

Physiology of Reproductive System (males)

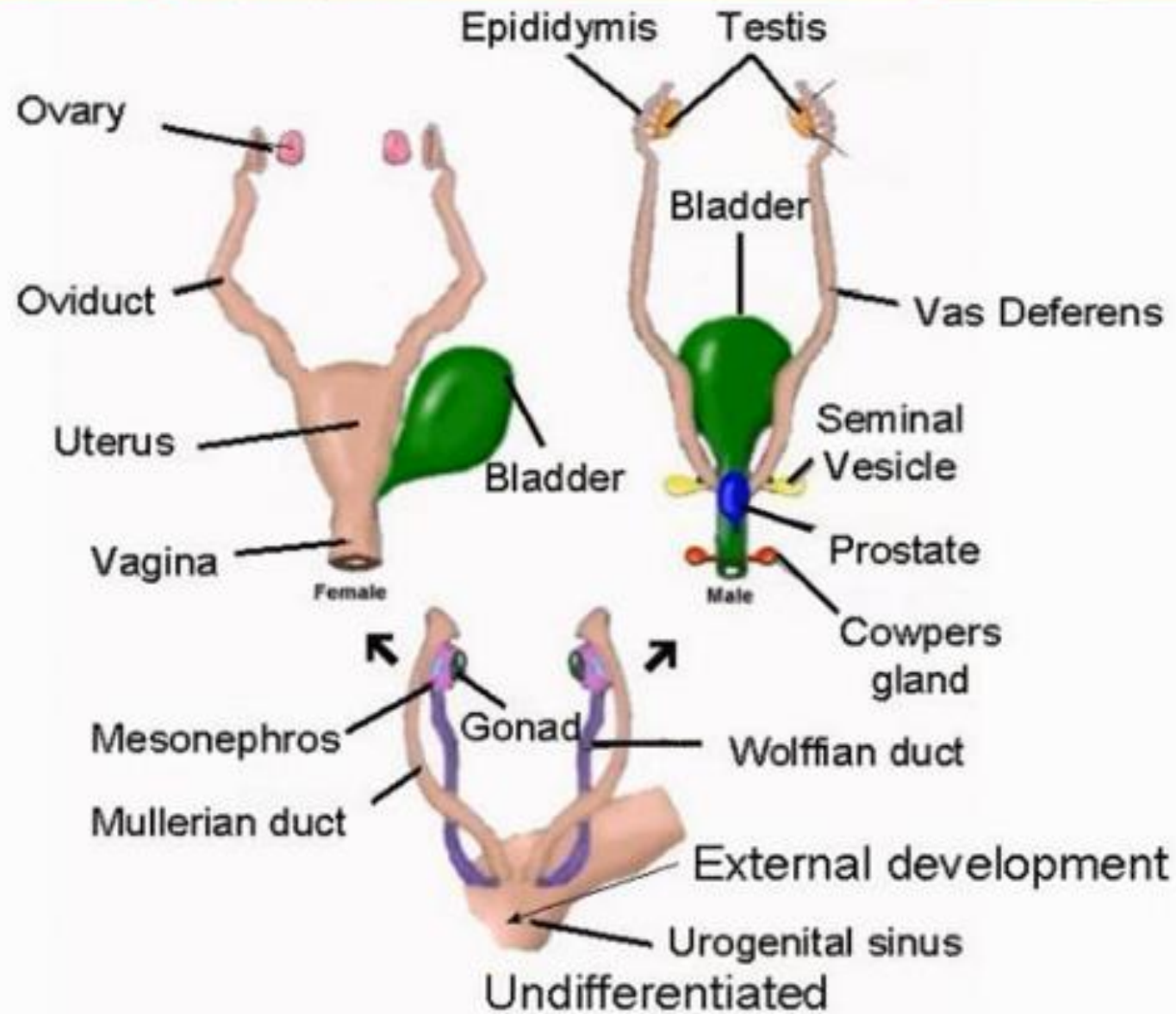
BY DR. A. K. GOUDARZI , D.V.M. PH.D

Contents

- Male genitalia organs
- Spermatogenesis
- Role of Hormones in Reproduction
- Puberty
- Regulation of rep. activity in males

Eng. Name	Per. name	Family	Sci. name	Female name	Male name	Birth proc.	M&F n.b. name	Male n.b. name	Fem. n.b. name	Cast. male name
Cattle	گاو	Bovine	Bos taurus	Cow	Bull	Calving (گوساله زایی)	Calf (گوساله)	Bull calf	Heifer (تلیسه)	Steer
Goat	بز	Caprine	Capra hircus	Doe (Nanny)	Buck (Billy)	Kidding (بزغاله زایی)	Kid (بزغاله)	Buckling	Doeling	Wether
Sheep	گوسفند	Ovine	Ovis aries	Ewe (میش)	Ram (قوچ)	Lambing (بره زایی)	Lamb (بره)	Ram lamb (بره قوچ)	Ewe lamb (بره میش)	Wether
Horse	اسب	Equine	Equus caballus	Mare	Stallion	Foaling	Foal (کدره اسب)	Colt	Filly	Geling
Swine (pig)	خوک	Porcine	Sus scrofa	Sow	Boar	Farrowing	Piglet (litter)	Boar	Gilt	Barrow
Dog	سگ	Canine	Canis familiaris	Bitch	Dog	Whelping	Puppy (litter)	-	-	-
Cat	گربه	Feline	Felis catus	Queen	Tom	Kindling	Kitten (litter)	-	-	-

