VET-114
Animal Anatomy and Physiology 2

Webinar
Chapter 18

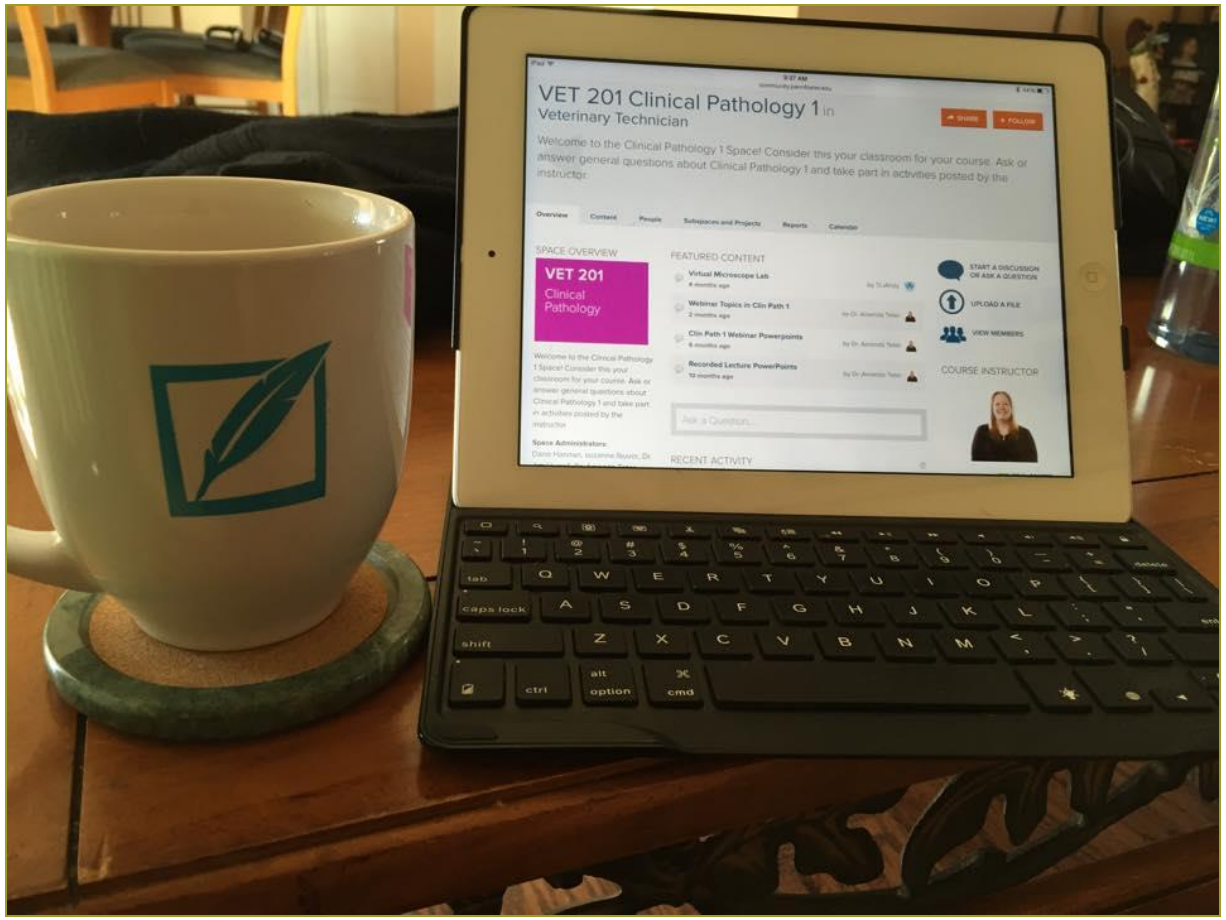
Pregnancy, Development, and Lactation

A Warm Welcome from My Faculty TEAM and Me!!! ☺

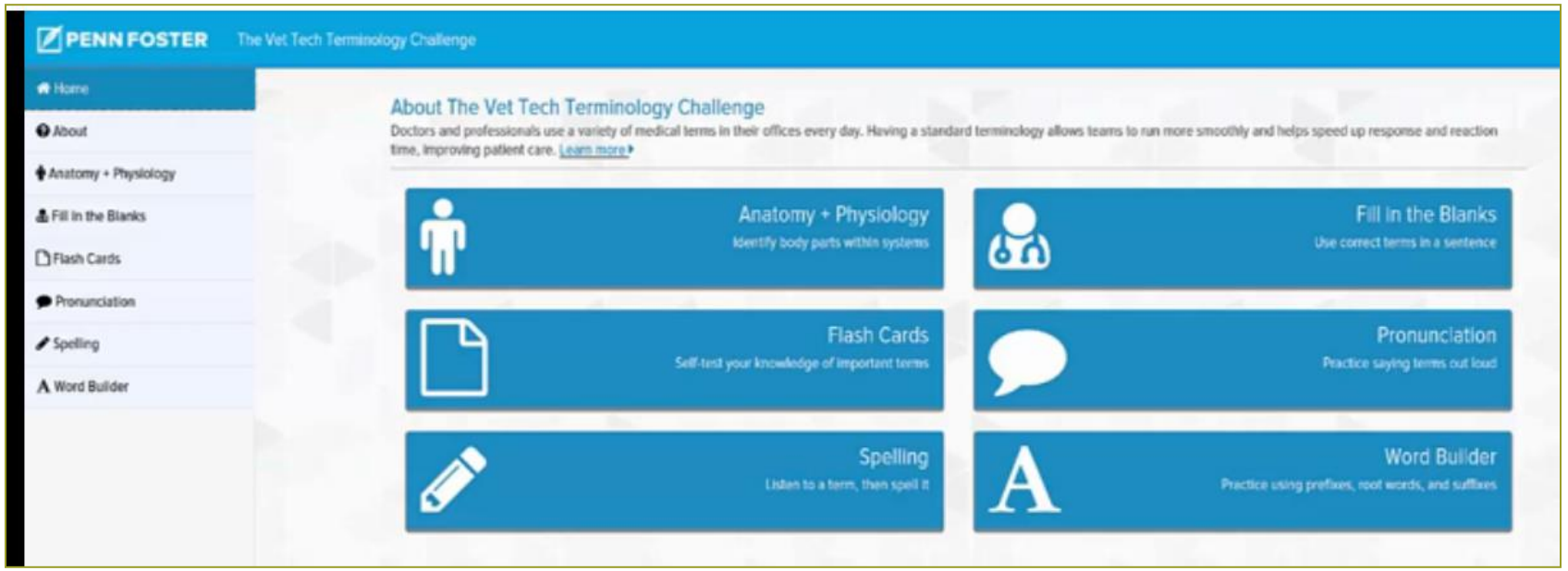
The Pledge of Allegiance

Tribute to Our Military Students and Their Spouses!

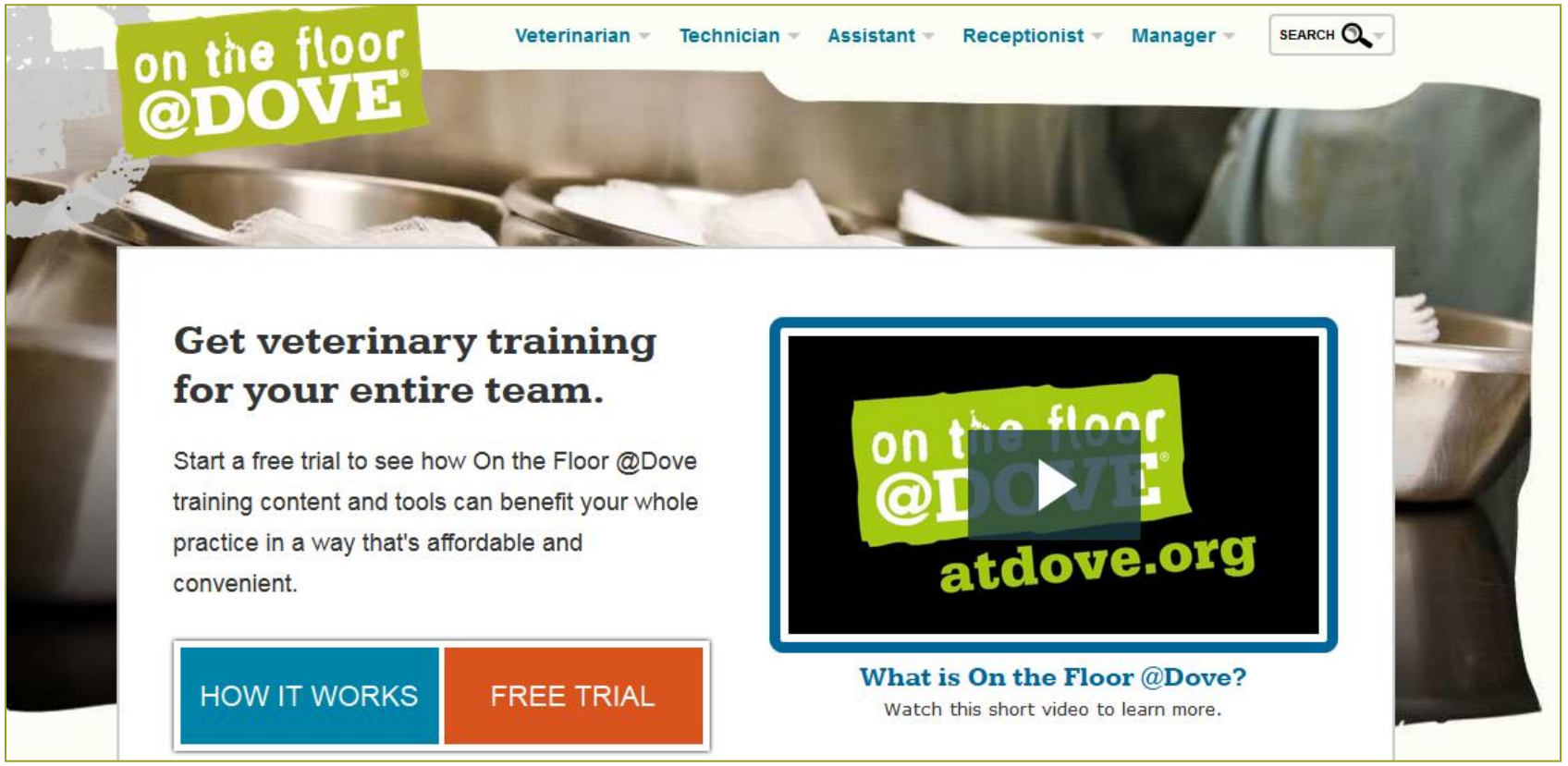
Are You Using the Course Spaces?



New “Medical Terminology Game”! Let’s Check it Out!!! ☺



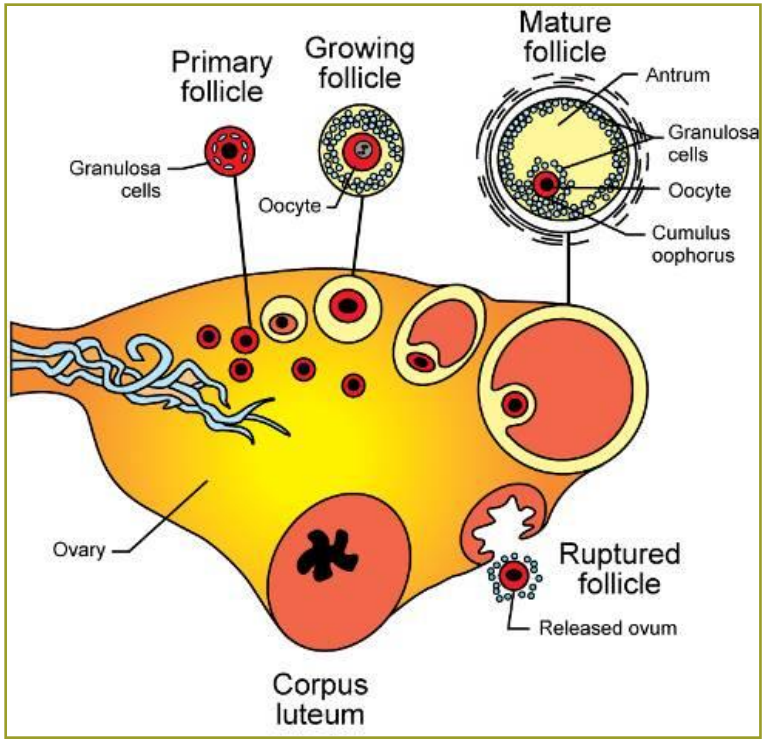
On the Floor at Dove!
https://www.atdove.org/welcome

