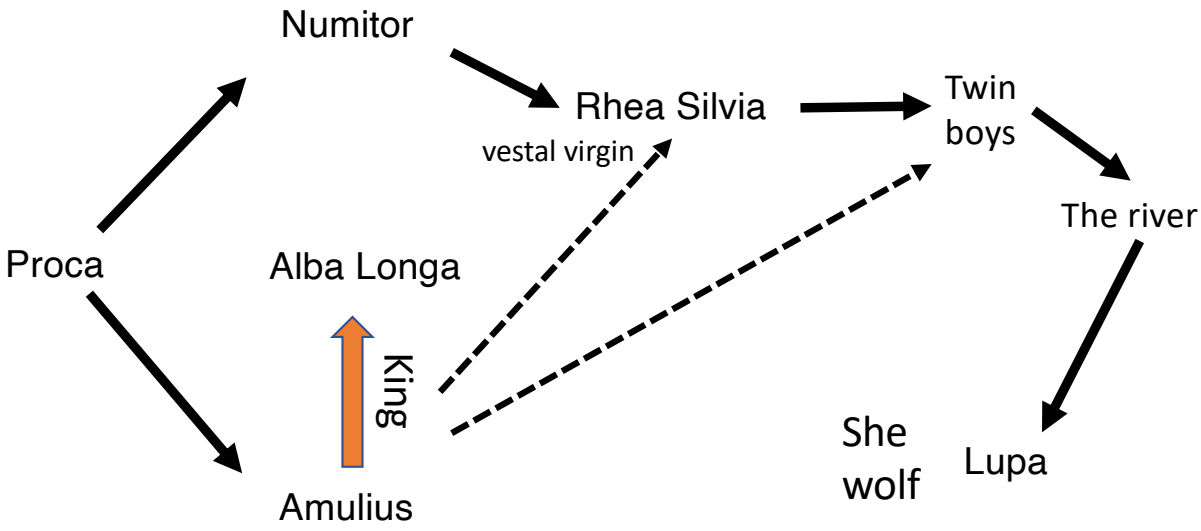
To start us thinking like a lactation biologist

[It's not just about milk]



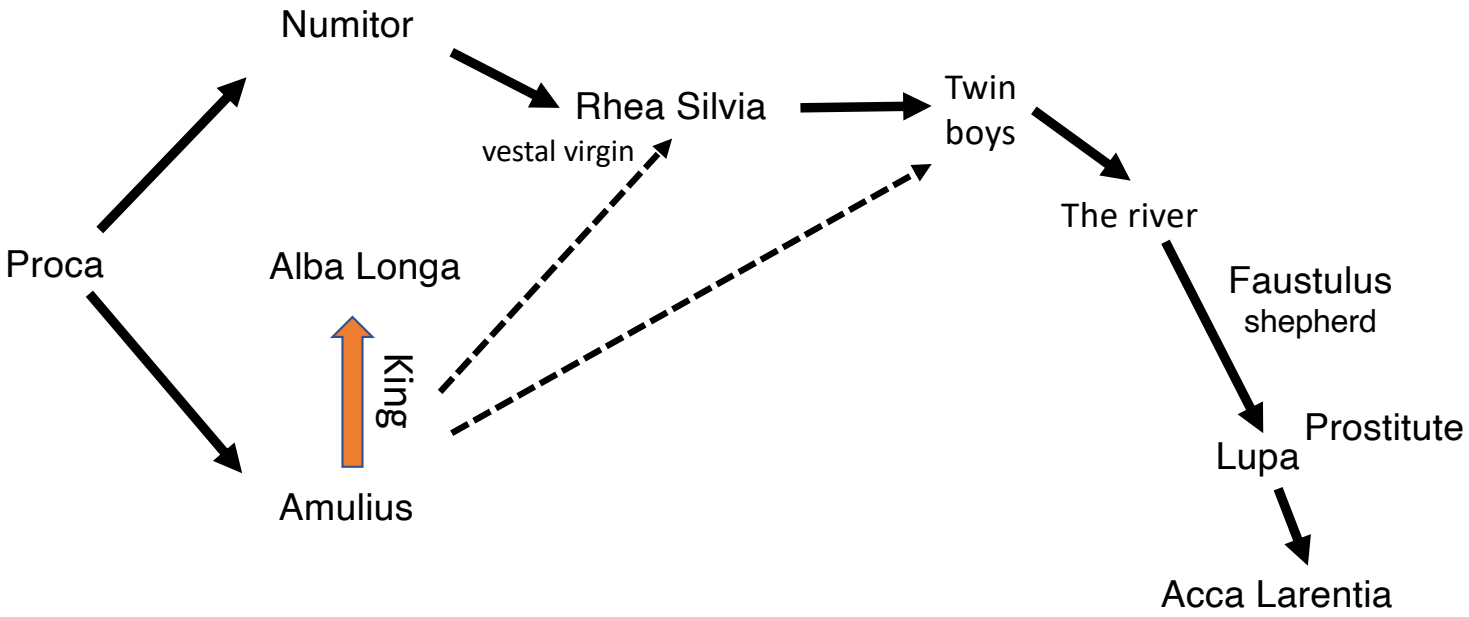

N
sea
12-13 miles


She wolf
Lupa
Cave



Questions through the lens of a lactation biologist:

- What about the interspecies nursing?
  - Does it happen?
  - Maternal behavior Behavior of the neonate
- What about the mammary gland?
  - What was the physiological state?
  - What was the stage of lactation?
- What about the milk?
  - Was enough milk produced?
  - What was the composition of the milk produced?