Ontogenesis of the male genitalia



Male genitalia organs

Testes

Spermatic cord

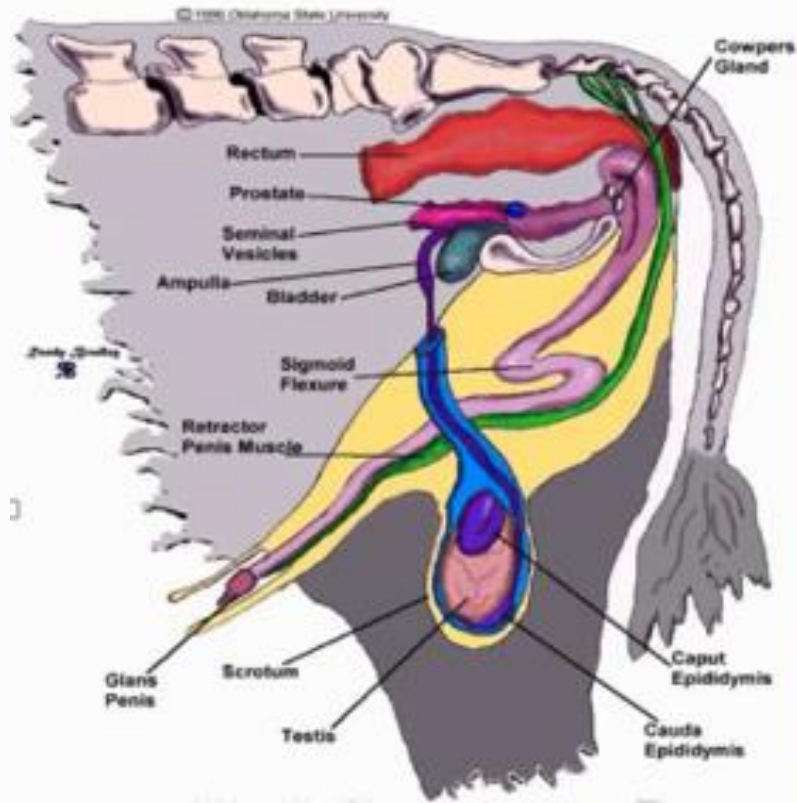
Epididymis

Ductus deferent

Urethra