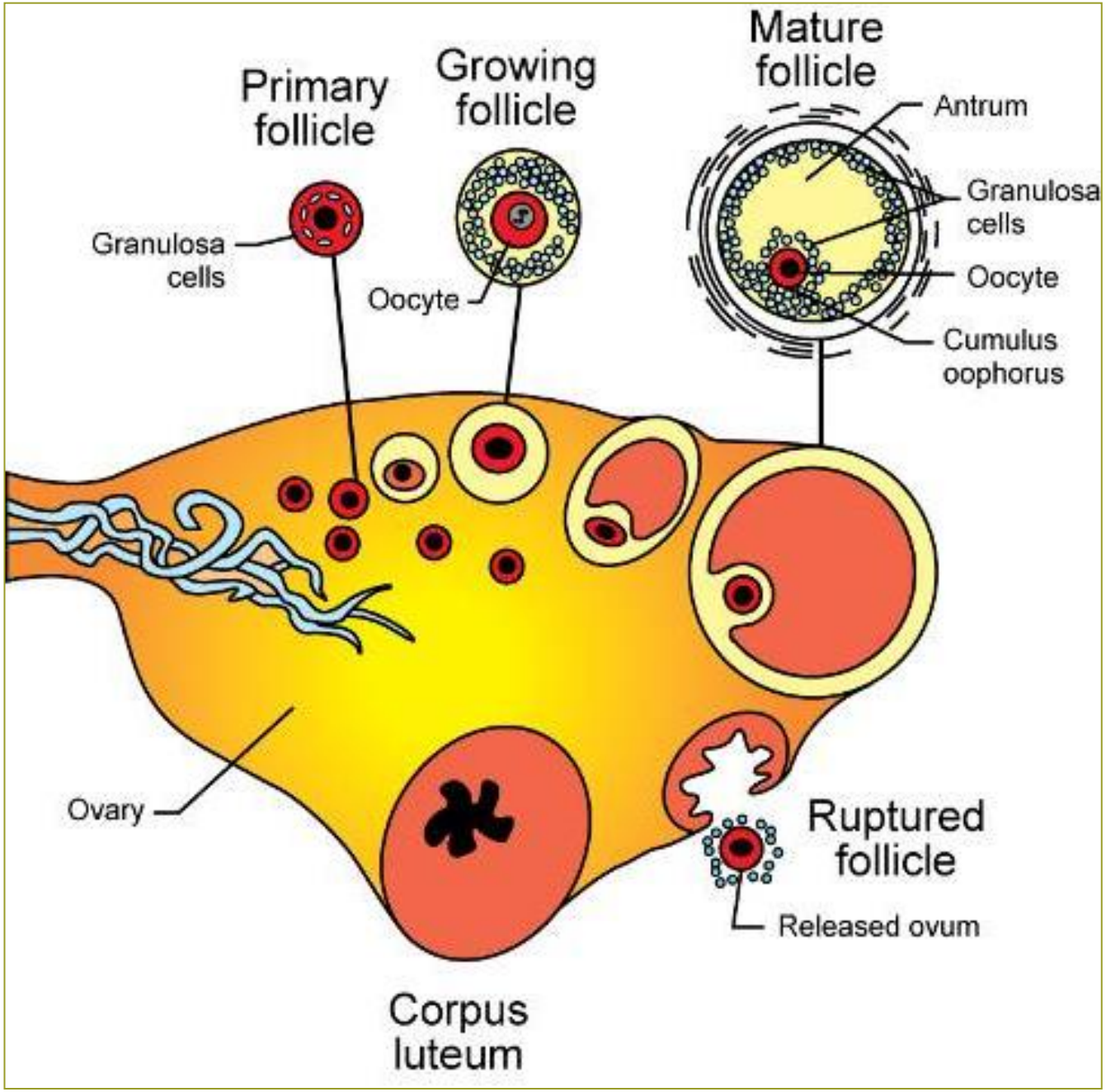


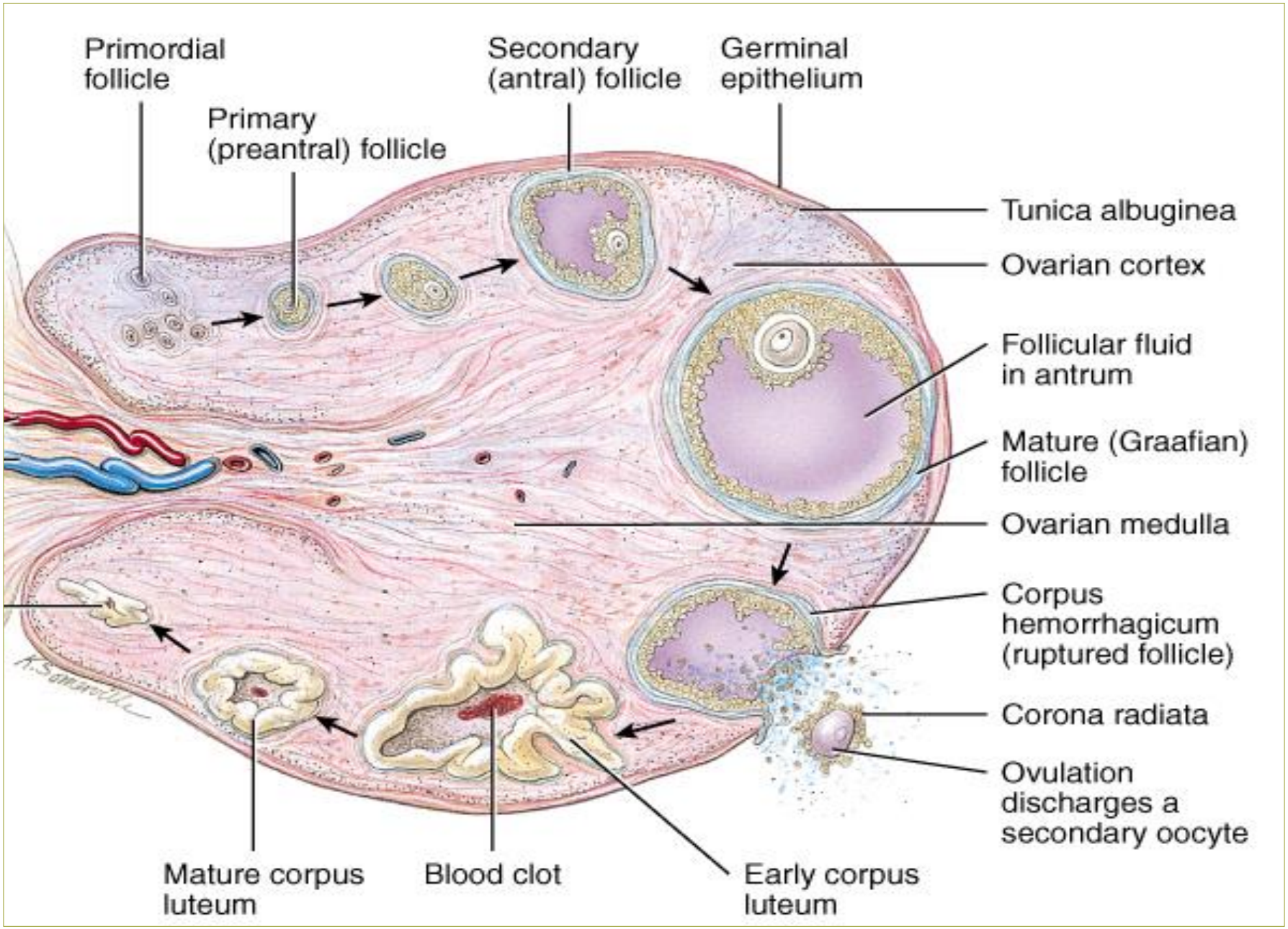
Ovarian Physiology

Figure 17-17, Page 401

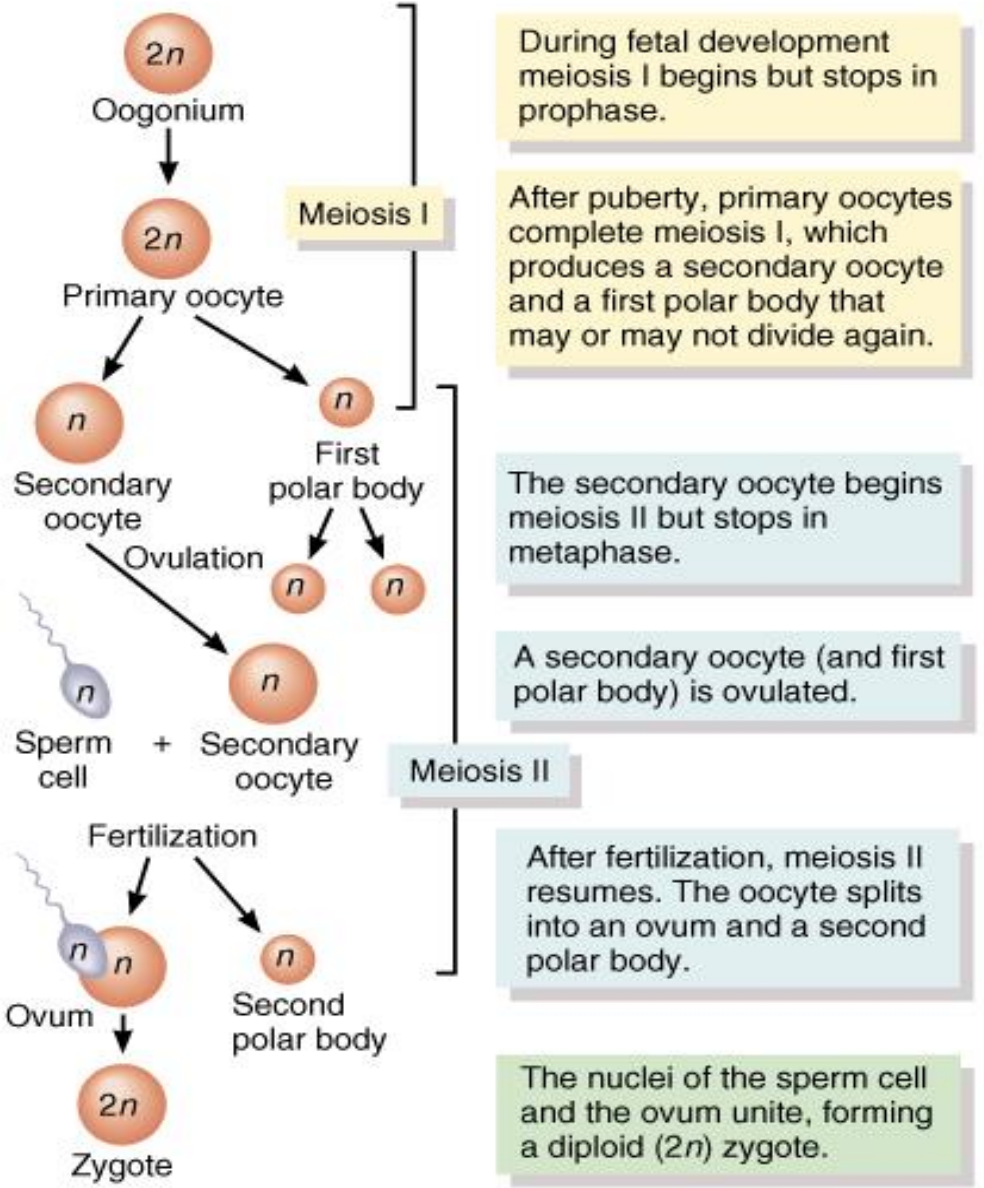
- Follicle
  - 1 egg (ovum)
  - Estrogen production
    - Prepares animal for breeding & pregnancy
- Graafian follicle (mature)
- Ovulation – follicle rupture
  - Egg “caught” by oviduct
  - Ruptured follicle become corpus luteum
- Corpus luteum produces progesterone
  - Maintains pregnancy




Primary follicle
Growing follicle
Mature follicle
Antrum
Granulosa cells
Granulosa cells
Oocyte
Oocyte
Cumulus oophorus
Ovary
Ruptured follicle
Released ovum
Corpus luteum


Primordial follicle
Primary (preantral) follicle
Secondary (antral) follicle
Germinal epithelium
Tunica albuginea
Ovarian cortex
Follicular fluid in antrum
Mature (Graafian) follicle
Ovarian medulla
Corpus hemorrhagicum (ruptured follicle)
Corona radiata
Ovulation discharges a secondary oocyte
Mature corpus luteum
Blood clot
Early corpus luteum

Oogenesis In Ovaries

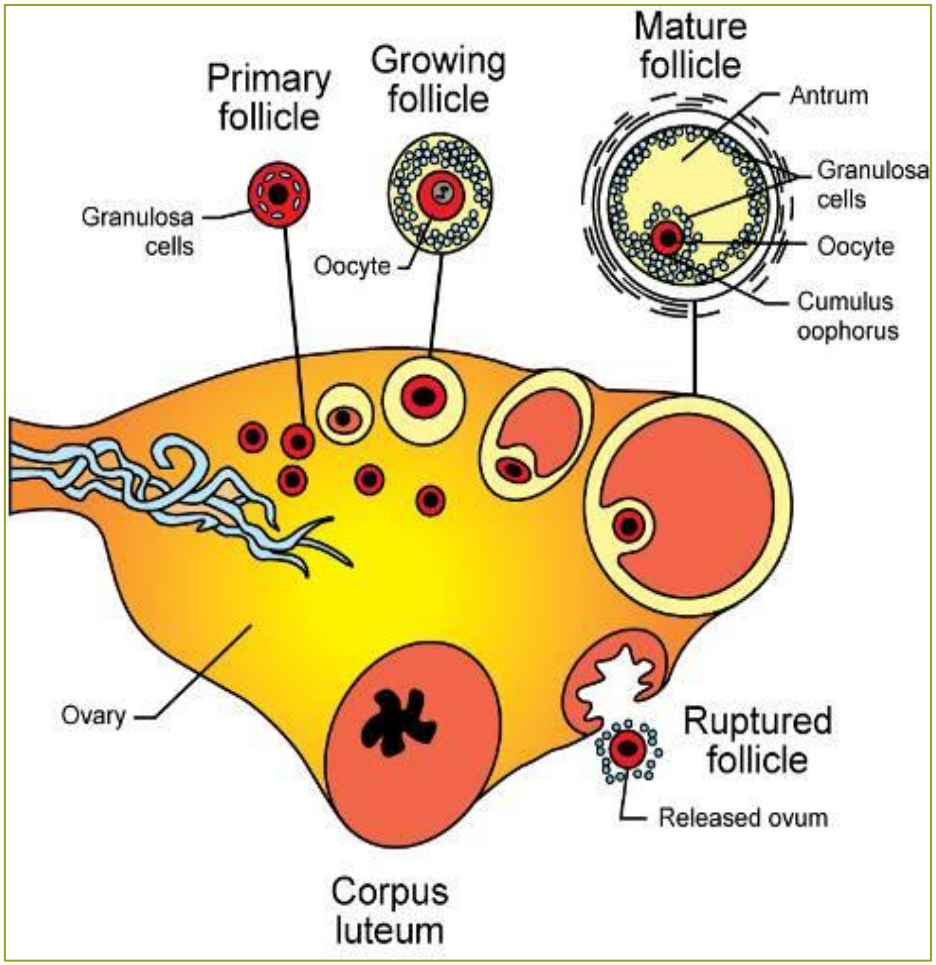


Corpus Luteum

- If pregnancy occurs, remains for entire pregnancy
- If pregnancy does not occur, degenerates after a short period
- False pregnancy (pseudocyesis)
  - Common in dogs

Ovarian Cycle

- Development of ovum, ovulation, formation of corpus luteum, and degeneration of unripened follicles and corpus luteum
- Influenced by follicle stimulating hormone (FSH) and luteinizing hormone (LH)



Ovulation

- Rupture of mature follicle and release of secondary oocyte into oviduct
  - Becomes ovum if fertilization occurs
- Surface of mature follicle weakens, ruptures
- Fluid released from antrum along with oocyte (still surrounded by corona radiata)
- Empty follicle fills with blood (corpus hemorrhagicum)

Ovulation

- Occurs spontaneously in most species as a result of rising levels of LH
- Induced ovulators: ovulation occurs after breeding
  - Cat
  - Rabbit
  - Ferret

Corpus Luteum

- Formed by divisions of granulosa cells that line the blood-filled follicle
- Influenced by continued stimulation of LH
- Produces progestins (primarily progesterone)
  - Necessary for maintenance of pregnancy
- Endocrine signal to ovary causes corpus luteum to be maintained if ovum implants in uterus

Topic 15

List the stages of the estrous cycle and describe the events that occur during each stage

A Dog's Menstrual (Heat) Cycle

Introduction

While dogs may seem to have a menstrual cycle that is very similar to a woman's menstrual cycle, dogs do not experience an actual menstrual cycle. Primates are the only mammals that have a true menstrual cycle. Instead, dogs have what is called an estrus cycle.