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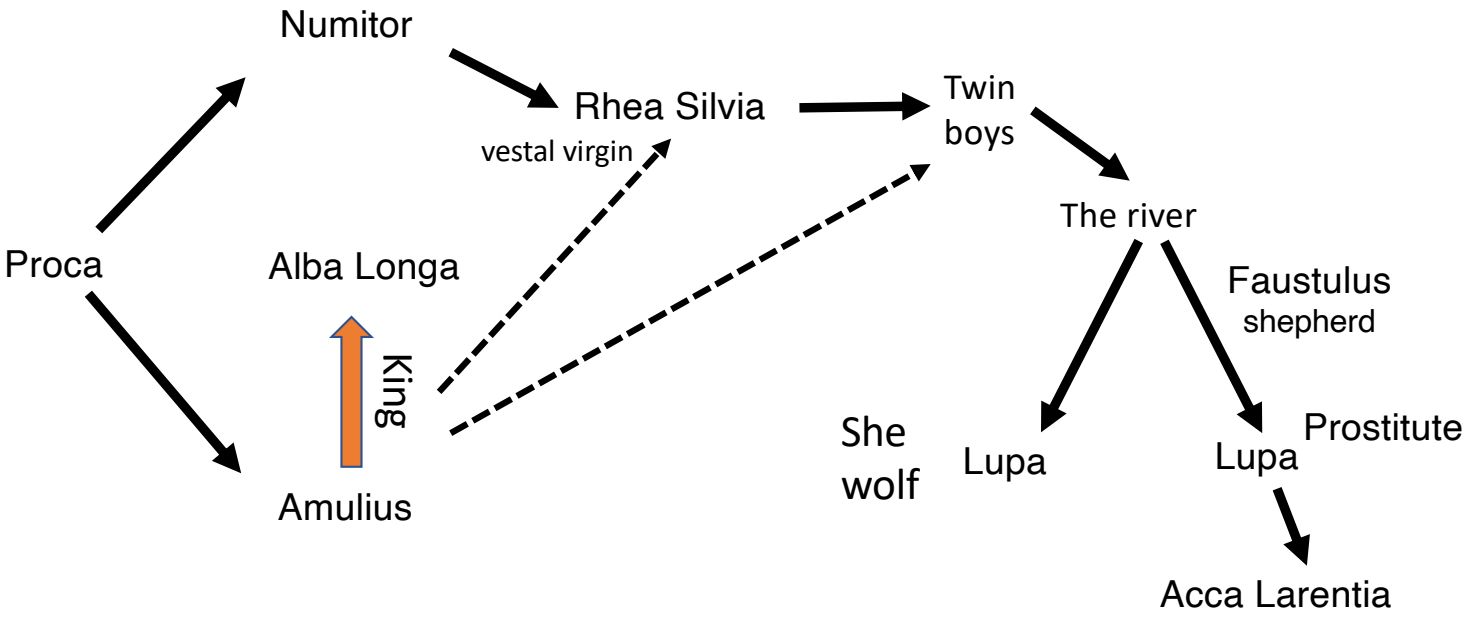
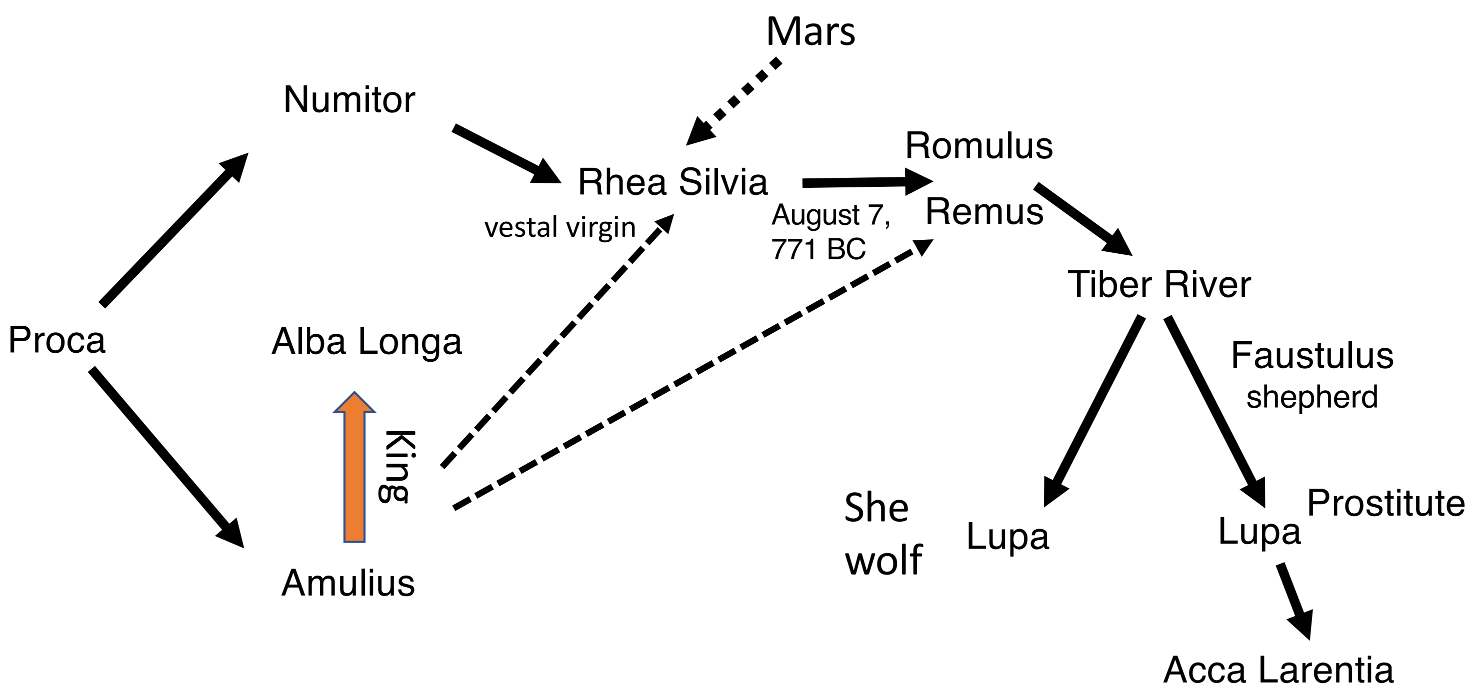
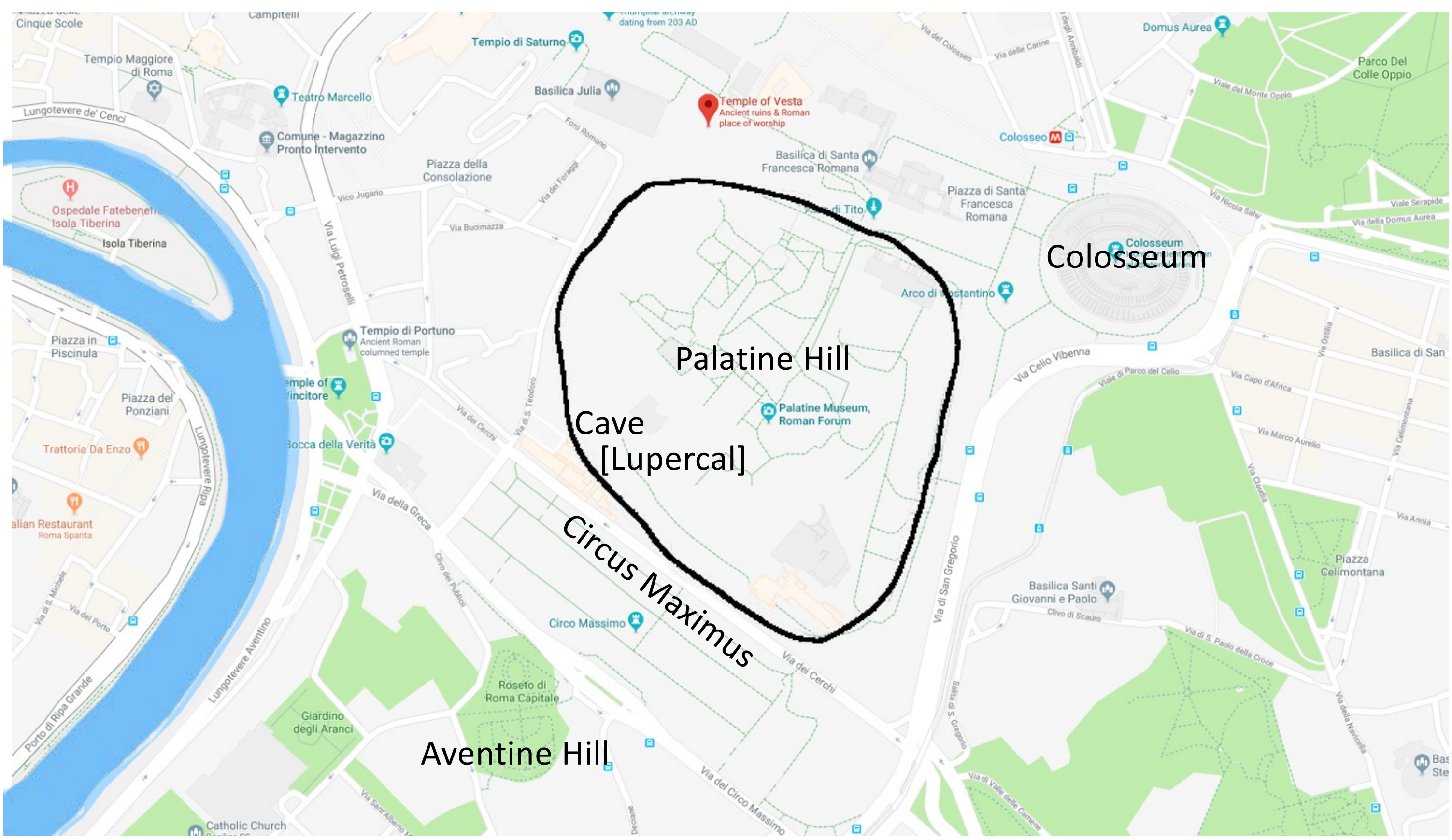