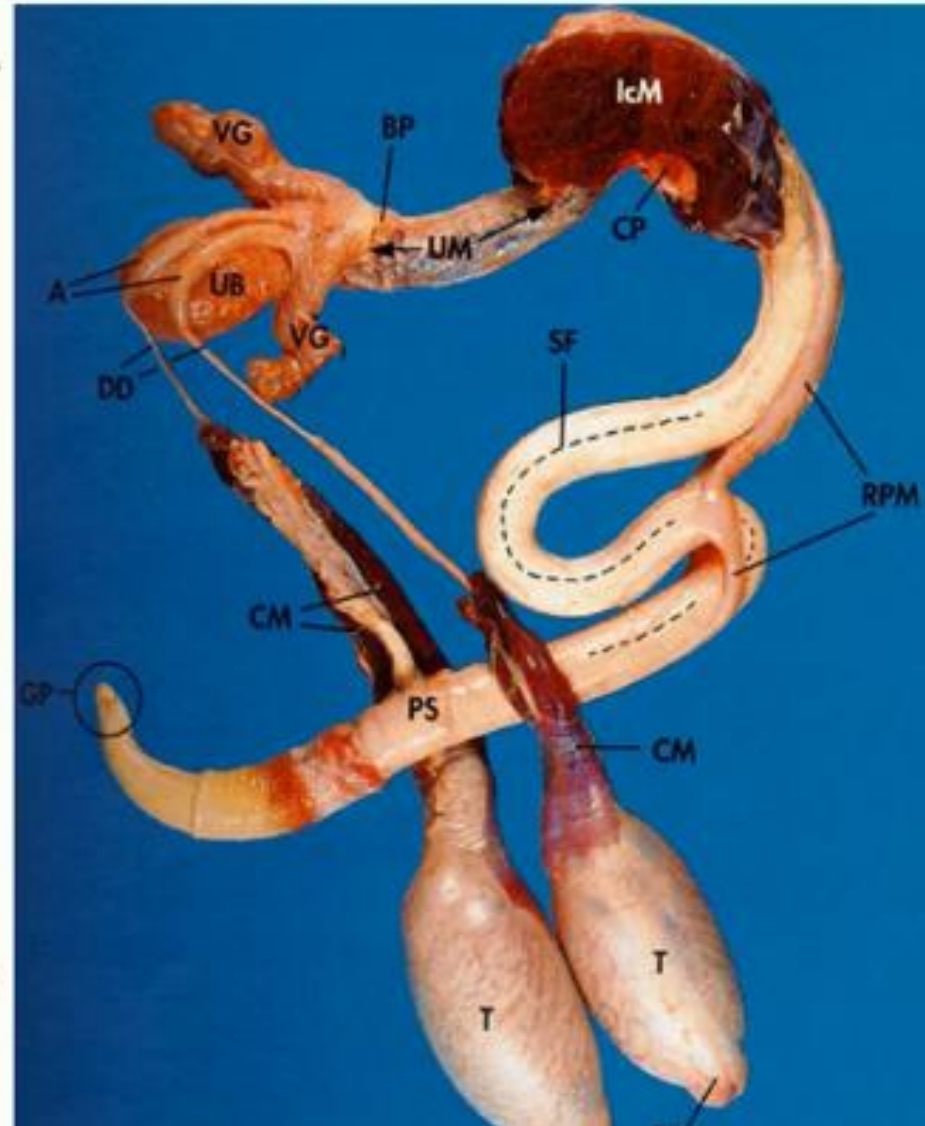
Accessory glands

Male Reproductive system

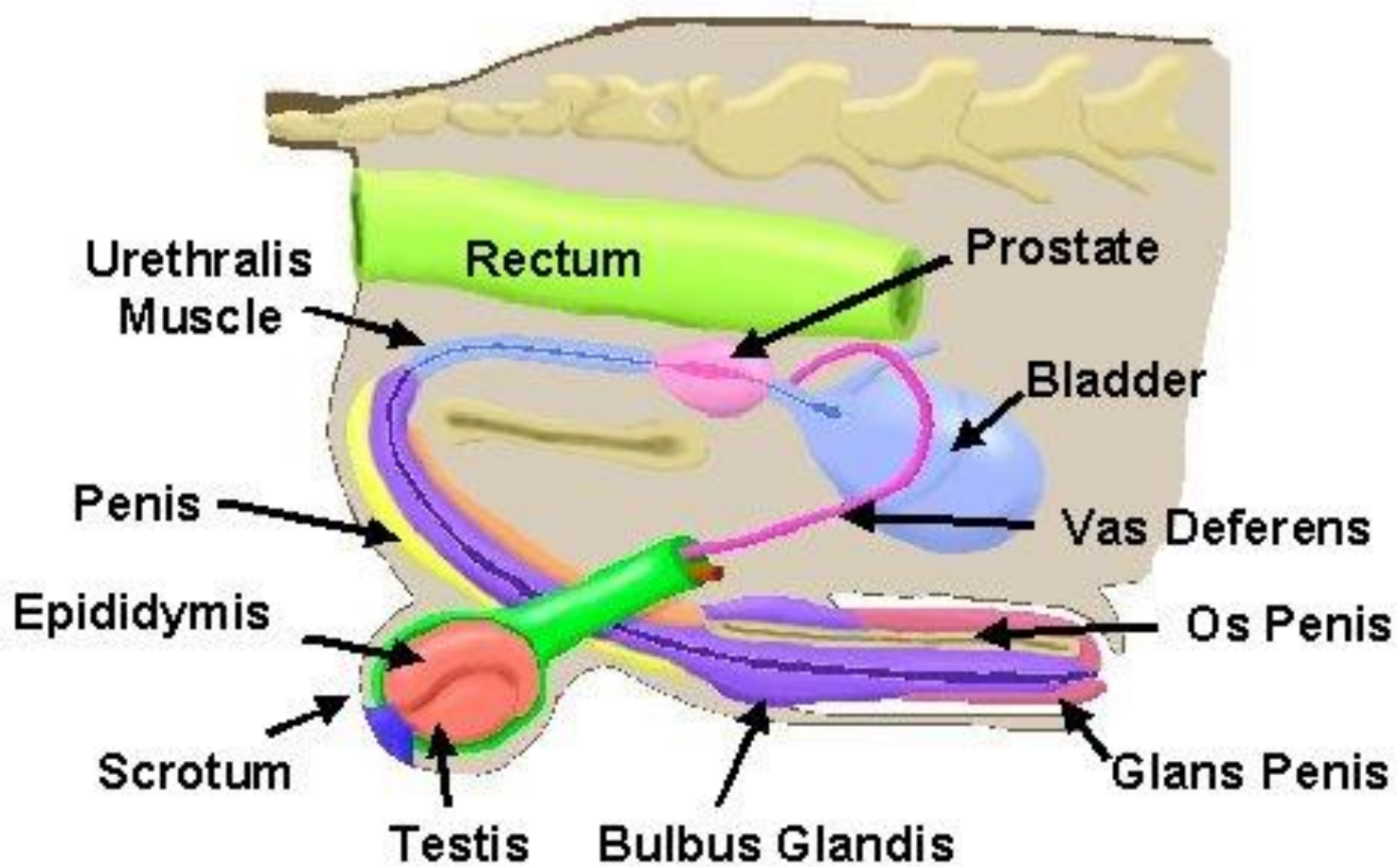


Secondary sex organs (duct system)