Female Reproductive Physiology

- Puberty – age at which reproductive organs become functional
- Males
  - Quite often mature later than female
  - Always ready for breeding
- Females
  - Usually mature first
  - Are only fertile and receptive for a brief time

Estrous Cycle

- Time from the beginning of one heat period to the beginning of the next
- Controlled by 2 anterior pituitary hormones
  - Follicle stimulating hormone (FSH)
    - Oogenesis
  - Luteinizing hormone (LH)
    - Ovulation, corpus luteum production

Estrous Cycle Stages

Proestrus

Estrus

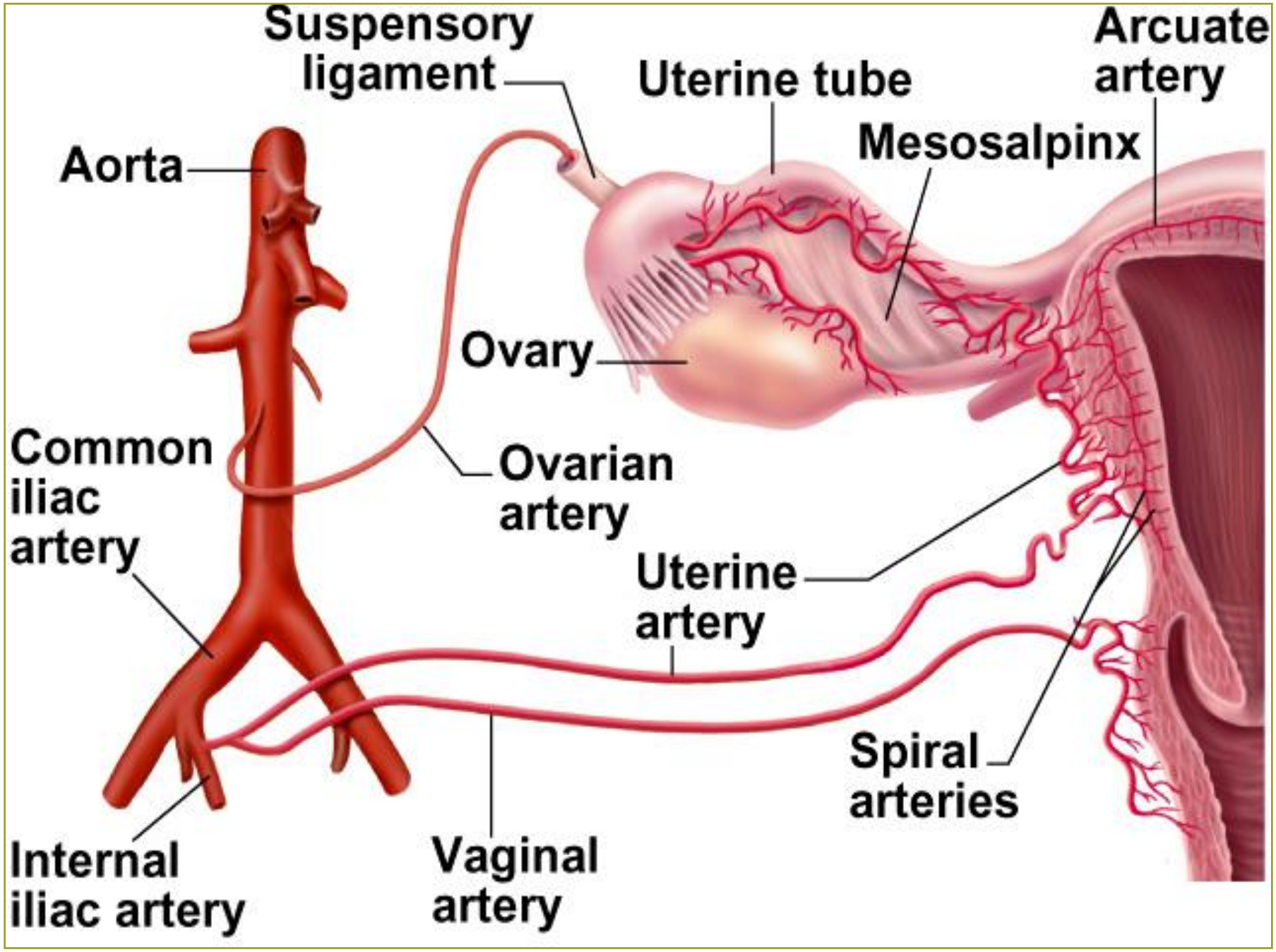
Metestrus

Diestrus

Anestrus (in some species)

Proestrus

- The “building up” phase (7 days)
- Blood spotting starts (Day 1)
- Follicles begin developing
- Estrogen output increases
- Blood supply to ovaries increases


Suspensory ligament
Uterine tube
Arcuate artery
Mesosalpinx
Aorta
Ovary
Common iliac artery
Ovarian artery
Uterine artery
Spiral arteries
Internal iliac artery
Vaginal artery

Estrus

- “True heat” (7 days)
- Estrogen level production peaks
- Female sexually receptive
- Bloody discharge lighter (straw colored?)
- Ovulation! (one or multiple ova)
  - Ovulation occurs near end of estrus in some species
- Induced ovulator species (e.g., cat, rabbit) remain in a prolonged state of estrus if not bred

Metestrus

- 7 days
- Time when corpus luteum develops
- Lining of uterus thickens for implantation
- Progesterone produced by corpus luteum temporarily inhibits follicular development in the ovary
- Cornified epithelial lining that developed in the vagina during proestrus and estrus is lost

Diestrus

- Corpus luteum at maximum size and exerting maximum effect
- If fertilized ovum implants, corpus luteum is retained well into the pregnancy
- If no pregnancy occurs, corpus luteum degenerates at the end of diestrus
  - Animal then either goes back into proestrus or ovary shuts down and animal goes into anestrus
- Seen in seasonally polyestrus animals (cat, horse, cattle, swine)

Anestrus

- Period of temporary ovarian inactivity
- Seen in seasonally polyestrus, diestrous, and monoestrous animals
- Ovary temporarily shuts down
- Ovarian inactivity (5+ months in dogs)
- Period between breeding cycles

Types of Estrous Cycles

- Polyestrous: animals that cycle continuously throughout the year if they are not pregnant (cattle and swine)
- Seasonally polyestrous: animals with seasonal variations in estrous cycles (horse, sheep, cat)
- Diestrous: animals with two cycles per year, usually spring and fall (dog)
- Monoestrous: animals with one cycle per year (fox and mink)

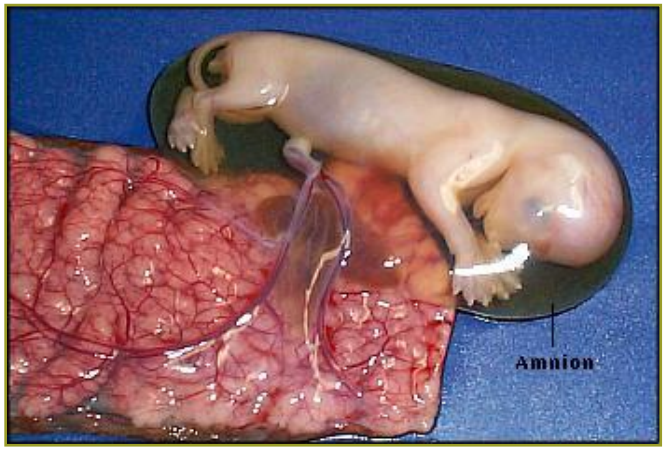
Why Are There Soooo Many Cats?

- Seasonally polyestrus (10 months)
- Anestrus (2 months)
- Induced ovulators
  - Need 2 stimuli
- Post-partum estrus
  - Can have 3 litters per year!
- Female cats left alone for 30 minutes outside…… pregnant!
- Rabbits the same

The Numbers!

Table 18-1, Page 409

Female	Length of Cycle	Length of Estrus	Gestation
Bitch	21 days	7 days	2 months
Queen	18-21 days	Induced Ovulator	2 months
Mare	~21 days	5 days	11 months
Cow	21 days	18 hours!	9 months



Pregnancy, Development, and Lactation Chapter 18

Pages 404-413

Textbook Learning Objectives

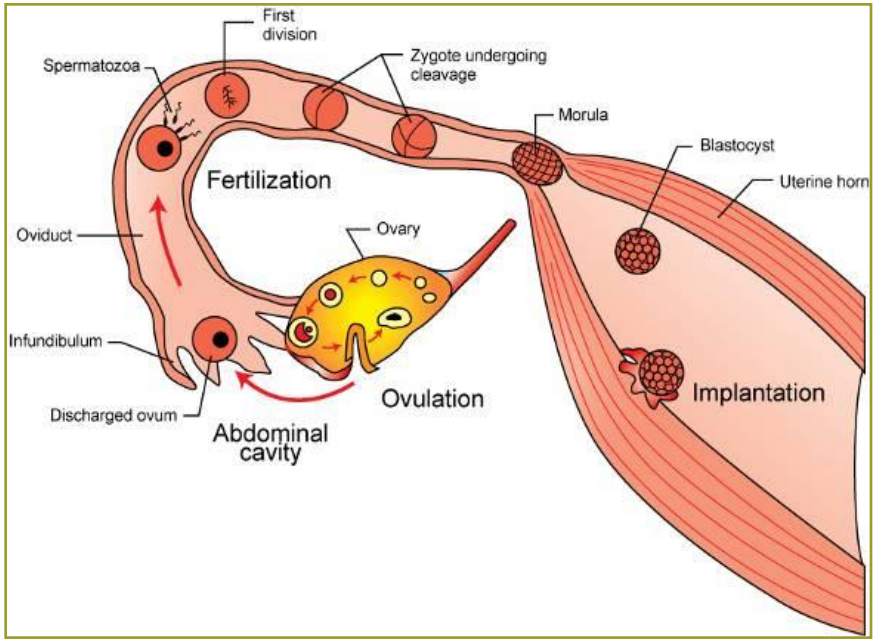
Chapter 18 – Page 405

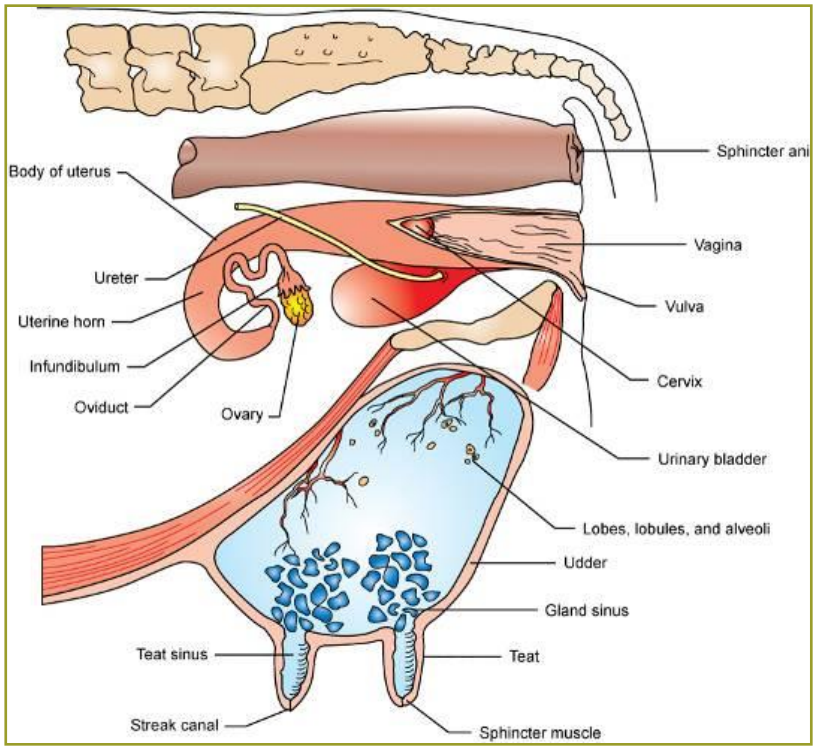
- Describe the processes of capacitation of spermatozoa and fertilization of the ovum.
- Describe the events that occur between fertilization of the ovum and implantation of the zygote.
- Describe the structure and functions of the placenta and explain the relationship between the fetus and the amniotic and allantoic sacs of the placenta.
- Describe the structures and functions of the components that make up the umbilical cord.
- Differentiate between diffuse, cotyledonary, zonary, and discoid attachments.
- List the stages of and describe the events that occur in each stage.
- Describe the structure and development of mammary glands.
- Describe the general composition of colostrum and explain its importance to the health of the neonate.
- Describe the overall process of lactation.


My brother from
another mother.