A Story

Now, the rest of the story


Mars
Numitor
Rhea Silvia
vestal virgin
Romulus
Remus
August 7,
771 BC
Tiber River
Proca
Alba Longa
King
Faustulus
shepherd
She
wolf
Lupa
Lupa
Prostitute
Amulius
Acca Larentia


Palatine Hill
Cave
[Lupercal]
Circus Maximus
Colosseum
Aventine Hill
Temple of Vesta
Basilica Julia
Tempio di Saturno
Teatro Marcello
Circo Massimo
Basilica Santi Giovanni e Paolo
Palatine Museum, Roman Forum

Rome

Site has been inhabited for as long as 14,000 years

Romulus and Remus are said to have been born August 7, 771 BC

Our story starts about 2792 years ago

Tradition has it that Rome was founded on April 21, 753 BC

Roman mythology holds that Rome was founded by Romulus (18 years old)

Questions through the lens of a lactation biologist:

What about the interspecies nursing?

Does it happen? 

Maternal behavior Behavior of the neonate

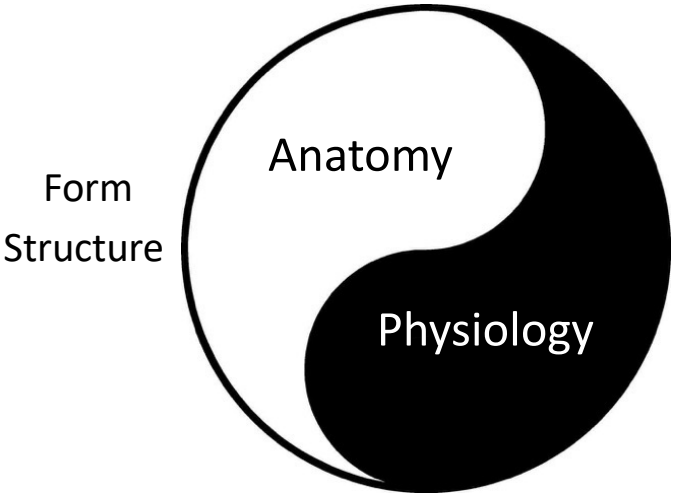

Intraspecies nursing

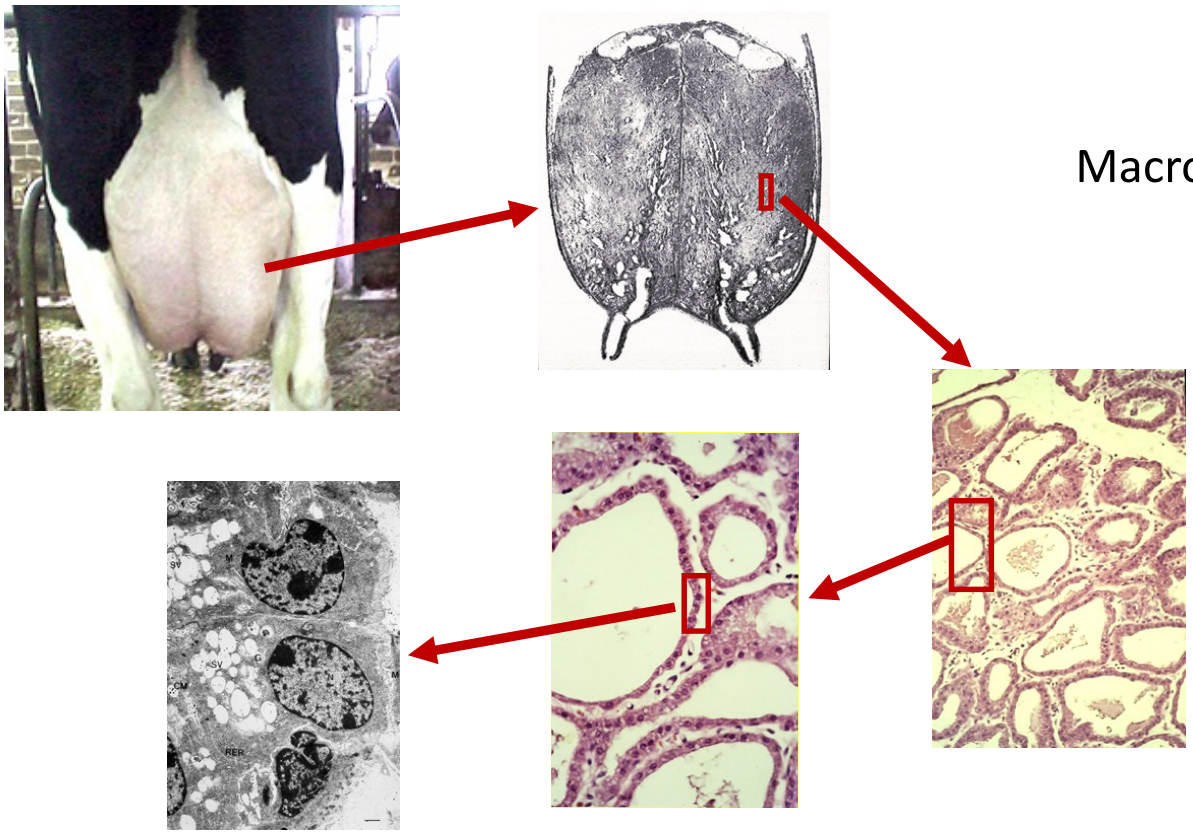

Interspecies nursing

Physiology of Lactation

Changes over time

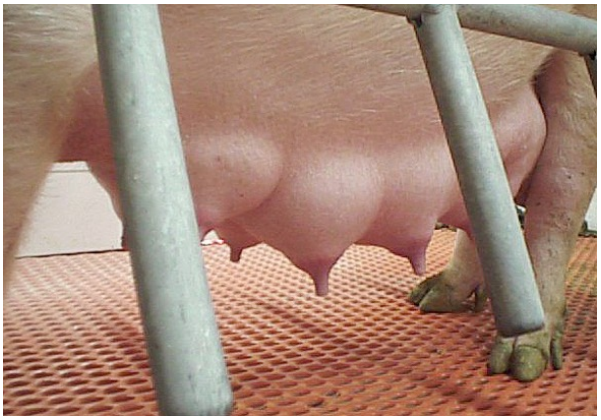
Mammary gland

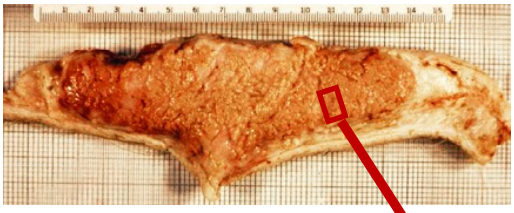




Cow