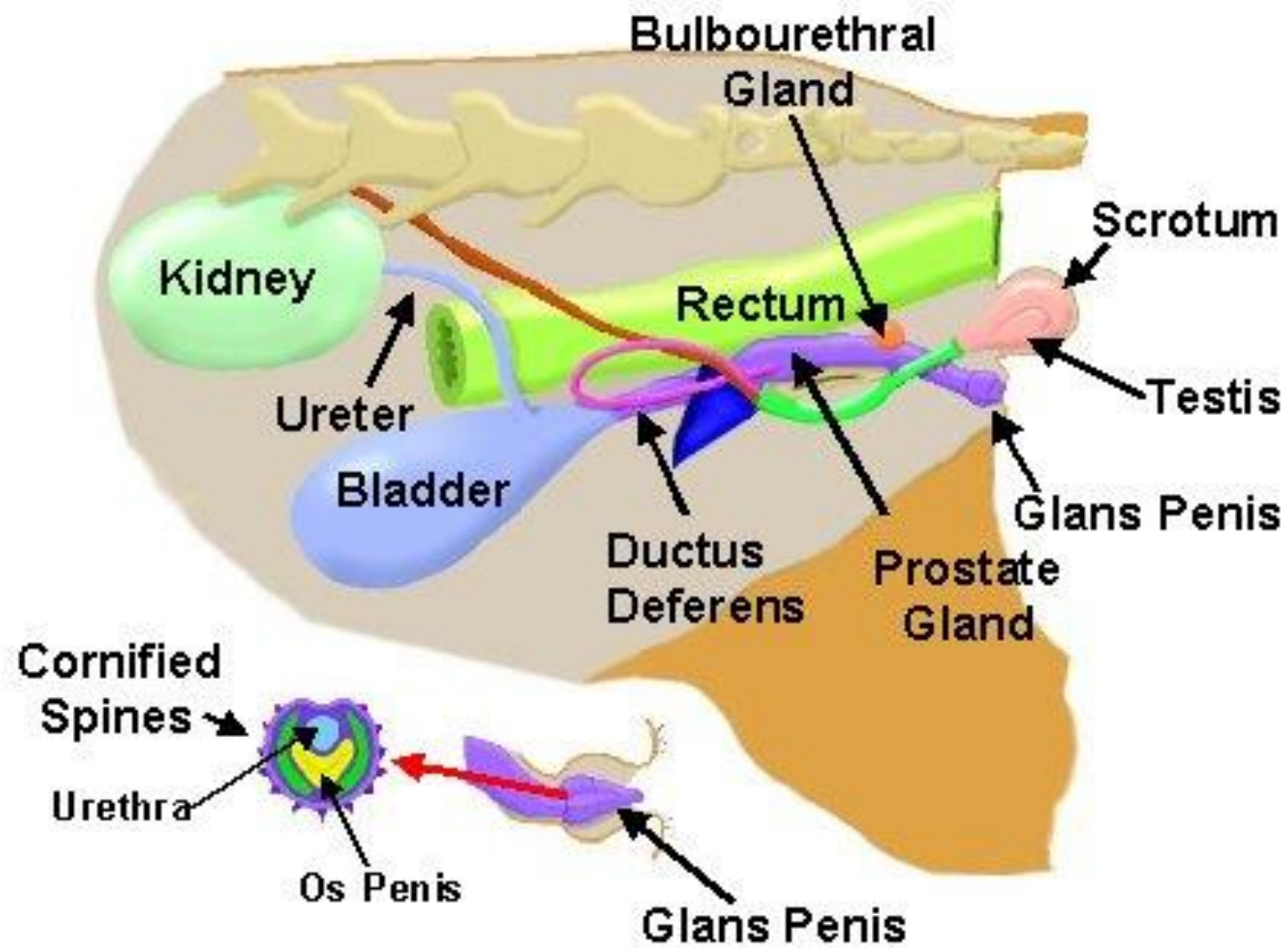
Accessory sex organs



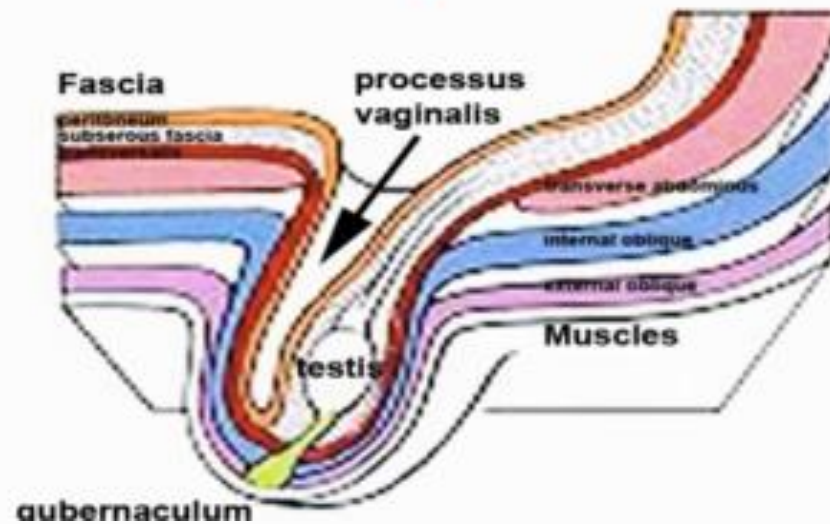
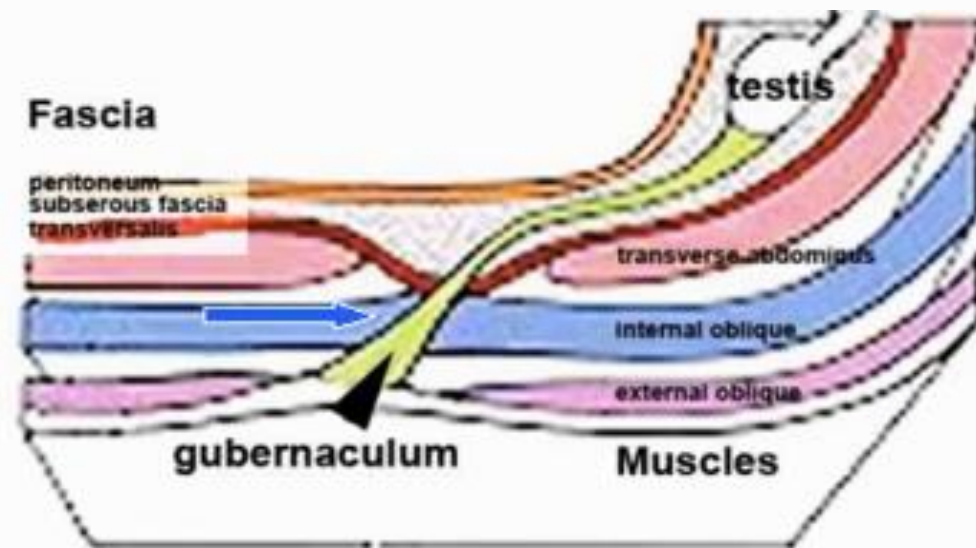
Reproductive Tract of Male



Anatomy of Tom



Descending of testis



Scrotum

Location :