Topic 14

Describe the events that occur in the female during pregnancy, development, and lactation

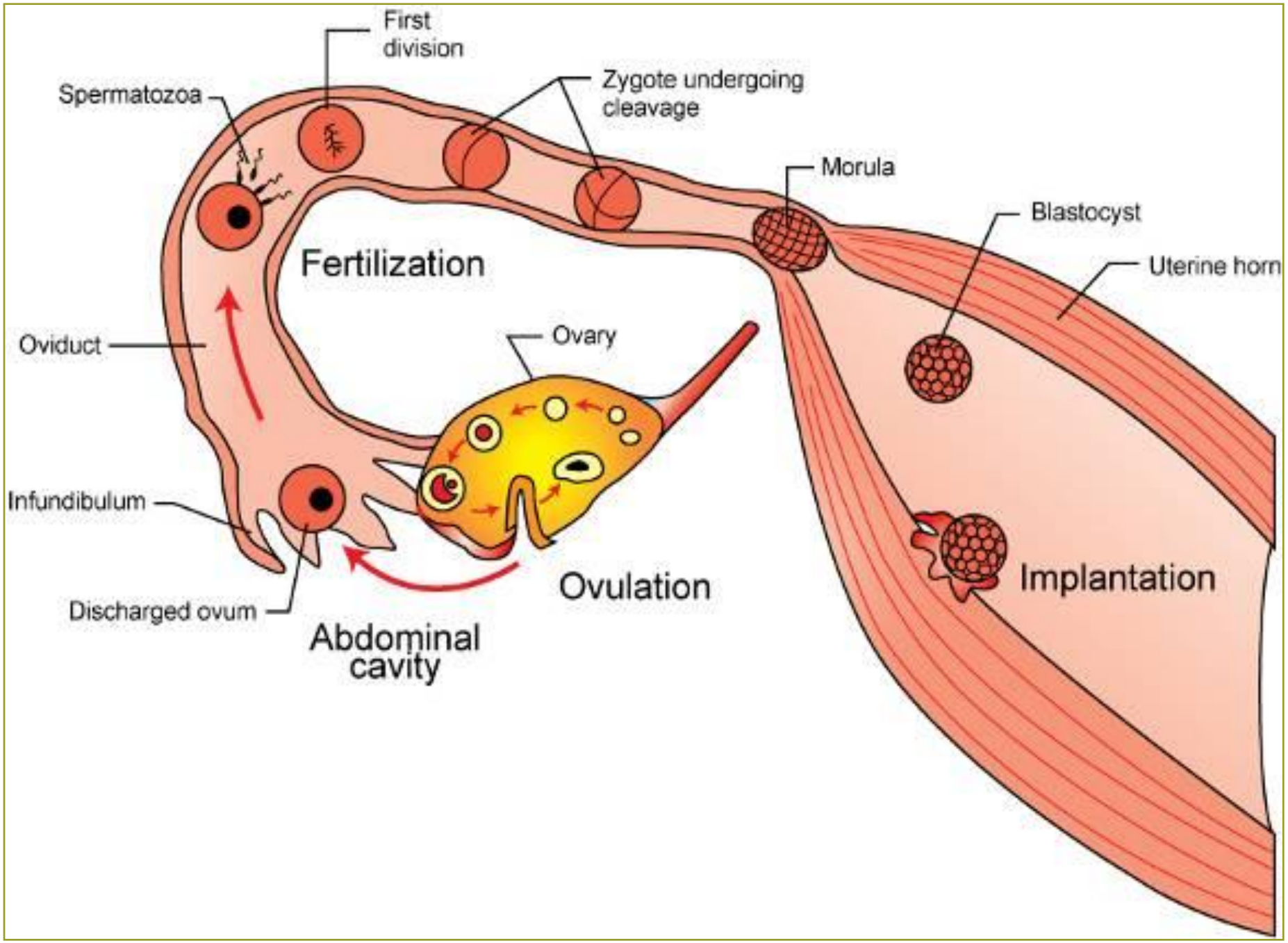


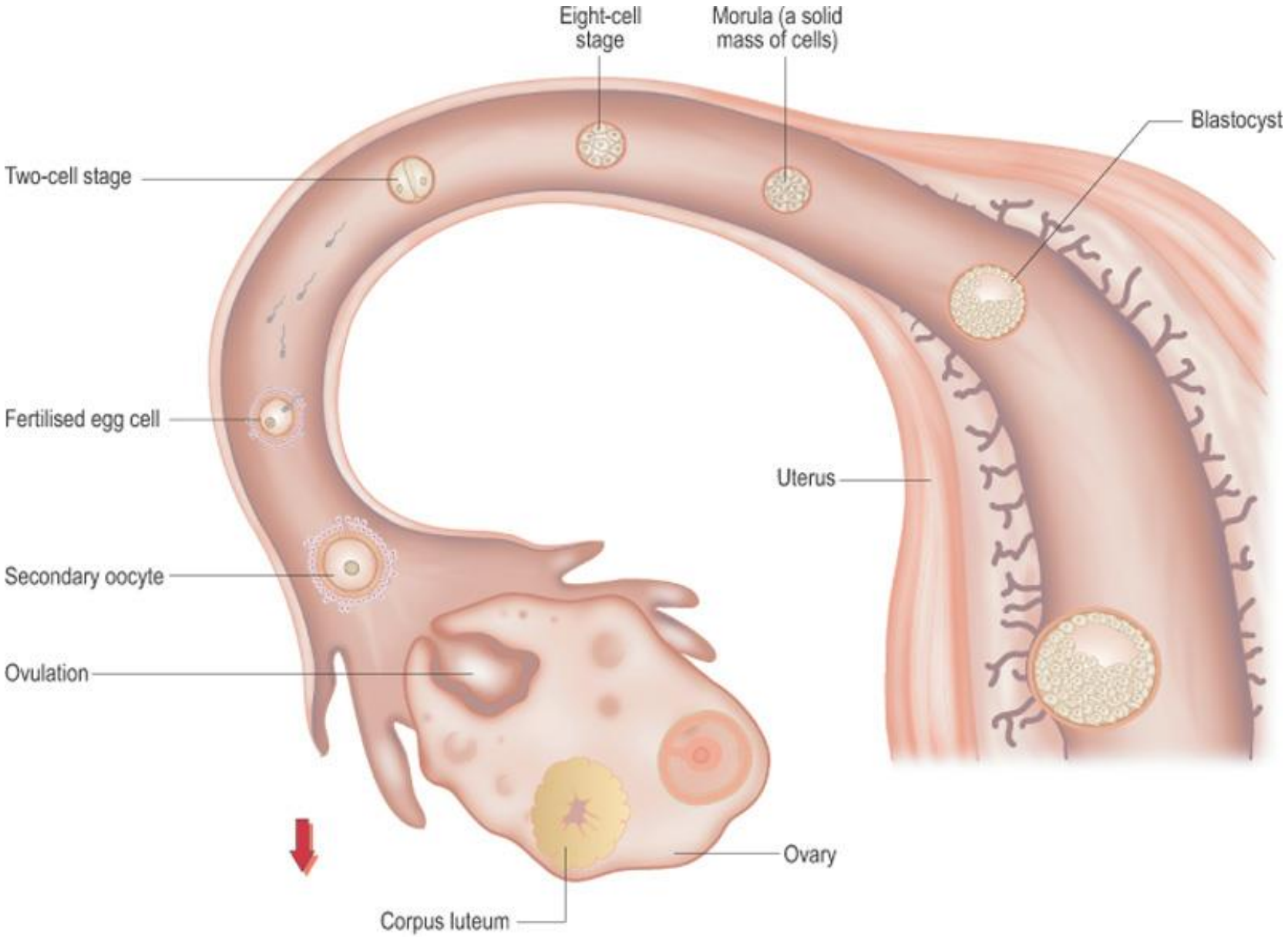


Fertilization & Implantation

Figure 18-1, Page 407

- Copulation – the act of breeding
- Fertilization – in oviduct
- Capacitation
  - Sperm must arrive first in order to mature
  - Acrosome becomes “armed”
- Cleavage – cell division of zygote
- Implantation – zygote attaches to endometrium


First division
Spermatozoa
Zygote undergoing cleavage
Morula
Blastocyst
Uterine horn
Fertilization
Oviduct
Ovary
Infundibulum
Ovulation
Implantation
Discharged ovum
Abdominal cavity



Fertilization

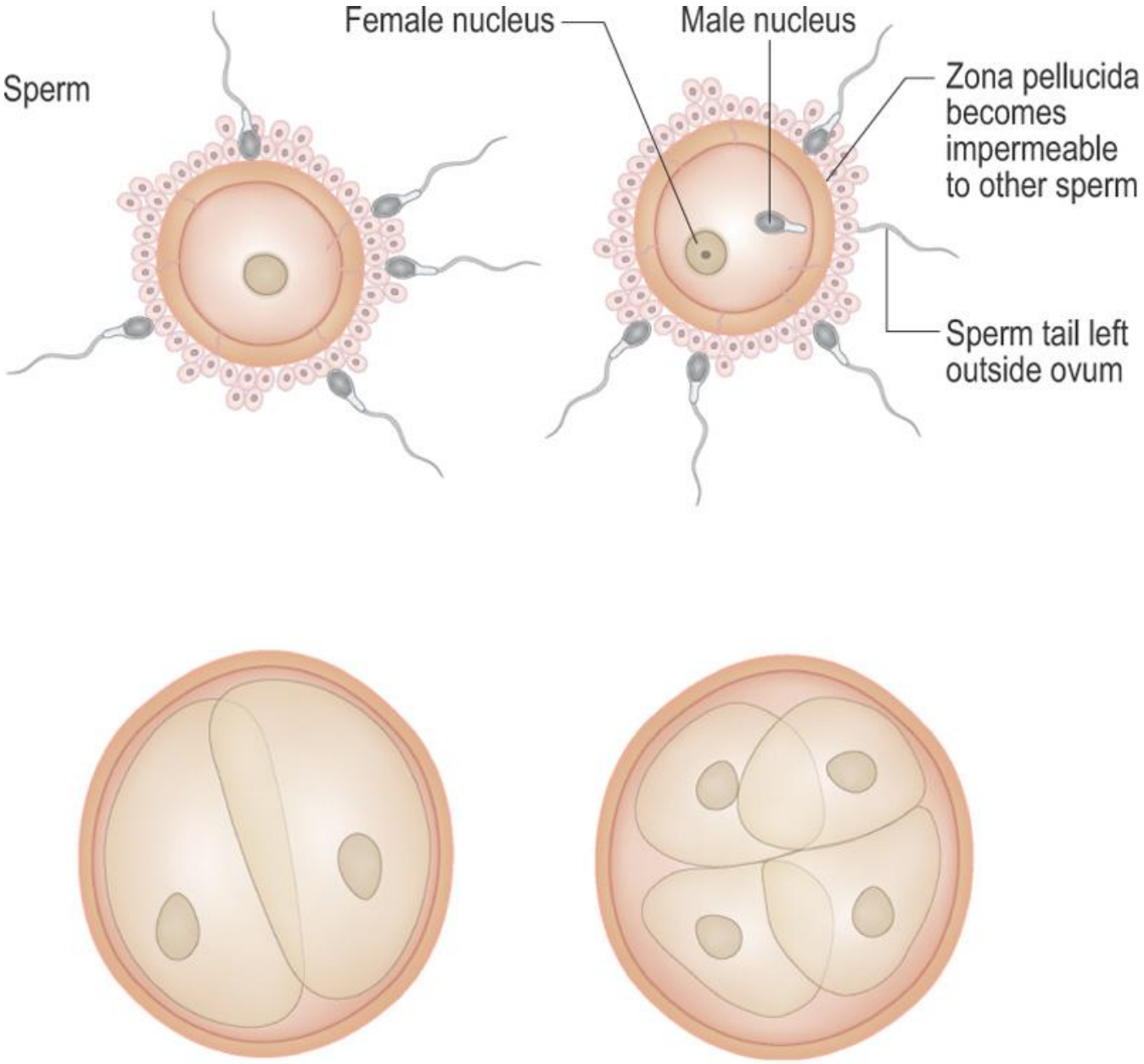
- Copulation: act of breeding; intromission, thrusting, and ejaculation
  - Copulation triggers oxytocin release from posterior pituitary gland of the female
  - Oxytocin causes contraction of smooth muscle of the female reproductive organs
- Semen is usually deposited in the upper portion of the vagina
  - Spermatozoa transported by swimming, by contractions of uterus and oviducts, and by action of cilia in oviducts

Fertilization

- Capacitation: series of changes spermatozoa undergo in the female reproductive tract
  - Changes in ion movement through the cell membranes; increase in cells' metabolic rates
  - Release of digestive enzymes from acrosome
    - Help the spermatozoa penetrate through layers surrounding the ovum to accomplish fertilization

Fertilization

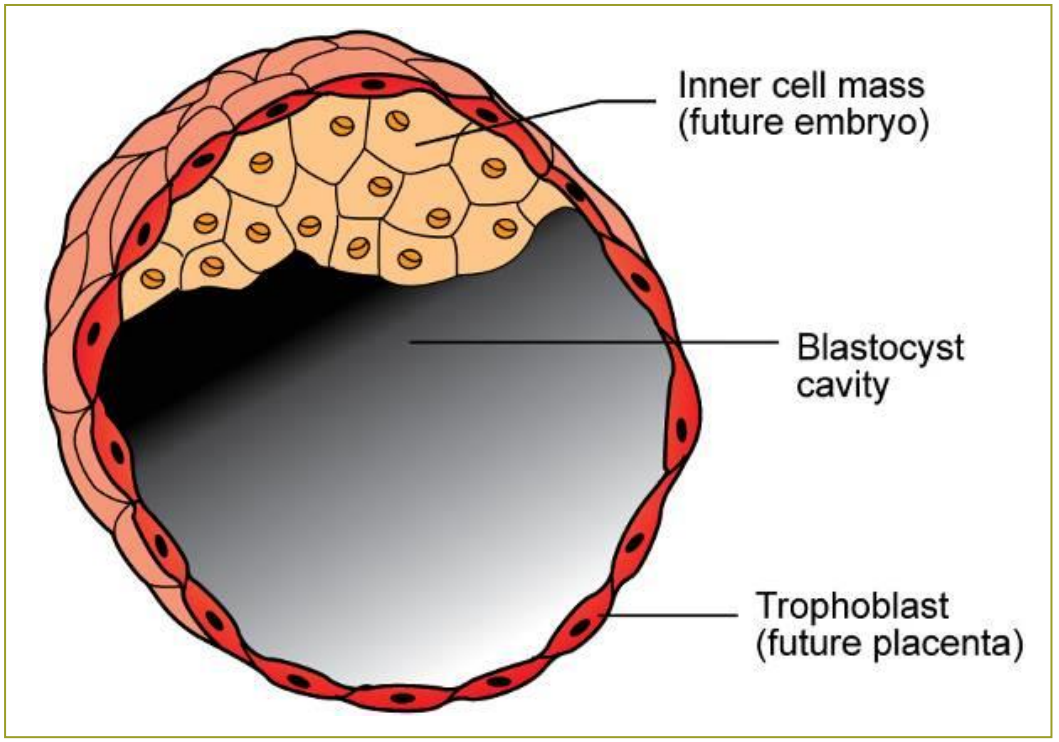
- Large number of spermatozoa find and swarm around the ovum in the oviduct
- Some begin tunneling through the layers surrounding the ovum
  - Aided by the digestive enzymes of their acrosomes
- Once a single spermatozoon penetrates cell membrane of the ovum, a change in the membrane blocks other sperm from entering