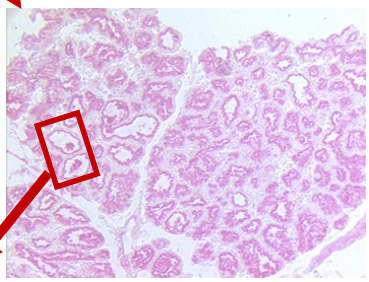
Macro to Micro

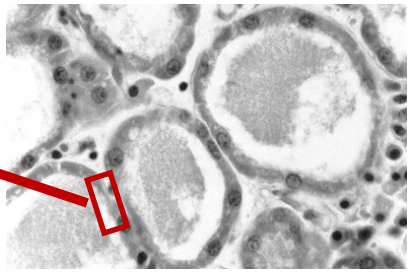


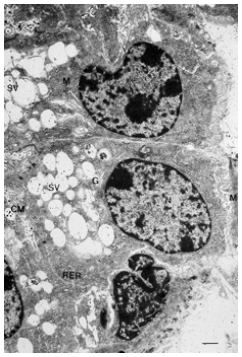


Sow

Macro to Micro

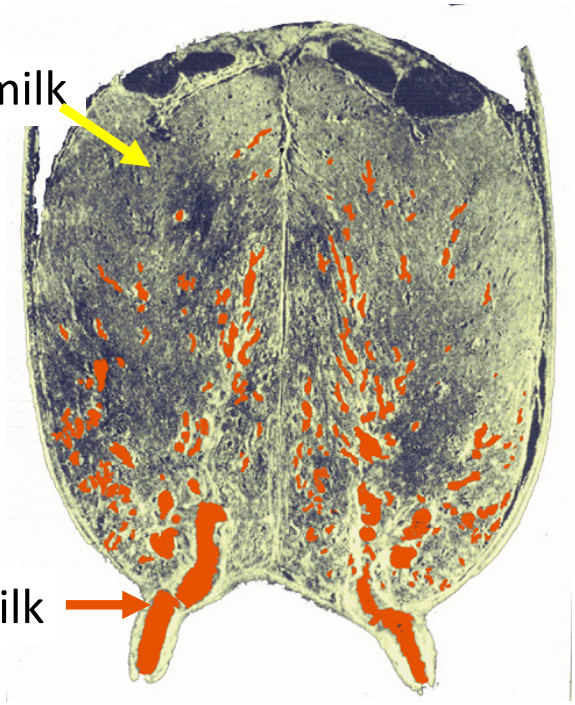


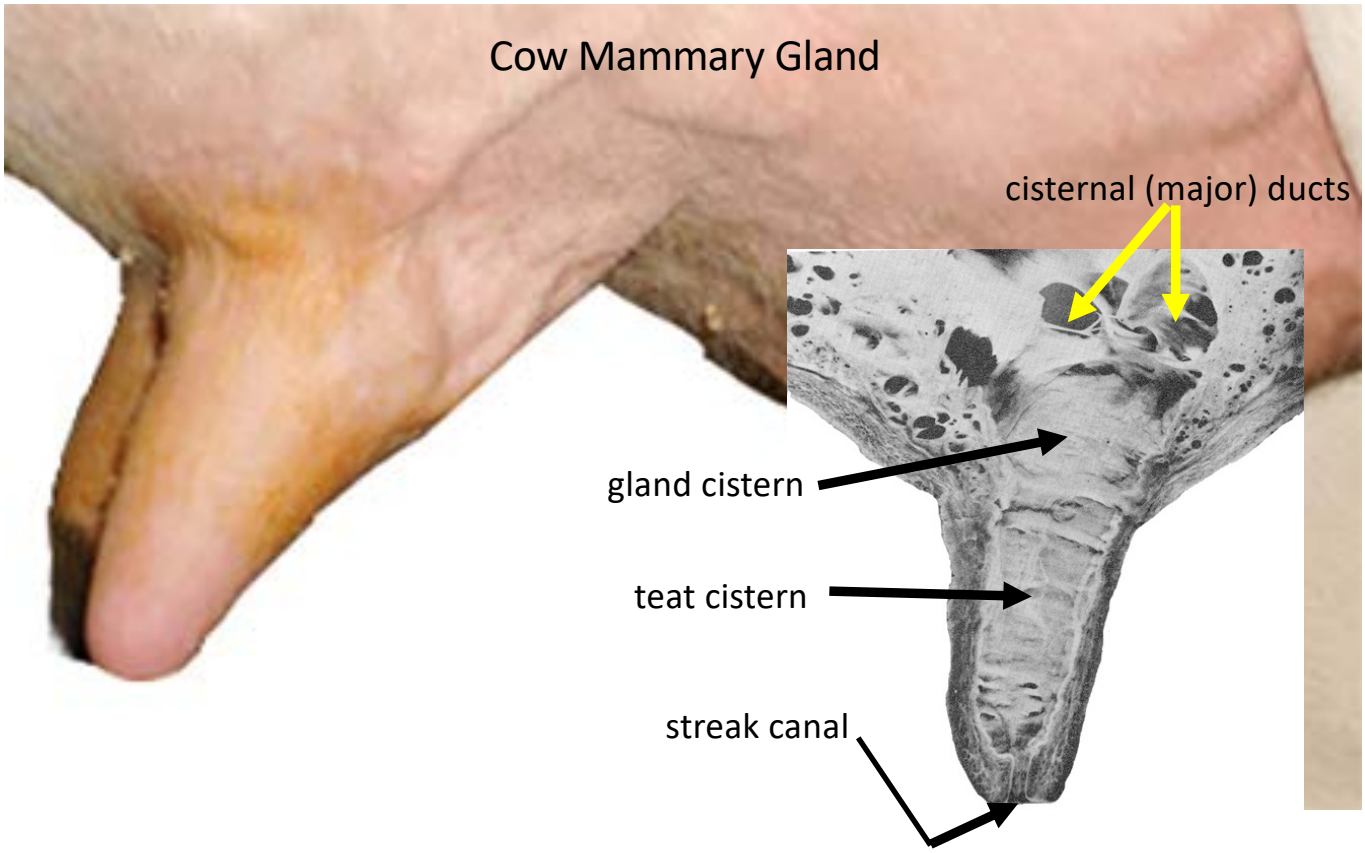




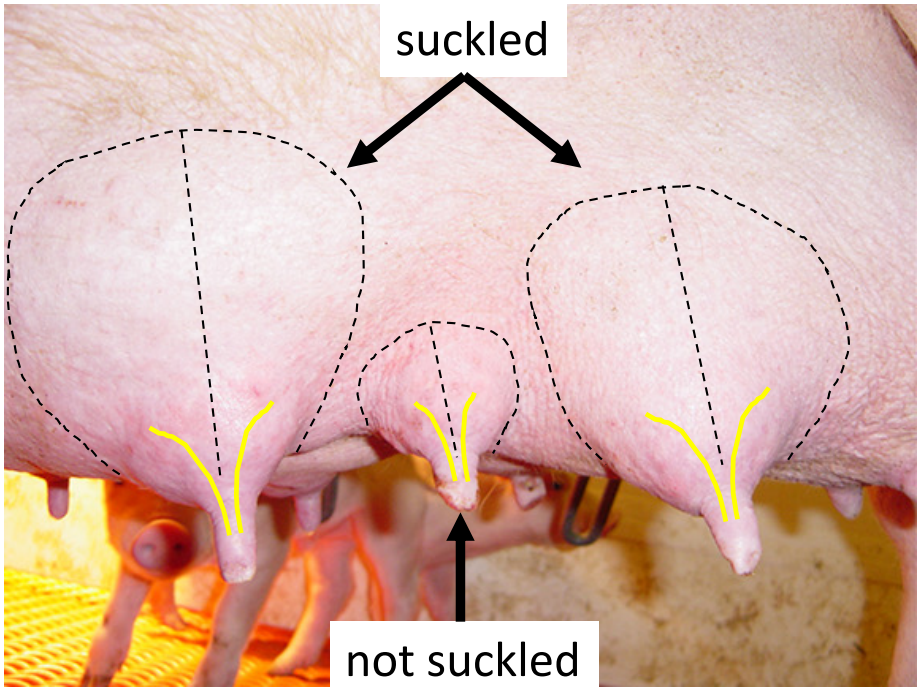
Alveolar milk

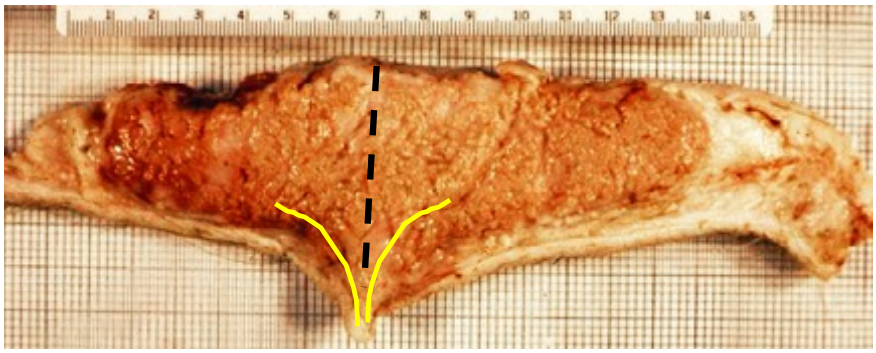
Cisternal milk

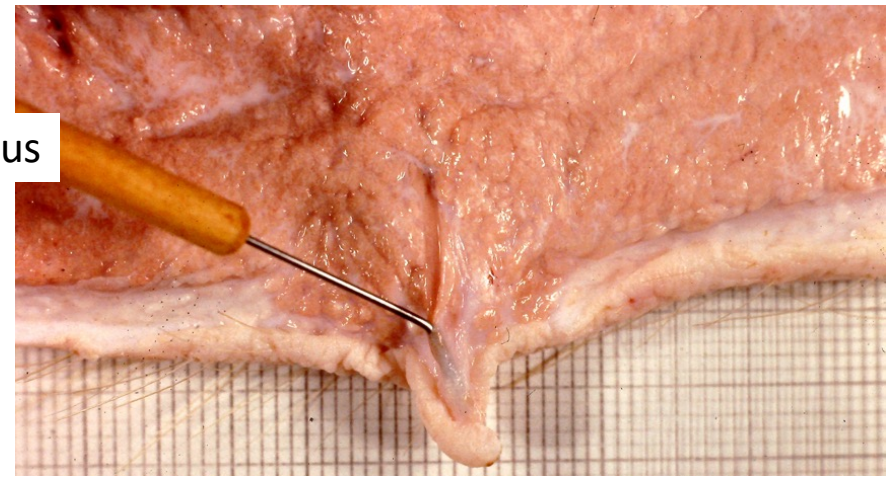



Cow Mammary Gland
cisternal (major) ducts
gland cistern
teat cistern
streak canal

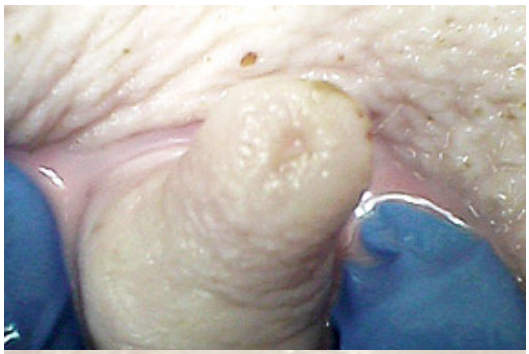

At parturition (giving birth, farrowing)