Bull



Buffalo-bull



buck



Ram



Stallion



Boar



Camel- bull



Dog

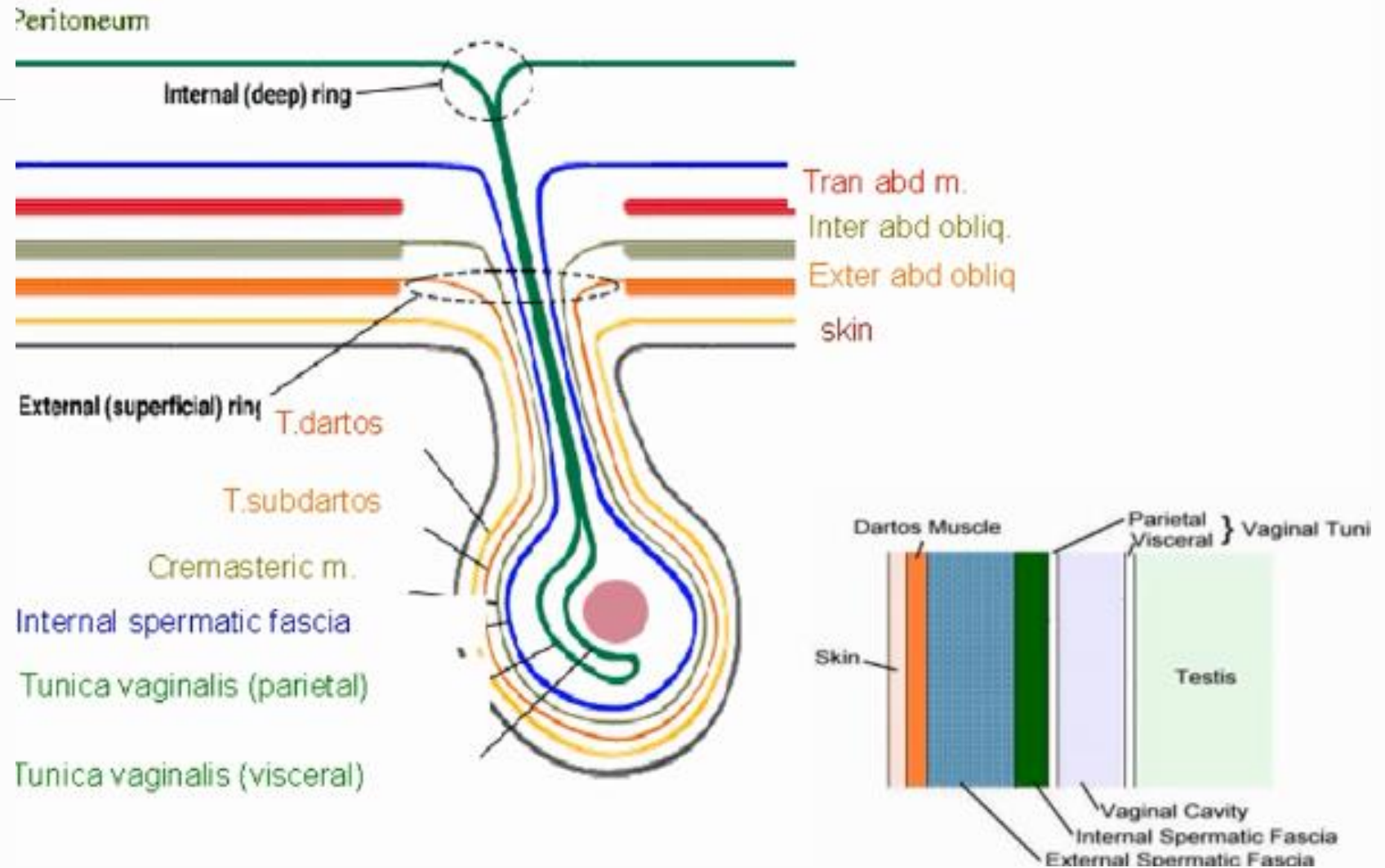


Tom cat

00:35.01

Scrotum

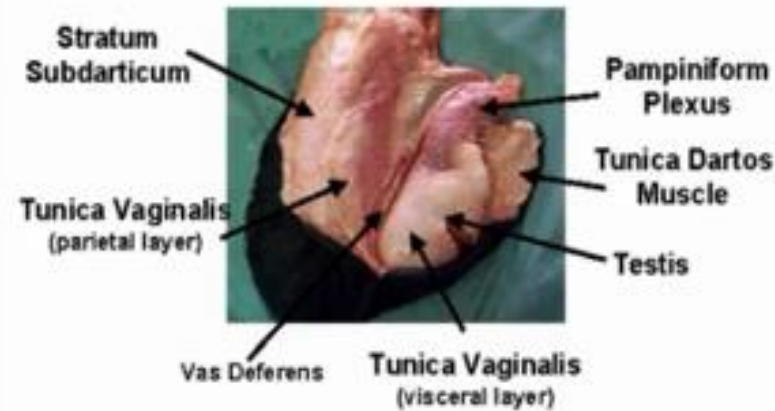
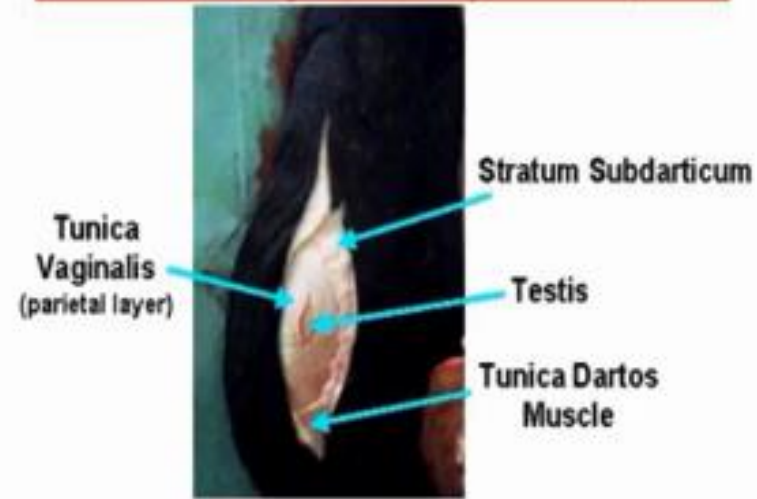
Anatomy:



Scrotum

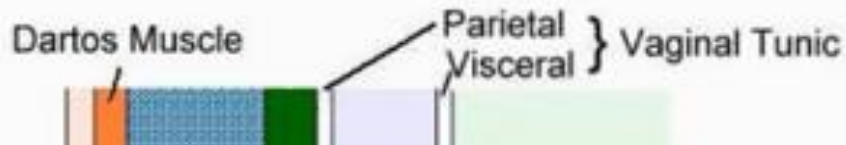
Functions:

support and protect the testis

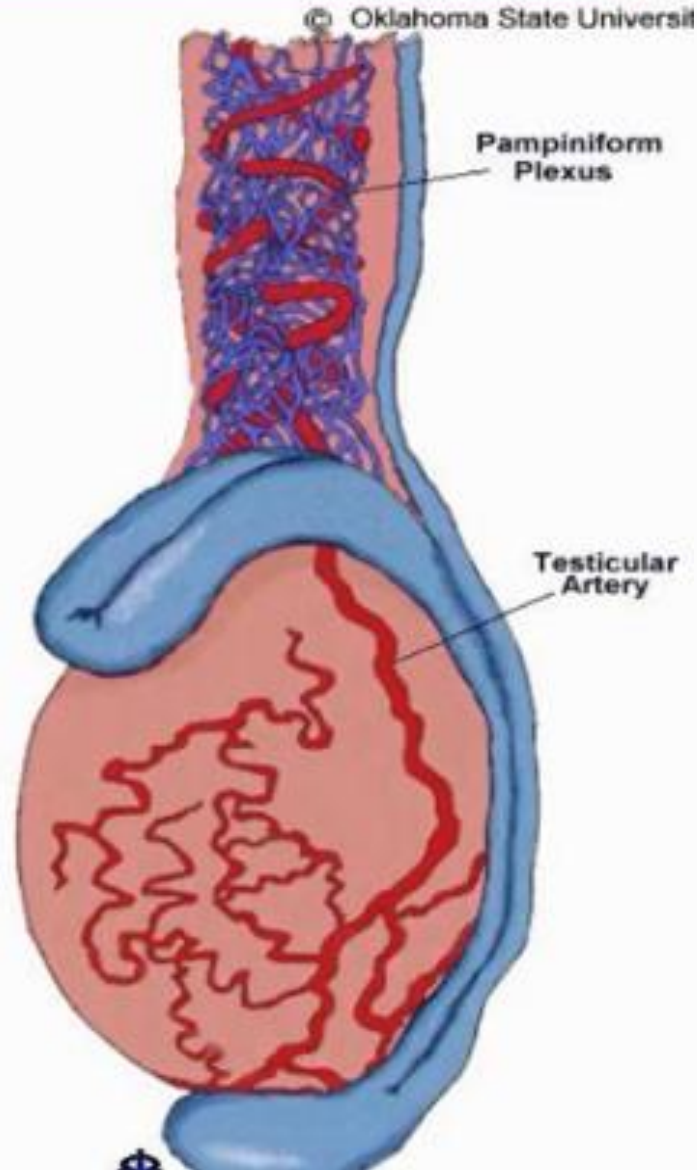
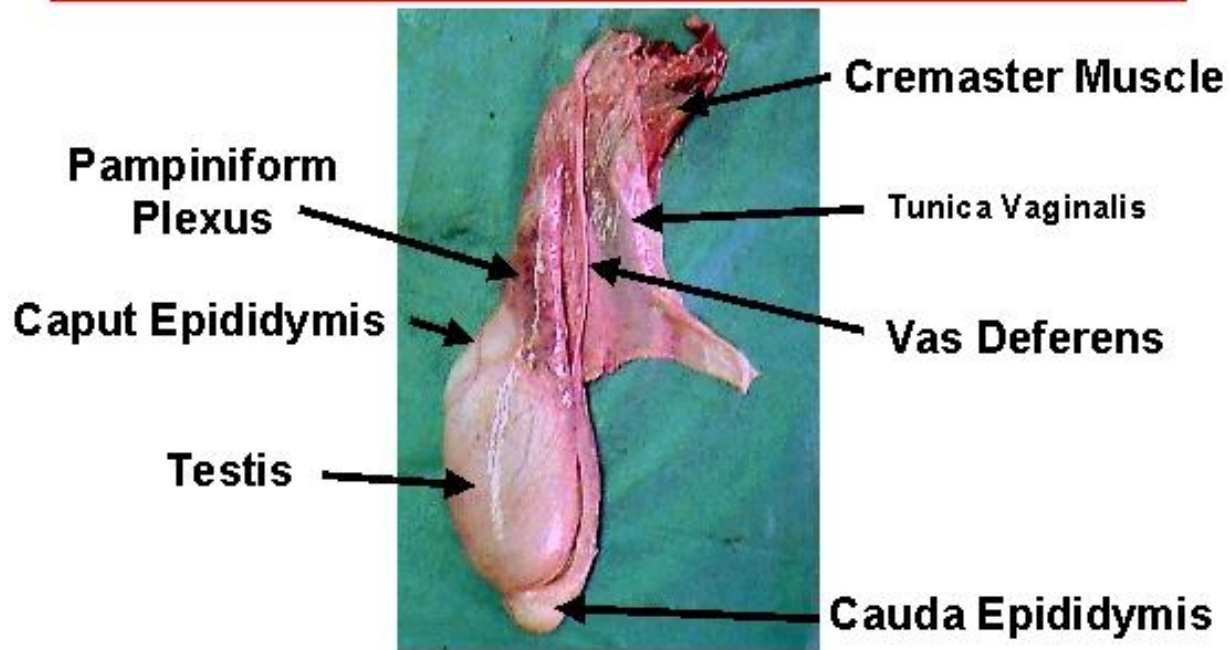