Cleavage

Figure 18-2, Page 407

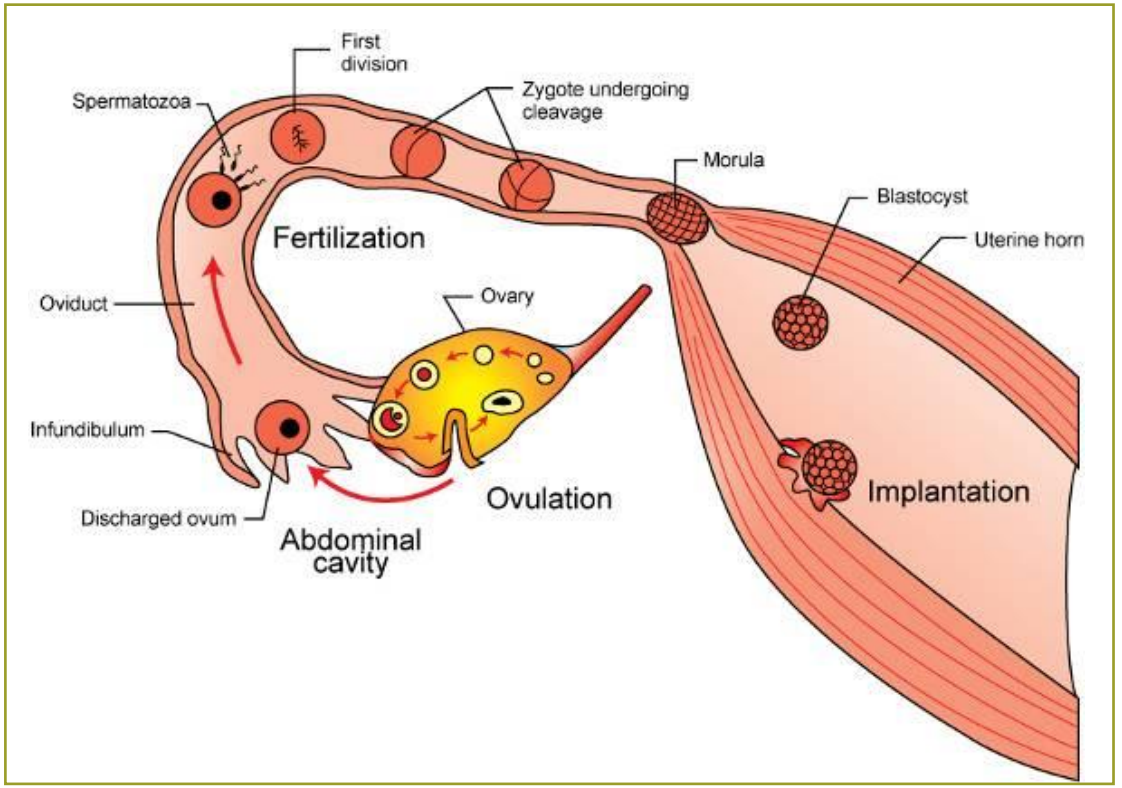
- Rapid mitosis of zygote
- Overall size of zygote does not change
- Morula: solid mass of cells
- Blastocyst: hollow ball of cells



Implantation

Figure 18-1, Page 407

- Enzymes produced by the blastocyst dissolve away a small pit in the endometrium
- Blastocyst attaches to endometrium in this pit



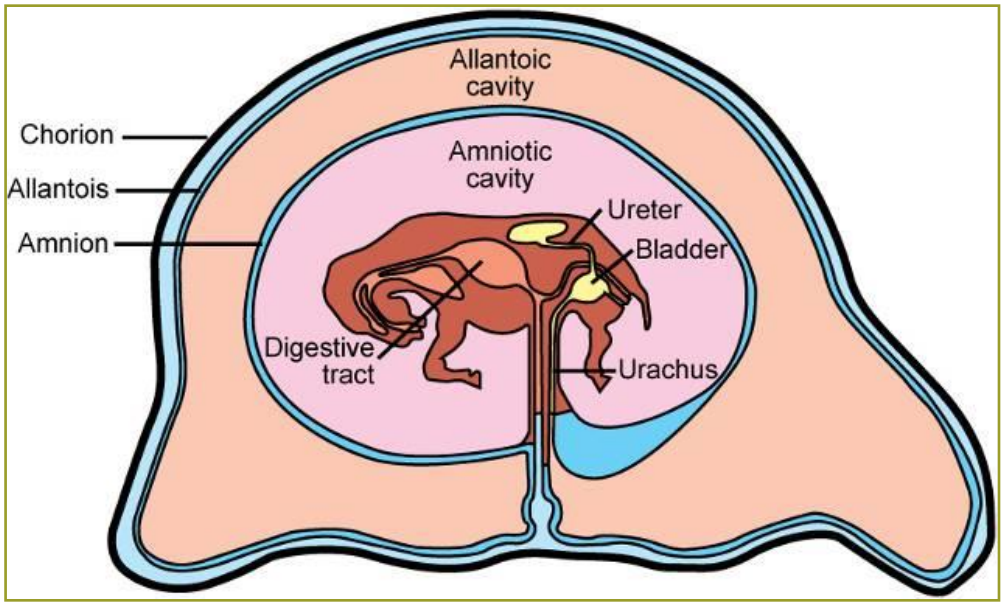
Implantation

- In multiparous (litter) species, the multiple blastocysts randomly space along the horns and body of the uterus
- Placenta begins to form as soon as the blastocyst implants in the uterus

The Placenta

Figures 18-3 & 18-4, Page 408

- Multi-layered fluid-filled sac around embryo
- Connected to embryo by umbilical cord
- Where attached to uterus lining, exchange of nutrients & waste takes place
- 2 sacs
  - Amniotic sac
  - Allantoic sac

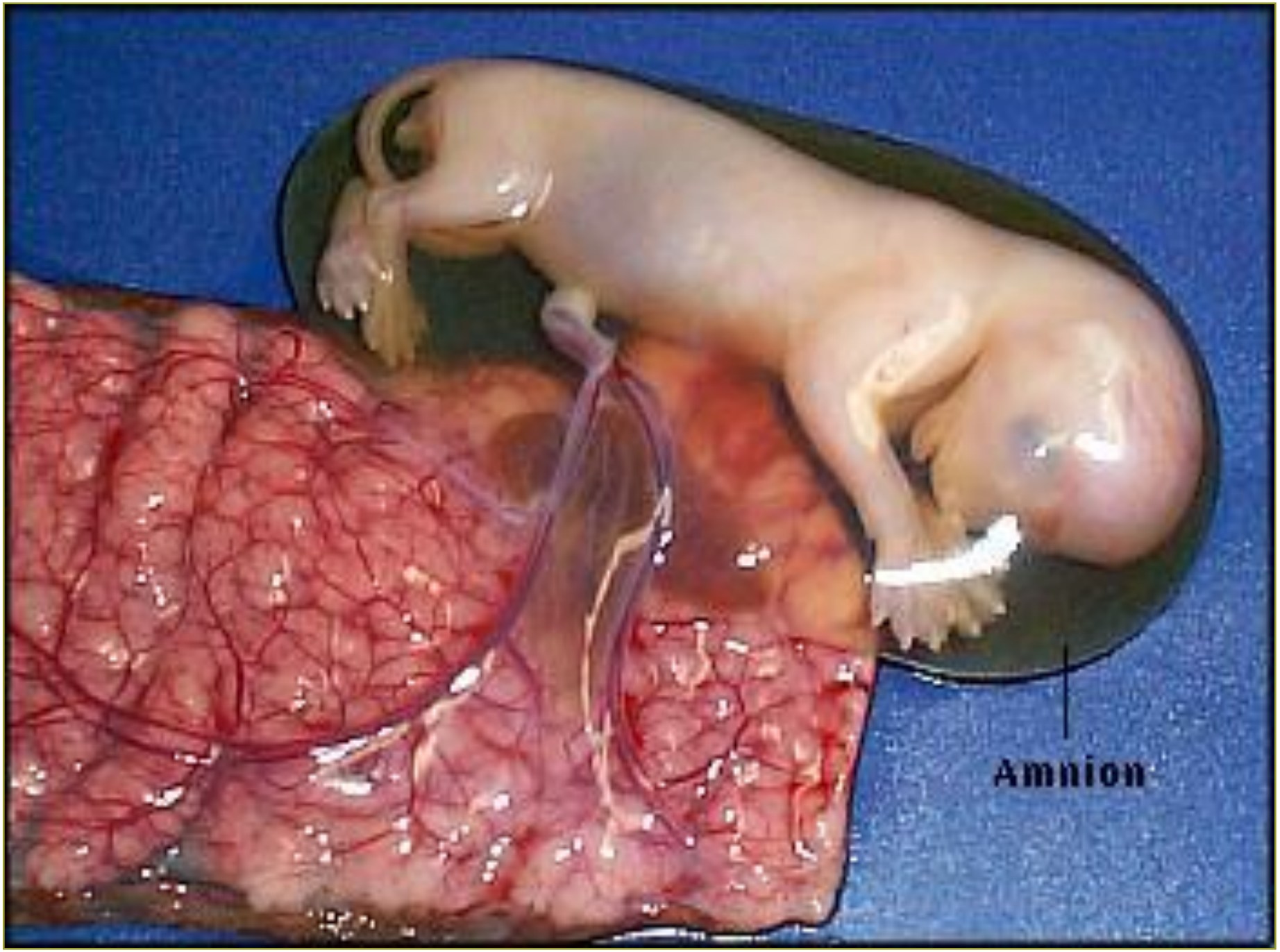


Placenta

- Multilayered, fluid-filled, membranous sac
- Outermost layer of placenta attaches to uterine lining in some areas
  - Fetal and maternal blood vessels are in close proximity to each other in this area
  - Site of exchange of blood nutrients and wastes

Placenta

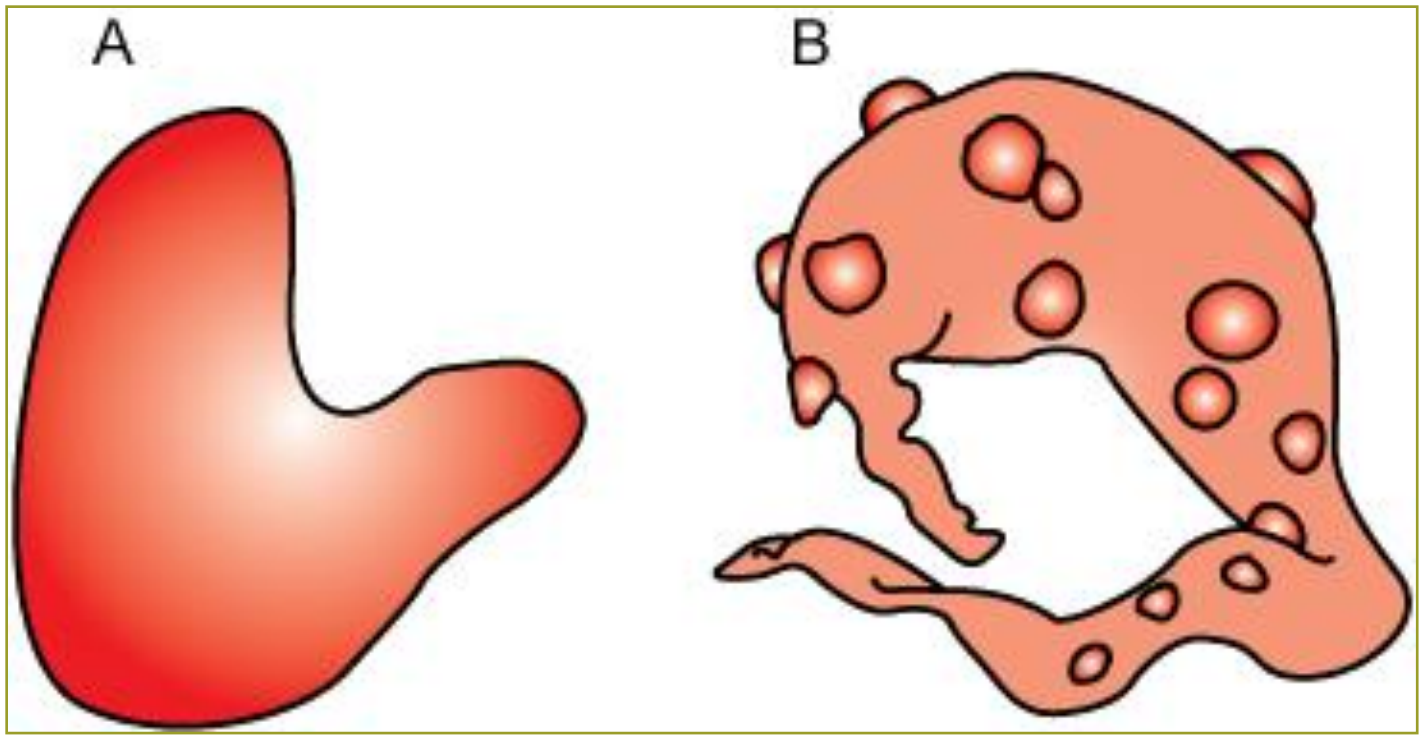
- Amnion: membranous layer immediately surrounding the fetus
  - Forms the amniotic sac
  - Fetus floats in amniotic fluid inside the amniotic sac
- Allantois: layer surrounding amniotic sac; forms the allantoic sac, which accumulates wastes