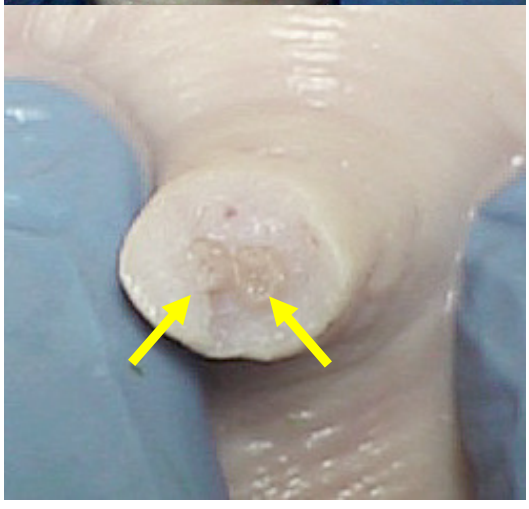

suckled
not suckled

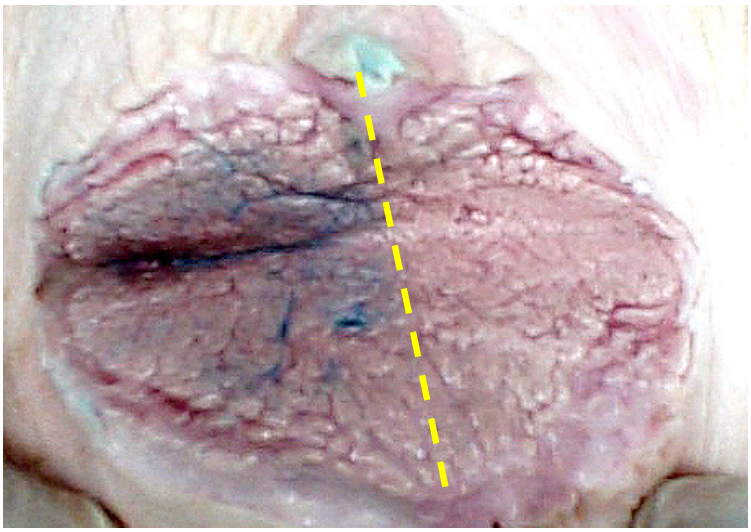


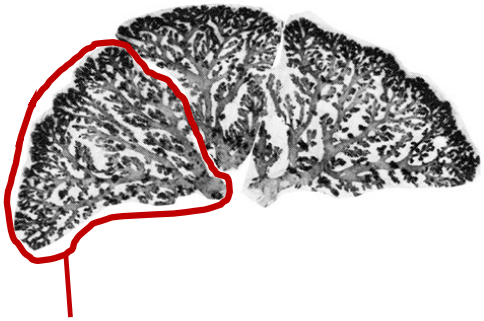


Lactiferous sinus

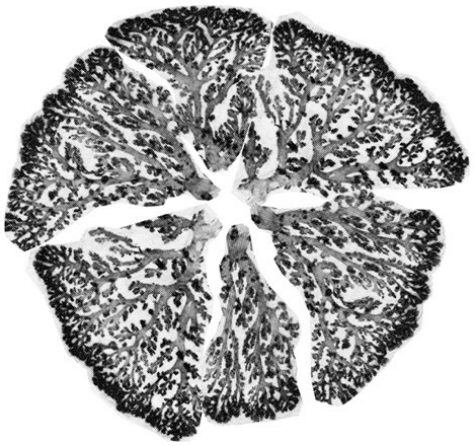


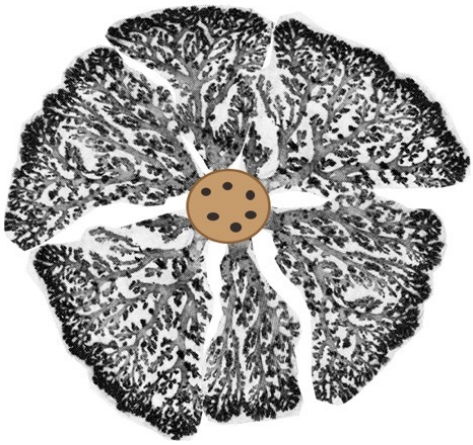






Rabbit mammary gland
(developing)