Thermo-regulatory mechanism in bull

Testis

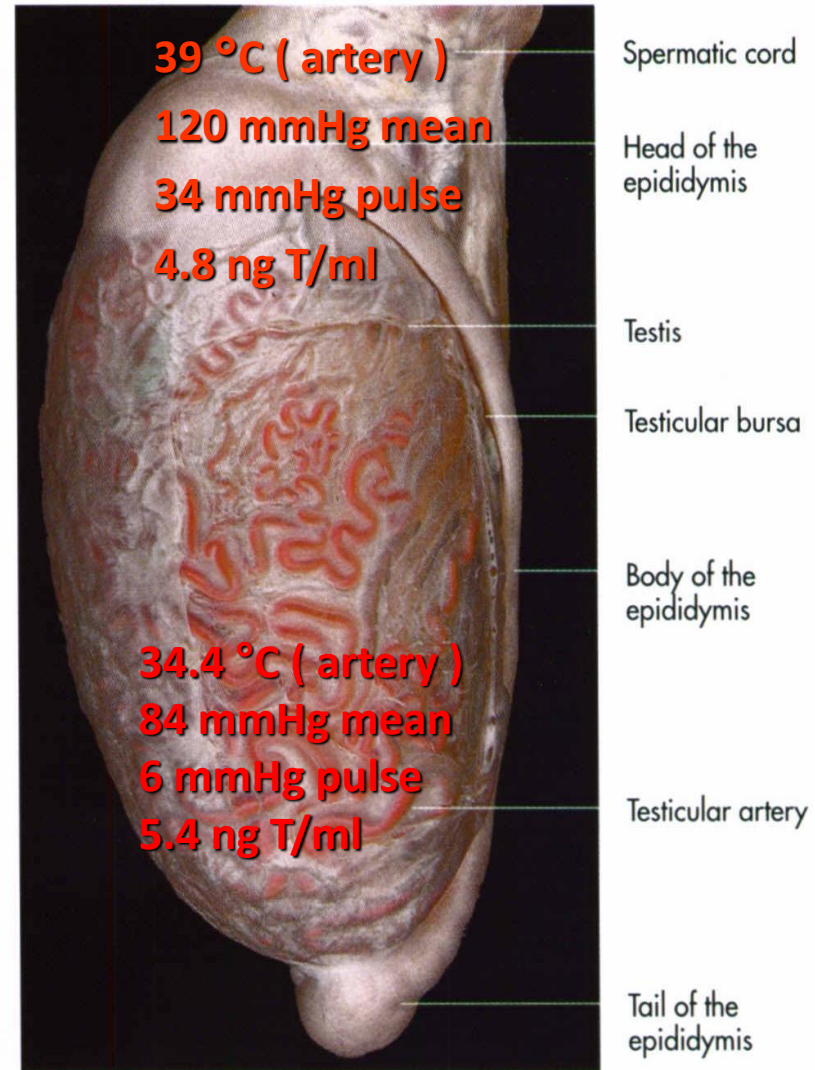
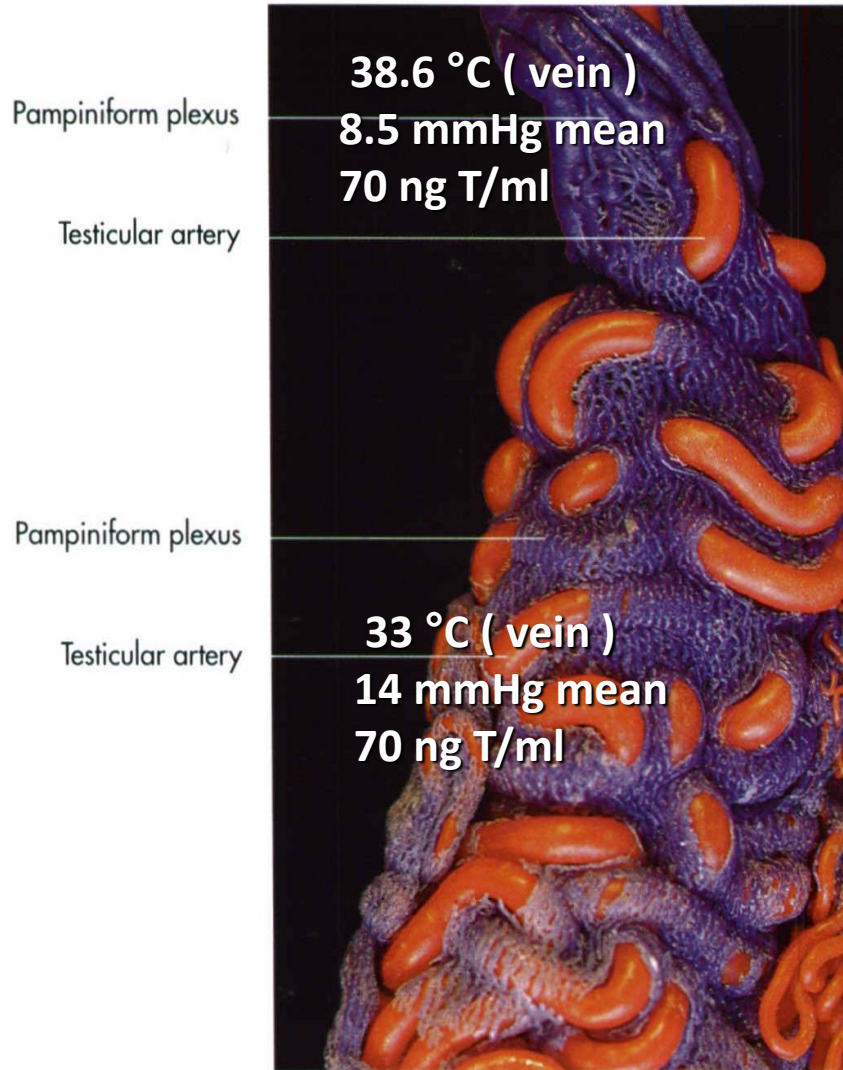


Testis - Pampiniform Plexus



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Pampiniform plexus





Hot weather (summer)



Cold weather (winter)