Amnion

Placental Attachments

Figure 18-4, Page 408

(A) Diffuse attachment – horse and pig
(B) Cotyledonary attachment – ruminants

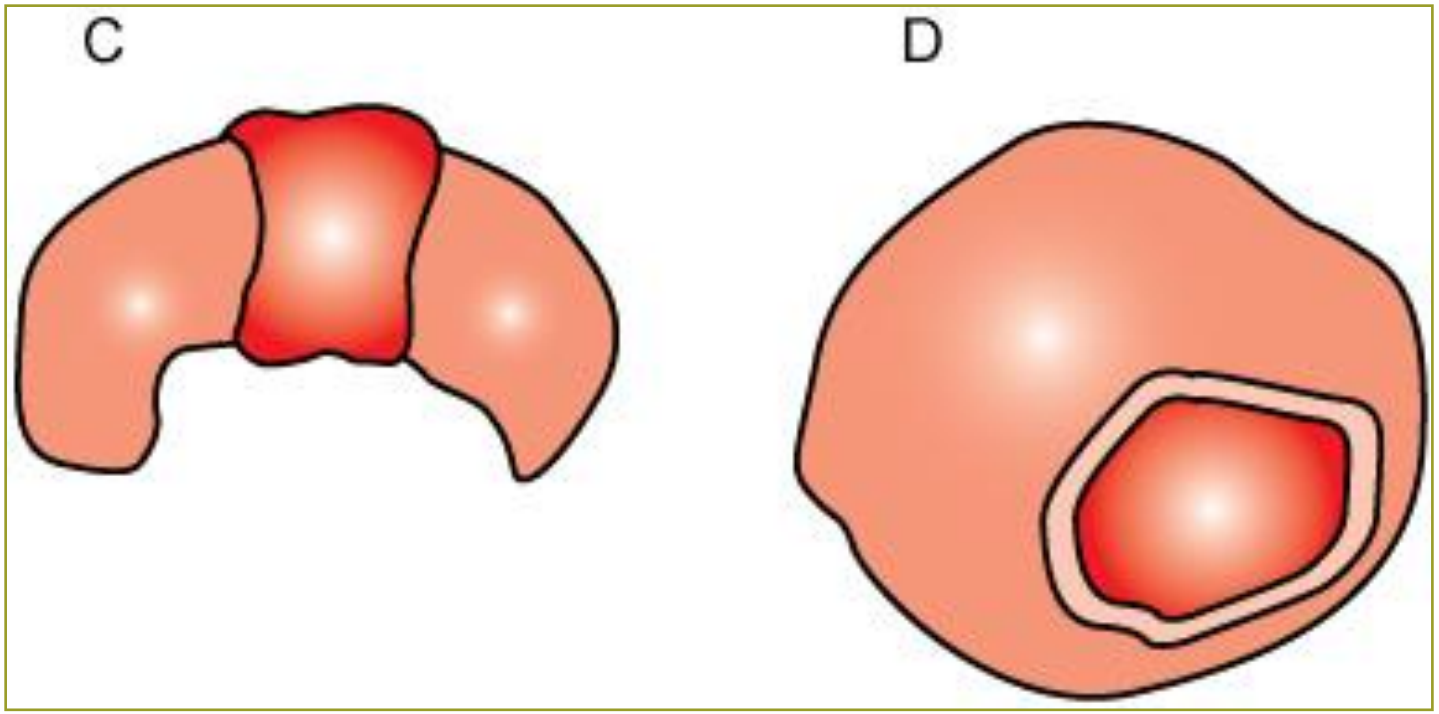


Placental Attachments

Figure 18-4, Page 408

(C) Zonary attachment – dog & cat

(D) Discoid attachment – primates, rodents



Pregnancy

- Gestation period: time from fertilization of ovum to delivery of newborn
- Divided into three segments (trimesters):
  - First trimester – embryonic period
    - Placenta develops
  - Second trimester – fetal period
    - Body tissues, organs, & systems develop
  - Third trimester – fetal growth period

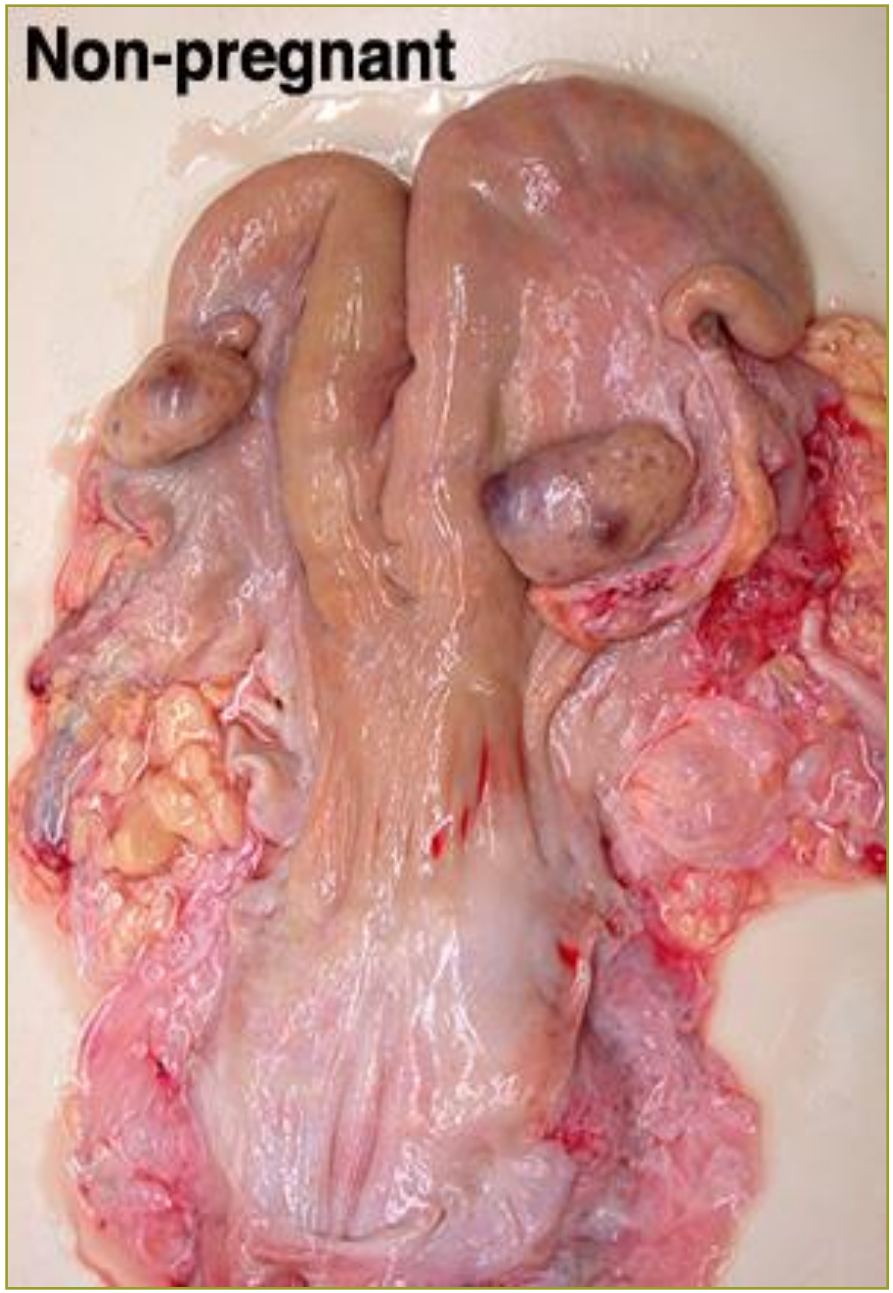
Average Gestation Periods

Table 18-1, Page 409

Species	Gestation Period (Months)	Average No. of Young
Bovine	9 months	1
Canine	2 months	4–10
Equine	11 months	1
Feline	2 months	4-6
Ovine	5 months	1–2