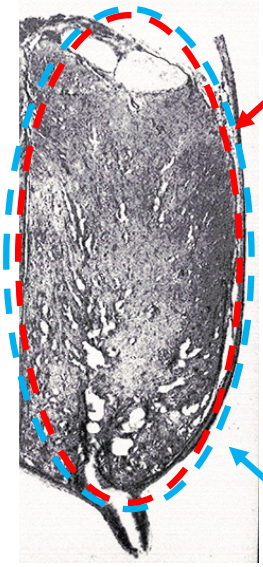


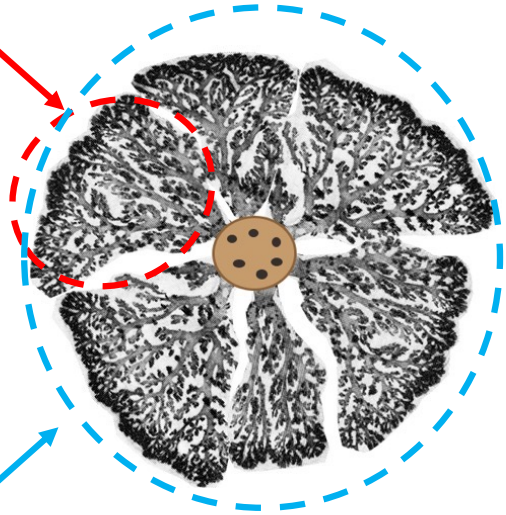


Cow

Rabbit

Simple gland



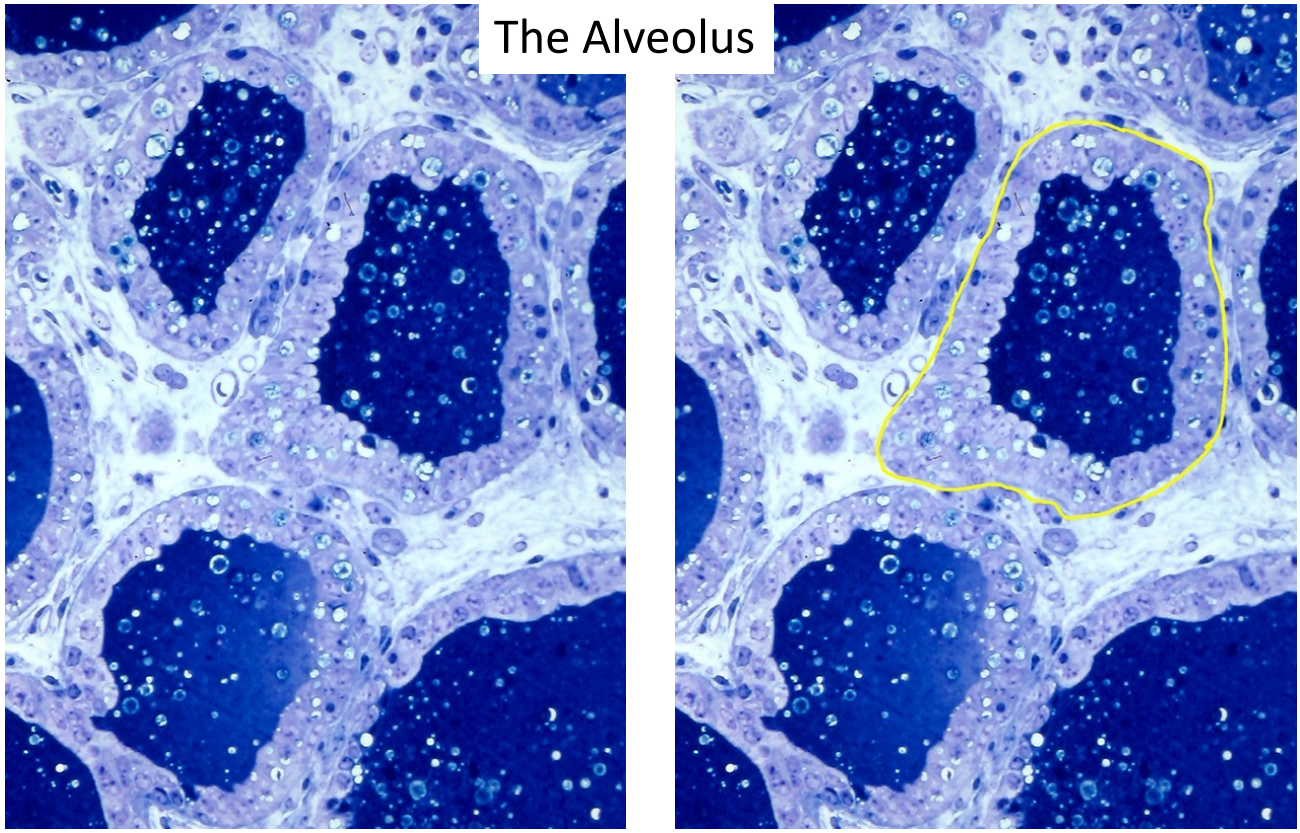


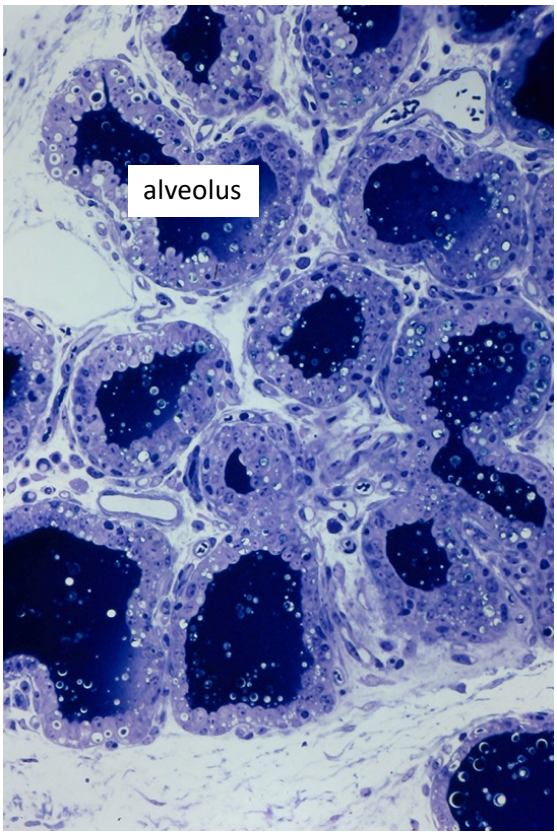
Complex gland

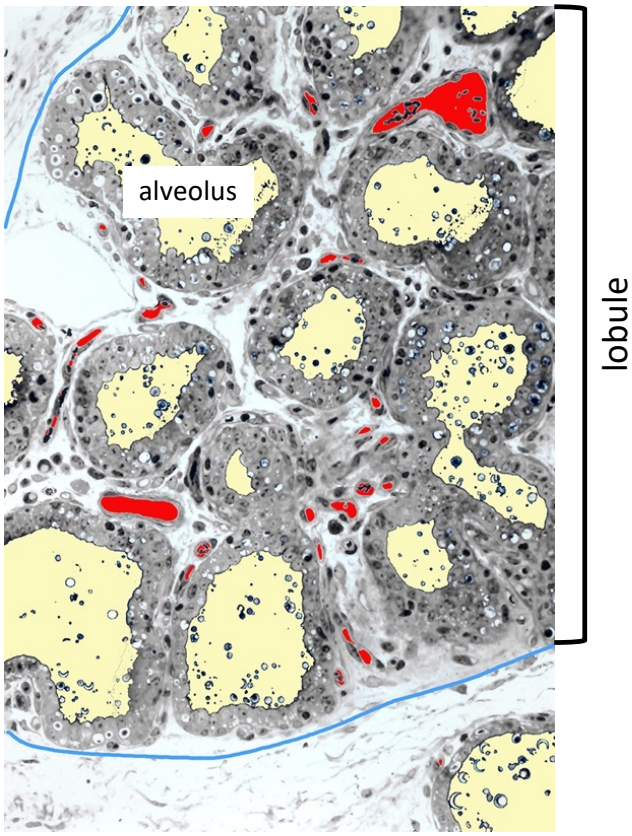
Mammary Gland Location & Simple vs Complex

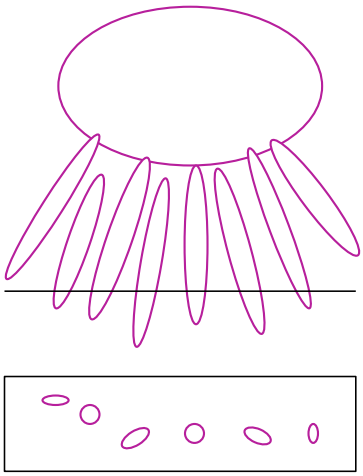
Species	Complex Glands	Thoracic Region	Abdominal Region	Inguinal Region	Openings per Teat	Total Simple Glands
Cattle	4	-	-	4	1	4
Goat, Sheep	2	-	-	2	1	2
Horse	2	-	-	2	2	4
Pig	12-14	4	6	4	2	24-28
Human	2	2	-	-	10-20	20-40
Cat	8	4	2	2	4-8	32-64
Dog	10	4	4	2	8-22	80-220
Rat	12	6	2	4	1	12
Mouse	10	6	-	4	1	10
Guinea pig	2	-	-	2	1	2