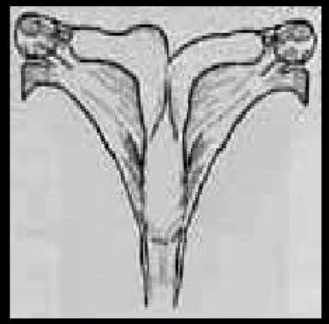
Pregnancy Diagnosis

- Rectal palpation
  - Horses, cows

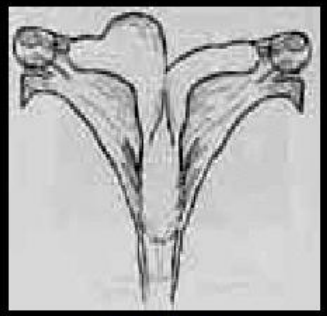

Non-pregnant


Pregnant

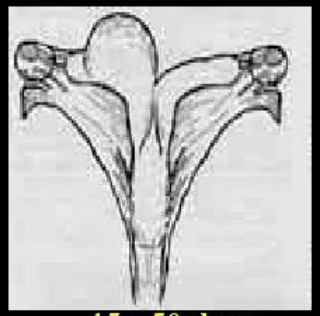
Horse



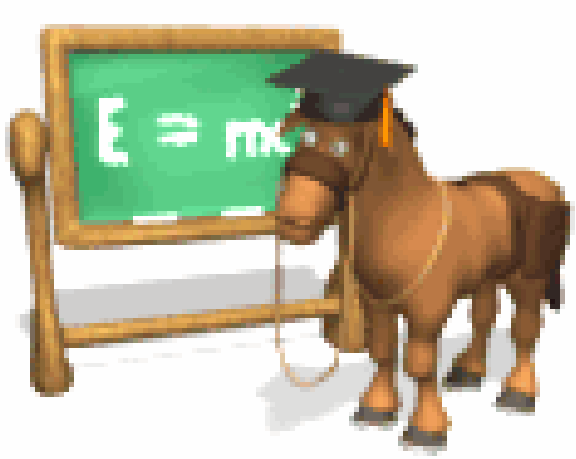
25 - 30 days

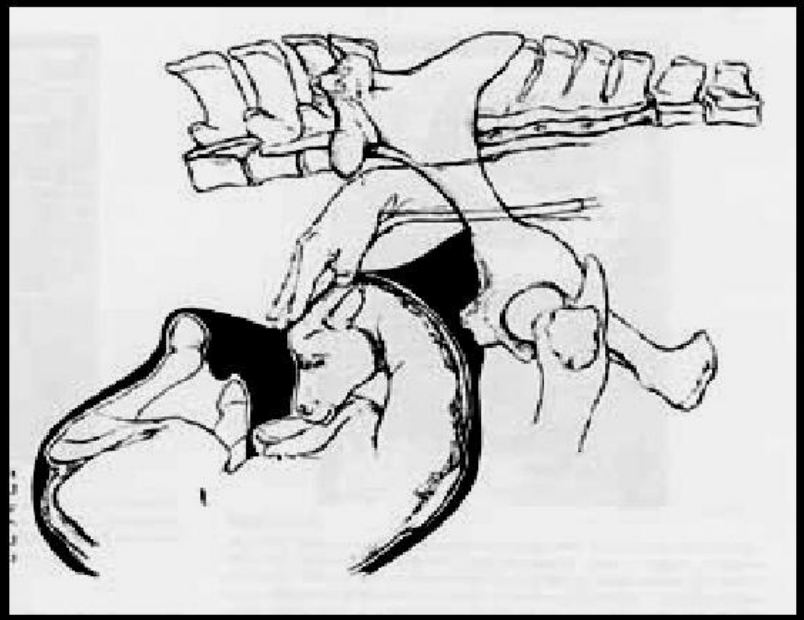


35 - 40 days



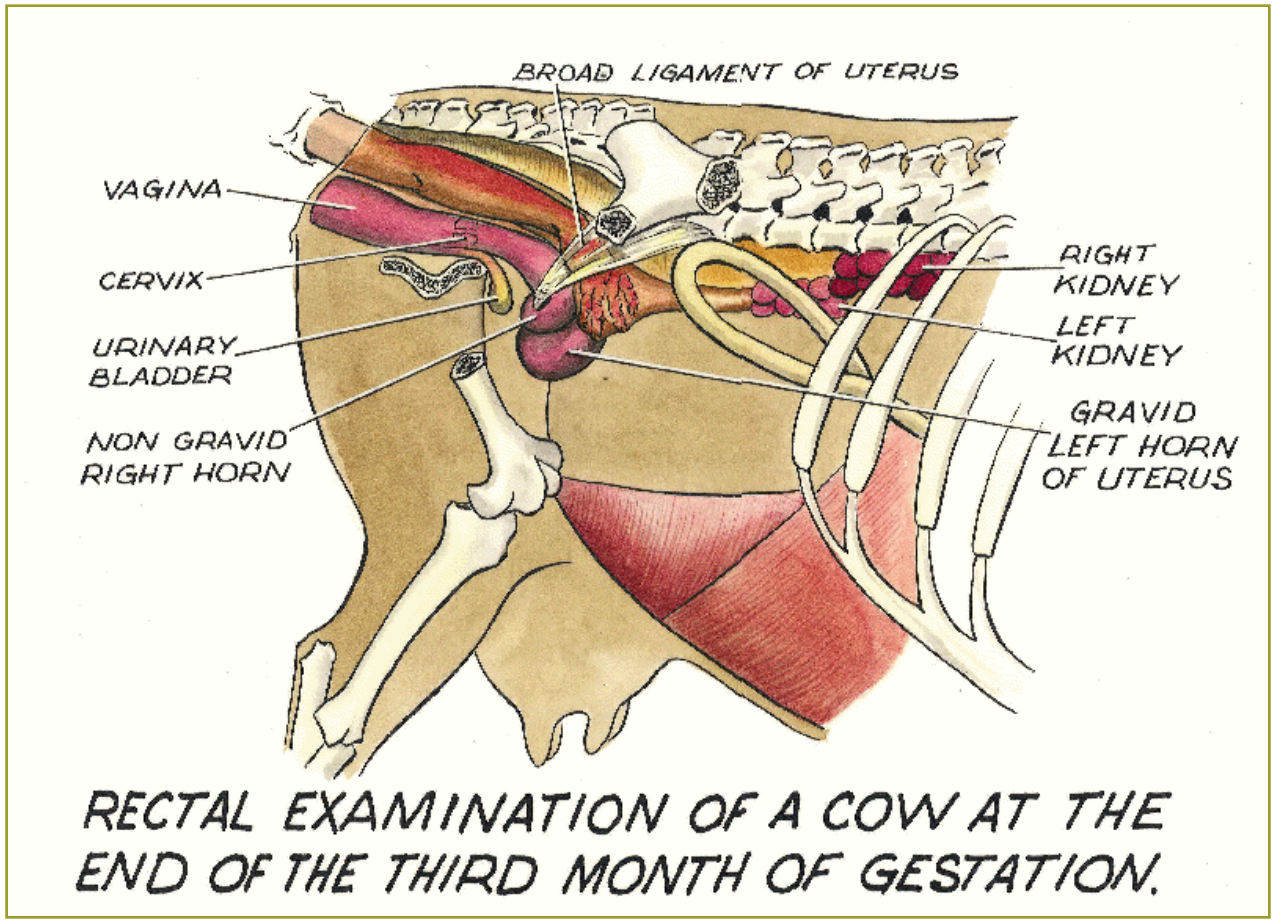
45 - 50 days



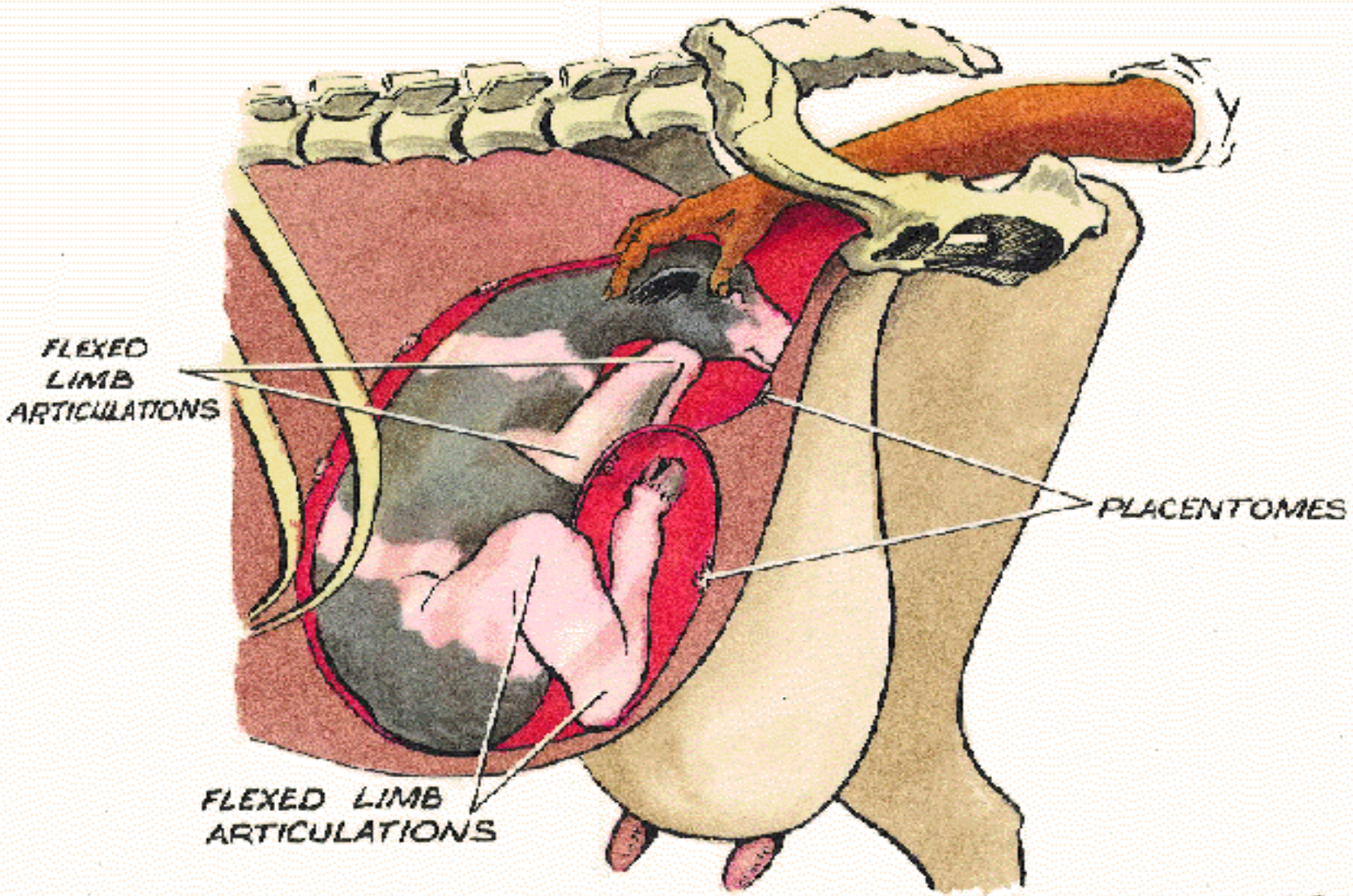


Last trimester of pregnancy

Cow



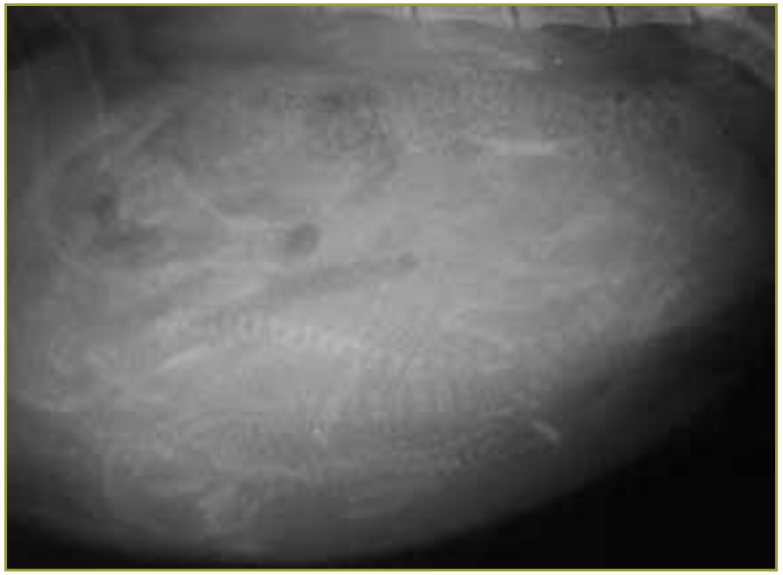
RECTAL EXAMINATION OF A COW AT THE END OF THE THIRD MONTH OF GESTATION.

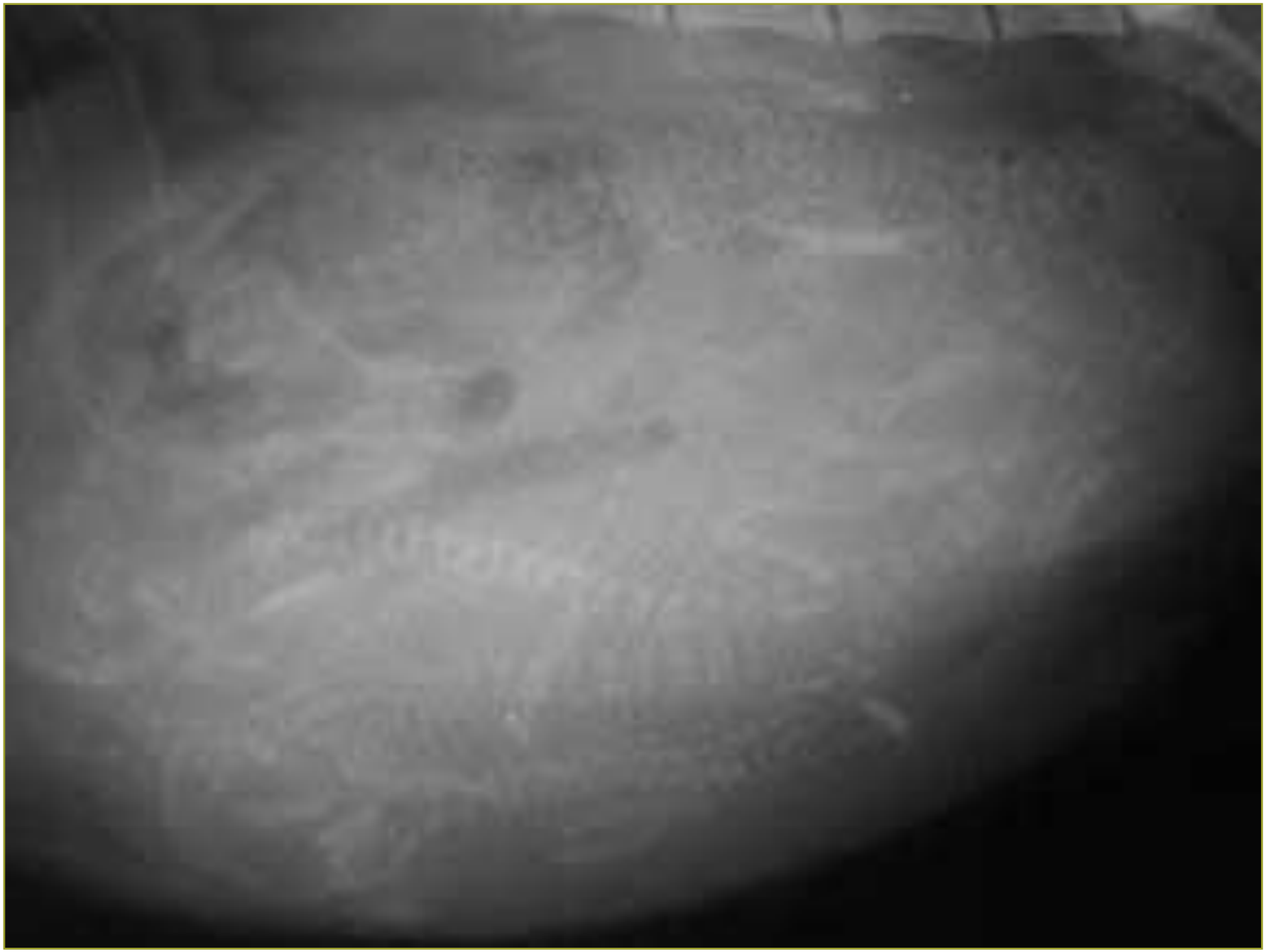


RECTAL EXAMINATION OF A COW APPROACHING TERM. RUMINANT STOMACH REMOVED.

Dogs & Cats

- Absence of heat (cats)
- Abdominal palpation – ~28 days after breeding
- Xrays in last 8-10 days
- Blood tests?





Parturition (Labor)

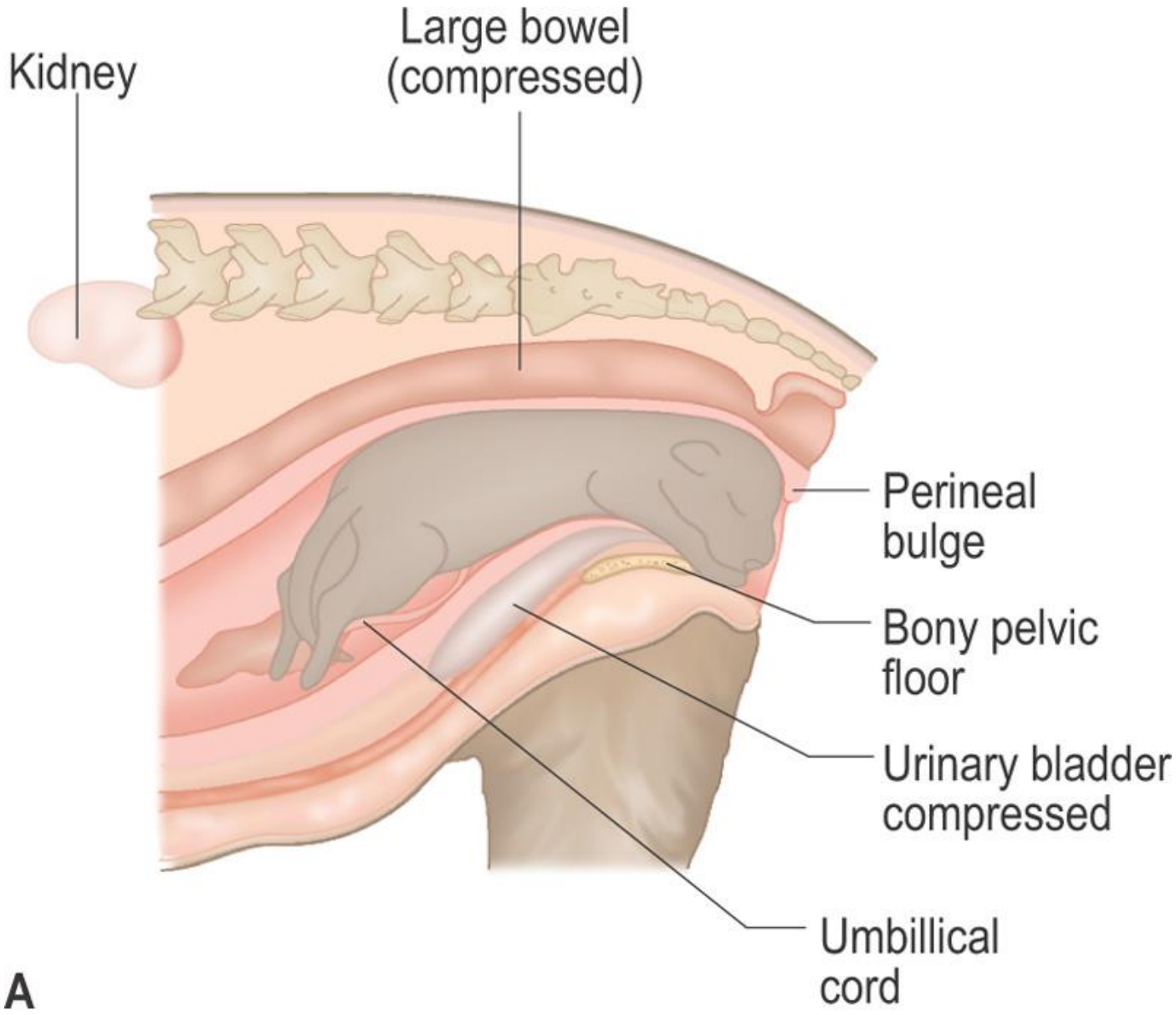
- The birthing process
- Multiple factors trigger parturition
  - Size and weight of uterus
  - Hormonal changes
- Fetal changes at birth
  - Lungs expand and start functioning
  - Foramen ovale and ductus arteriosus close

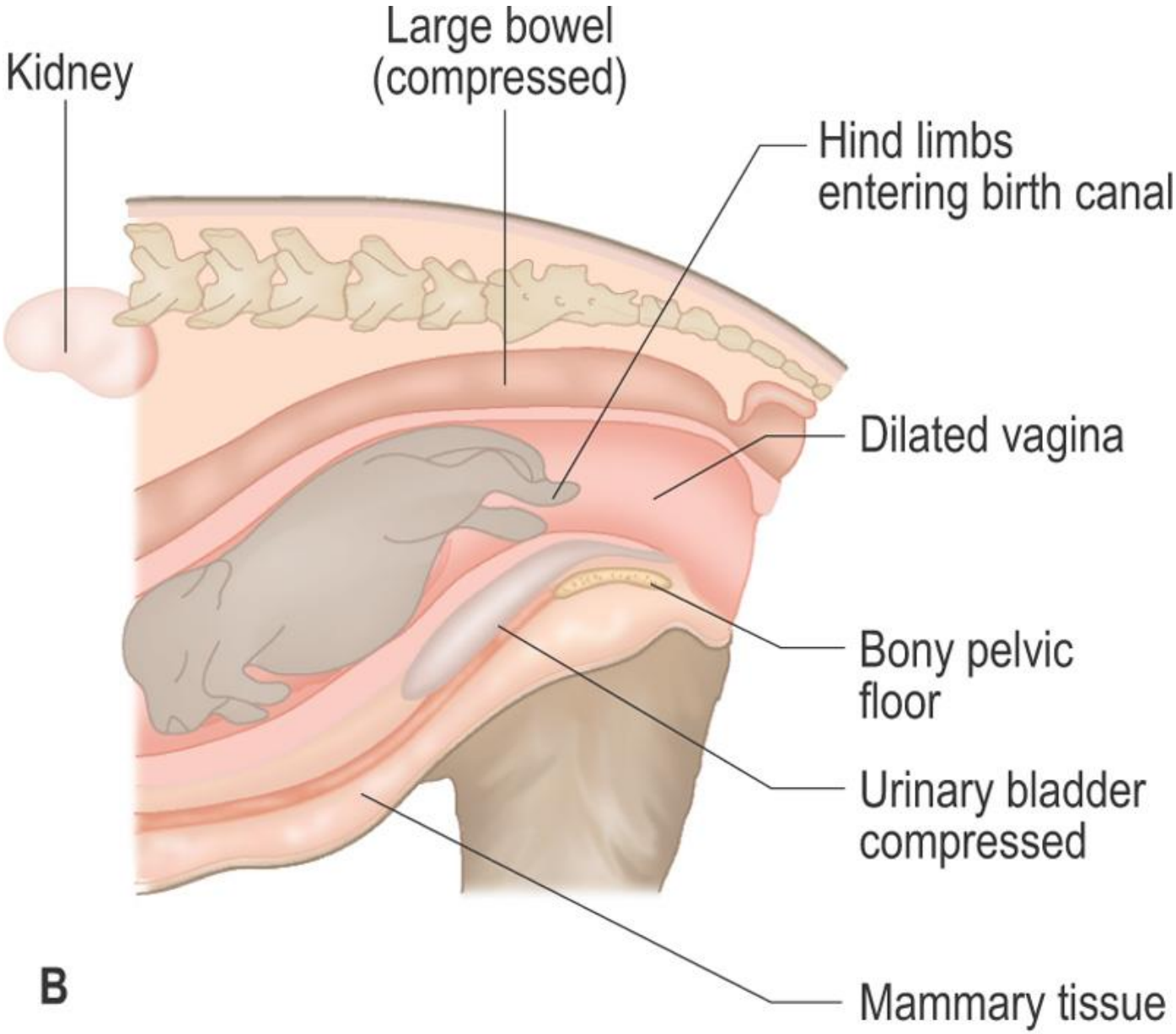
Parturition

- 2 hormones
  - Estrogen – increases myometrium sensitivity to oxytocin
  - Oxytocin
    - Myometrium contractions
    - Milk letdown

Labor – Comparative Physiology

Species	Term	Newborn	Litter?	Breach OK?
Canine	Whelping	Pups	Yes	Yes
Feline	Queening	Kittens	Yes	Yes
Equine	Foaling	Foals	Twins bad	No
Bovine	Calving	Calf	Twins ok	No
Ovine	Lambing	Lambs	Twins good	No
Porcine	Farrowing	Piglets	Yes	Yes





Stages of Labor

First stage – uterine contractions

Second stage – delivery of the newborn

Third stage – delivery of the placenta

Uterine Contractions

- Myometrium contracts and presses fetus down against the cervix
- Sustained contractions cause the cervix to gradually dilate

Delivery of the Newborn

- Results from combination of strong uterine and abdominal muscle contractions
- Rupture of amniotic and allantoic sacs of the placenta usually precedes actual delivery of the newborn

Delivery of the Placenta

- Placenta separates from wall of the uterus and is expelled by weaker uterine contractions
- Post-partum examination – very important!

Involution of the Uterus

- Uterus gradually returns to its non-pregnant size
- Endometrium sloughs into lumen of uterus at sites of placental attachment
- Myometrium continues mild contractions to move remaining uterine contents out through birth canal
- May take from a few weeks to a month or more for involution to be complete

Mammary Glands & Lactation

- Specialized skin glands
  - Colostrum – passive immunity
  - Milk
- Present in both males & females
- Undeveloped until puberty
- Lactation
  - Milk production
  - Begins towards end of pregnancy
  - Continues as long as gland is emptied

Mammary Glands – Comparative Anatomy

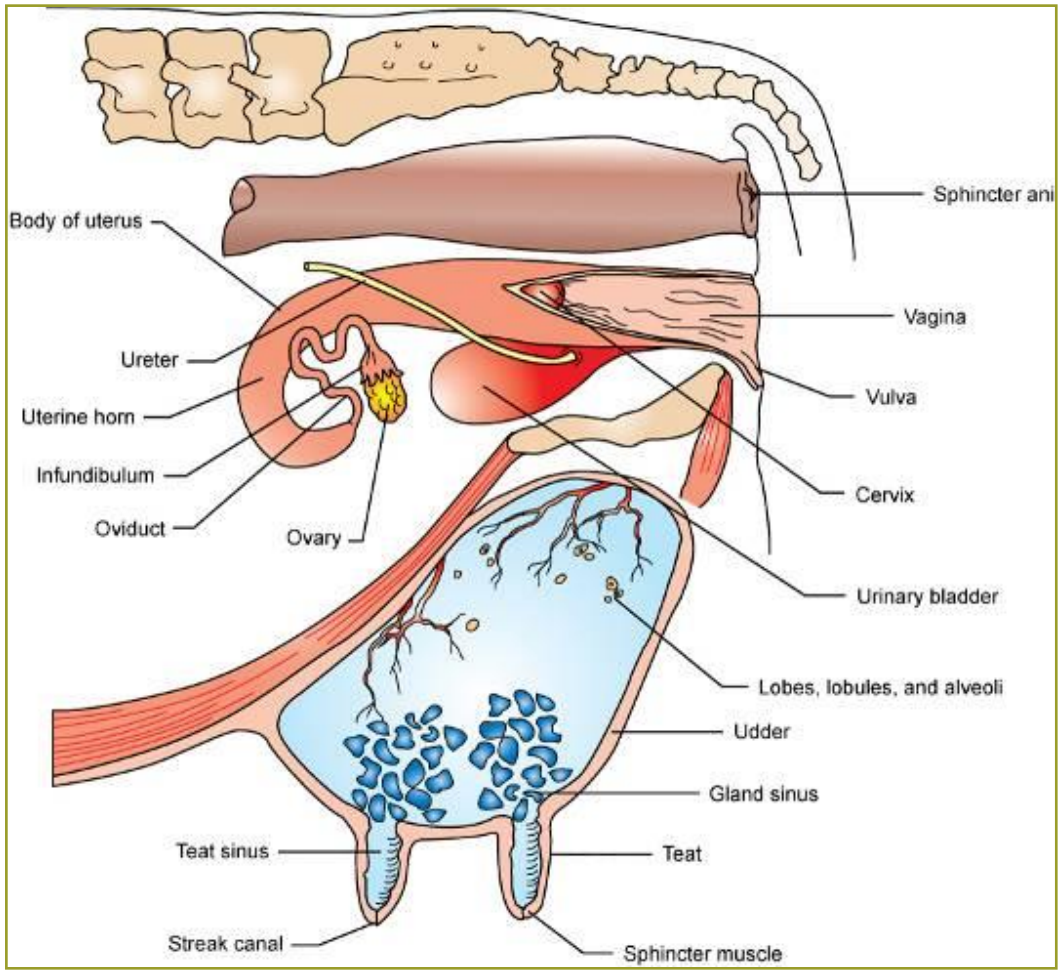
Table 18-2, Page 411

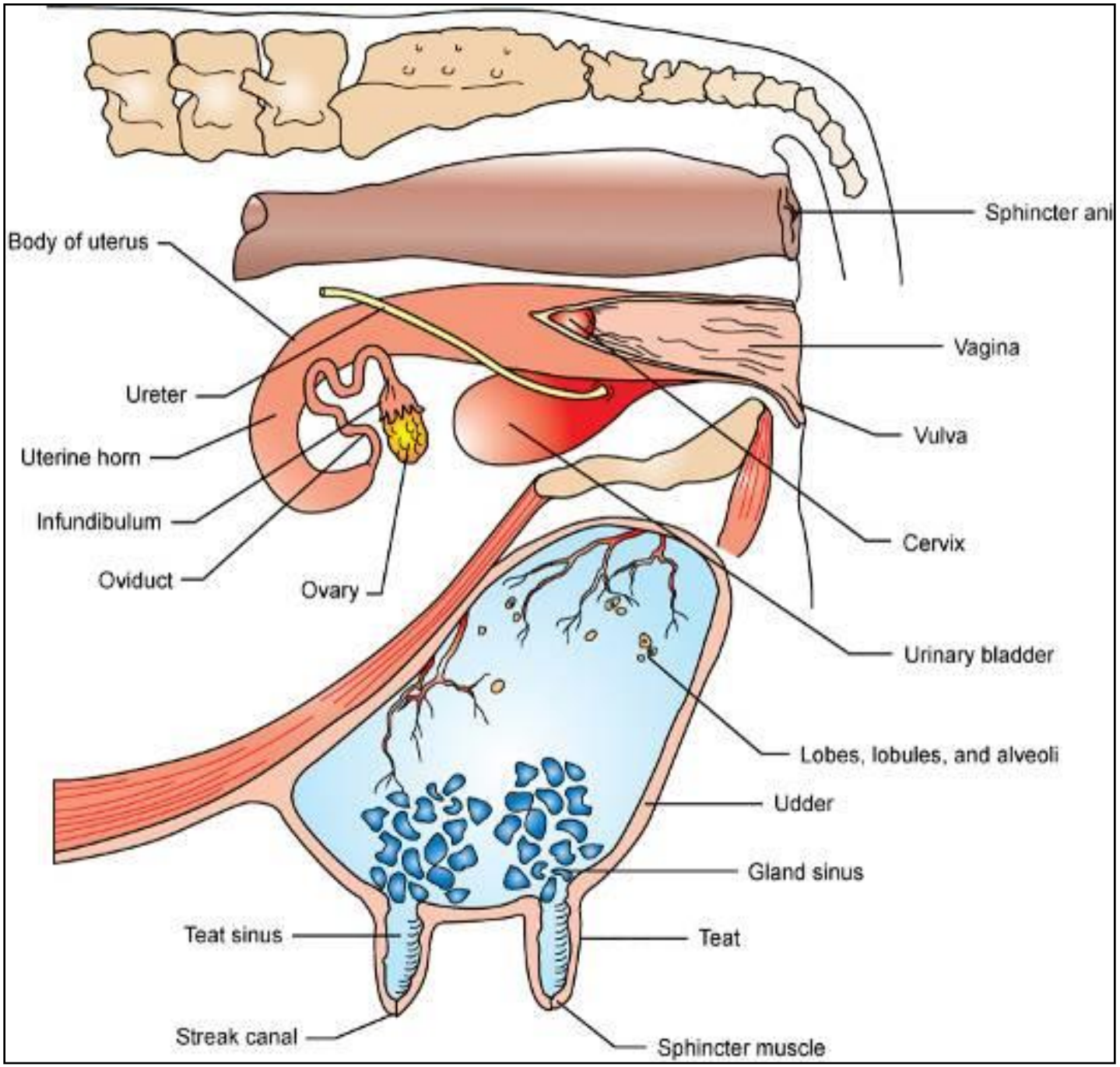
Species	Usual Number of Glands	Location of Glands	Number of Openings in Teats or Nipples
Cats	10	Inguinal, abdominal, and thoracic regions	3–7
Cattle	4	Inguinal	1
Dogs	10	Inguinal, abdominal, and thoracic regions	8–20
Goats	2	Inguinal region	1
Horses	2	Inguinal region	2–4
Humans	2	Thoracic region	15–24
Pigs	14	Inguinal, abdominal, and thoracic regions	2–3
Sheep	2	Inguinal region	1

Udder of Cow

Figure 18-5, Page 412

- Four mammary glands (quarters)
- Quarters are completely separate units from each other
- Each quarter has its own milk-secreting systems and ducts leading down to separate teats




Sphincter ani
Body of uterus
Vagina
Ureter
Vulva
Uterine horn
Infundibulum
Cervix
Oviduct
Ovary
Urinary bladder
Lobes, lobules, and alveoli
Udder
Gland sinus
Teat sinus
Teat
Streak canal
Sphincter muscle

Cow Udder

Figure 18-5, Page 412

- 4 separate mammary glands (quarters)
- Nipples are called "teats"

Mares, Ewes, Goats

Table 18-2, Page 411

- 2 mammary glands in one udder

Mammary Gland Development

- Mammary glands develop in response to hormones produced at puberty
- Prolactin and growth hormone directly encourage mammary gland development
- Estrogen and progesterone encourage the mammary alveoli and duct systems to develop

Colostrum

- Pre-milk secretion
- Contains large amounts of proteins, lipids, amino acids, and vitamins
- Supplies important nutrients to newborn
- Imparts "passive immunity" – transfer of preformed antibodies from dam to newborn

Lactation

- Physical stimulation of teat or nipple and regular removal of milk from the gland stimulates anterior pituitary to continue production of hormones that keep lactation going
- Lack of hormonal stimulation combined with increased pressure in the mammary gland gradually causes lactation to cease

Milk Letdown

- Milk accumulates high up in the mammary gland in mammary alveoli and small ducts
- Physical stimulation of the nipple or teat sends sensory nerve impulses that cause release of oxytocin from posterior pituitary

Test Yourself

KNOW THESE IN EVERY CHAPTER!

Pages 407, 409, 410, 413

Clinical Applications

Pages 408, 410, 413