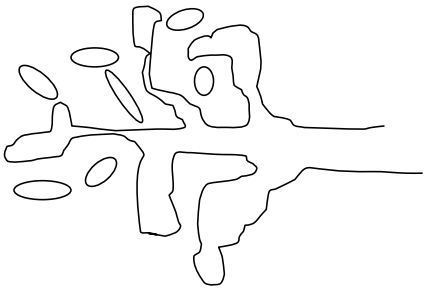
The Alveolus



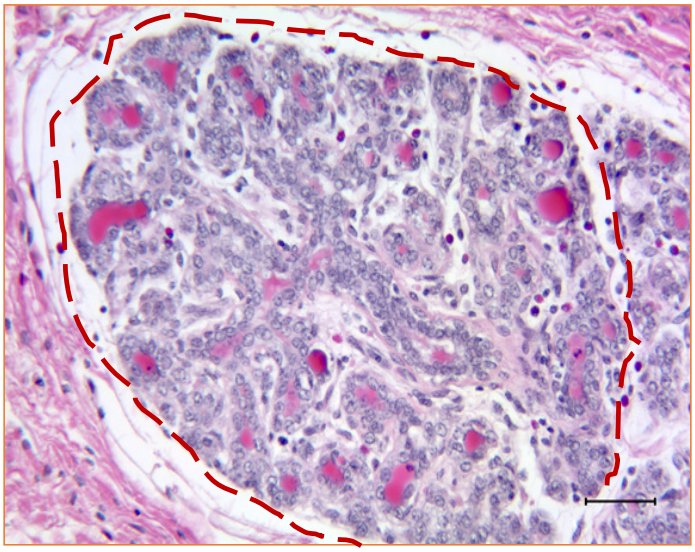

alveolus

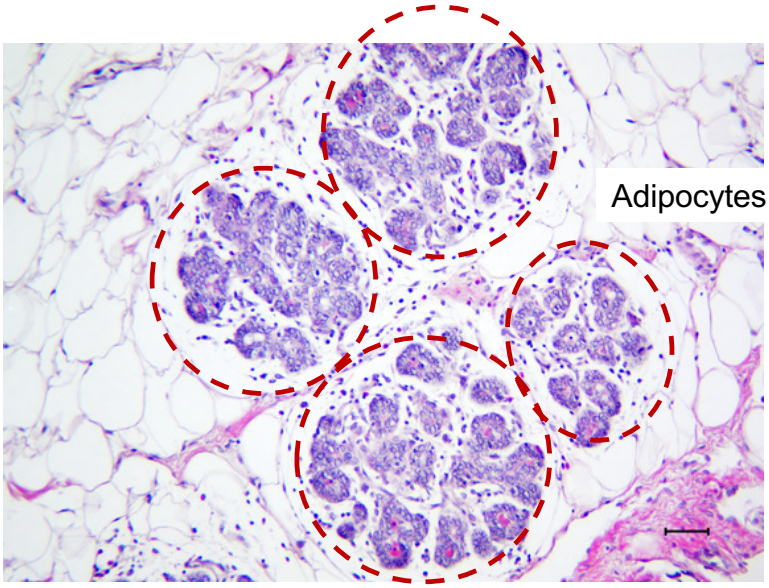

alveolus
lobule



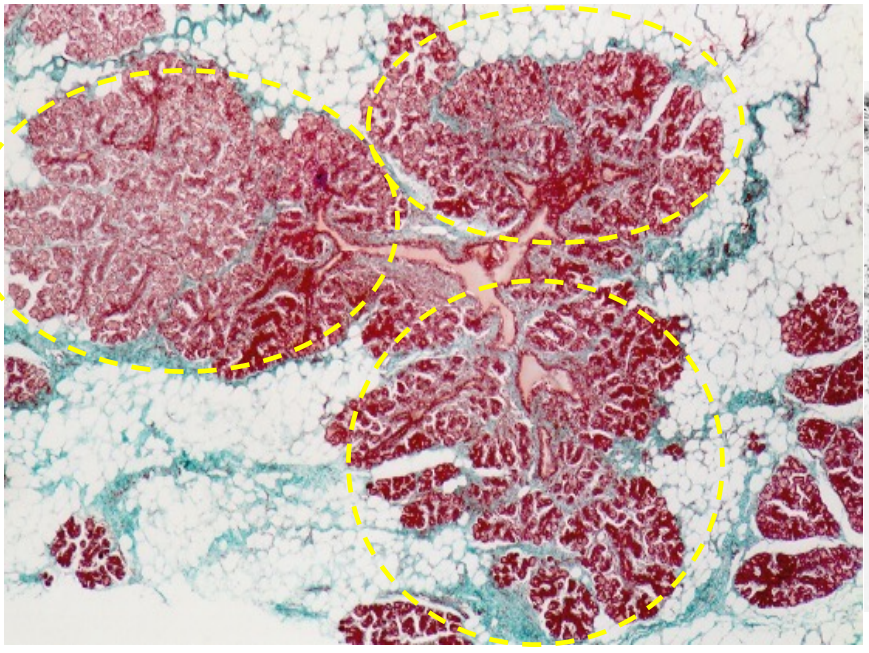


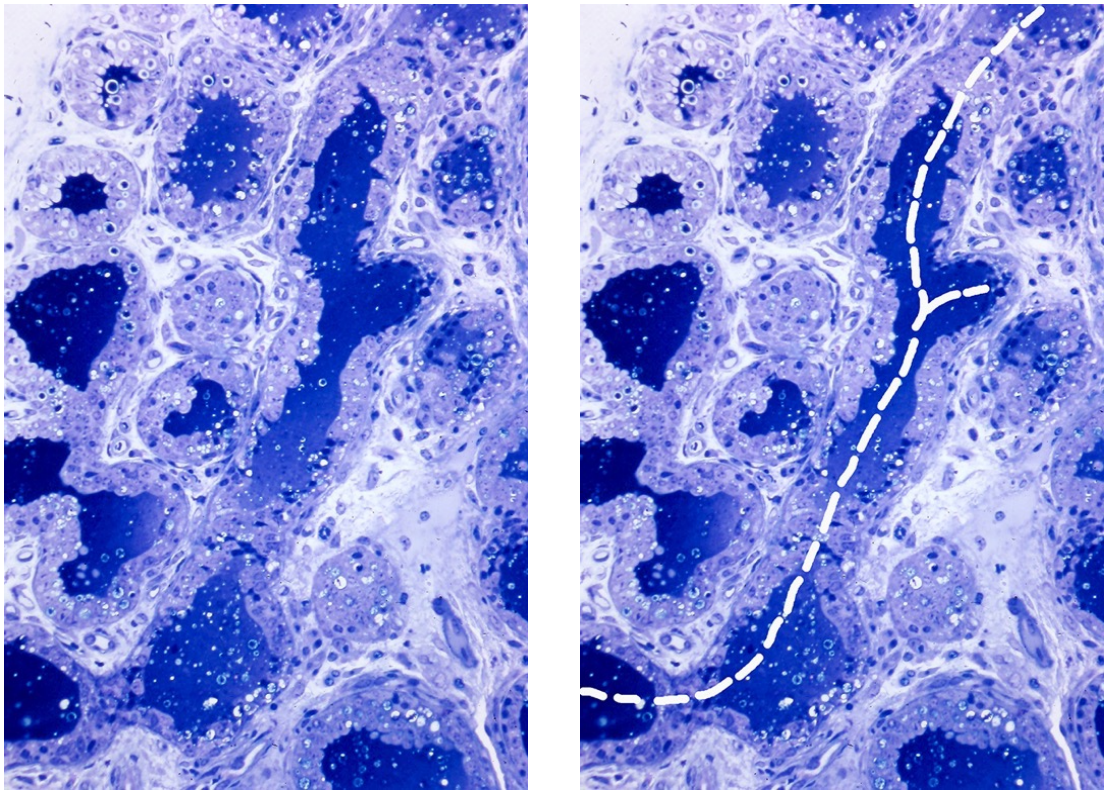
The Lobule



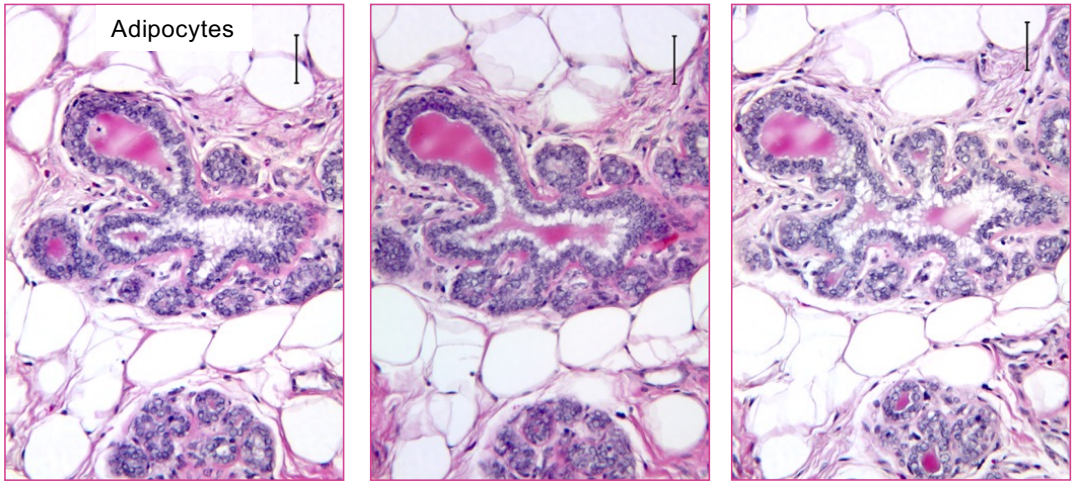


The Lobule





Consecutive sections through a developing lobule



Day 60 pregnant gilt