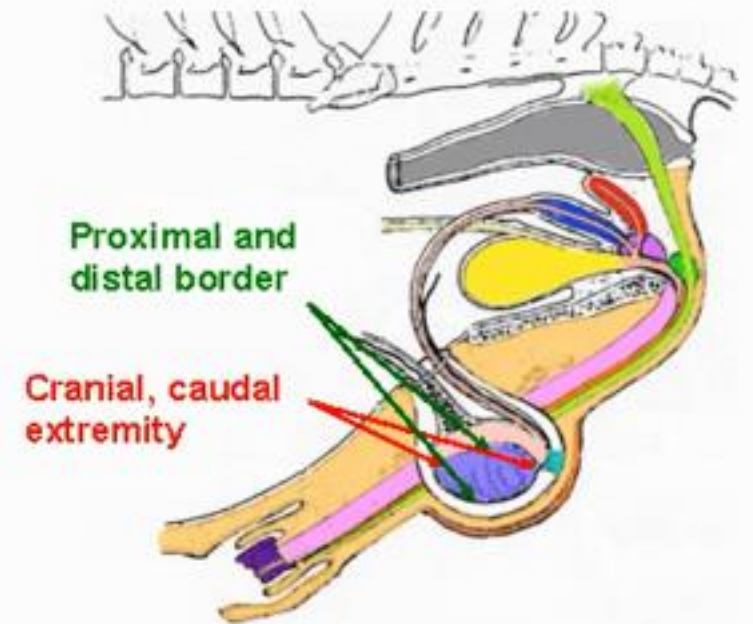
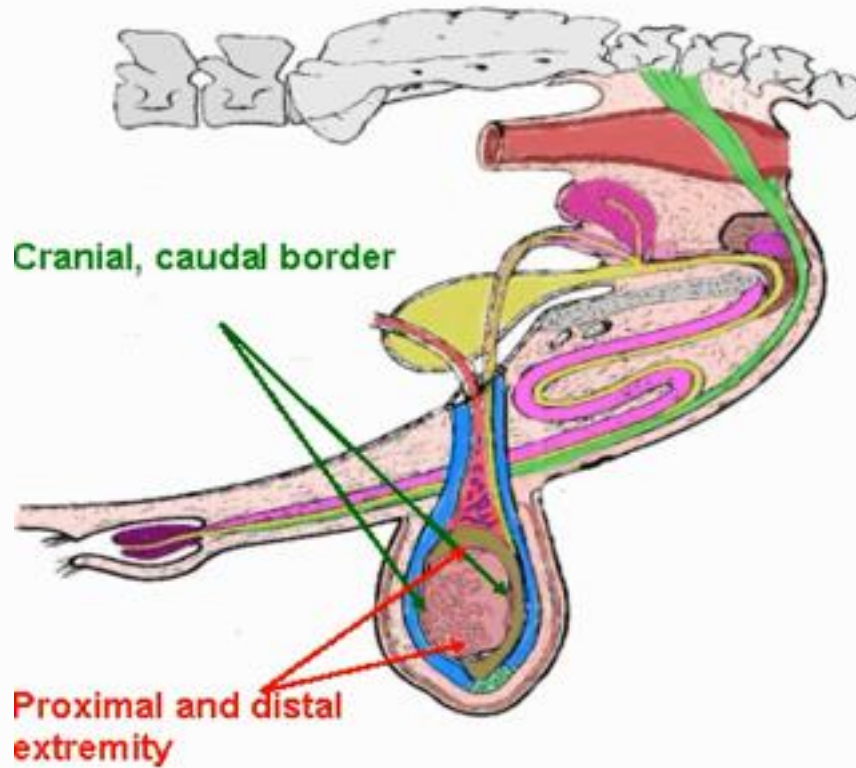
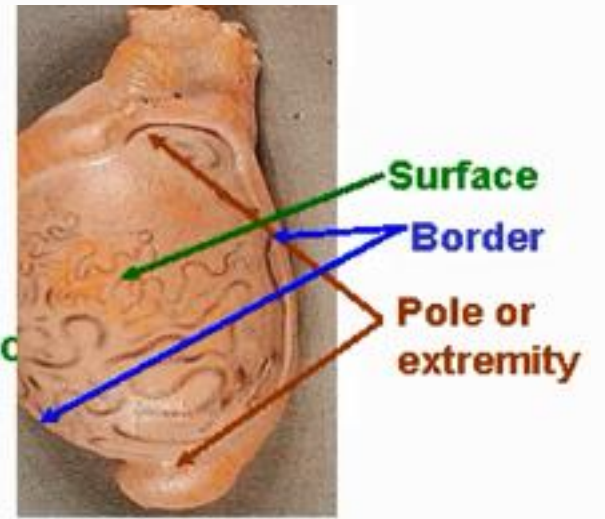
Testis

Shape

Length = Distance between the two pole

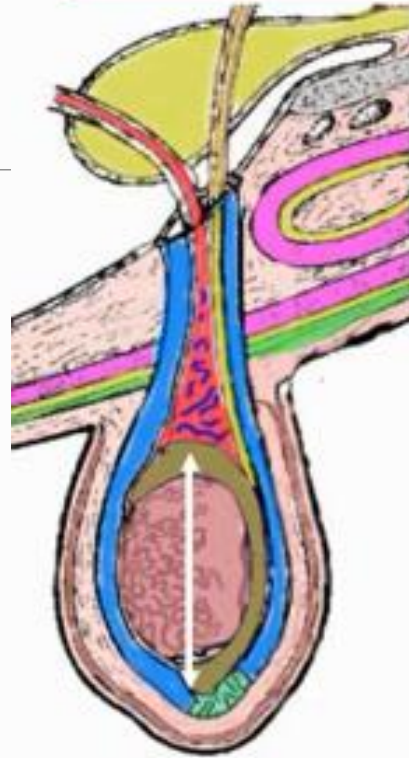
Width = Distance between the two border

Thickness = Distance between the two surface

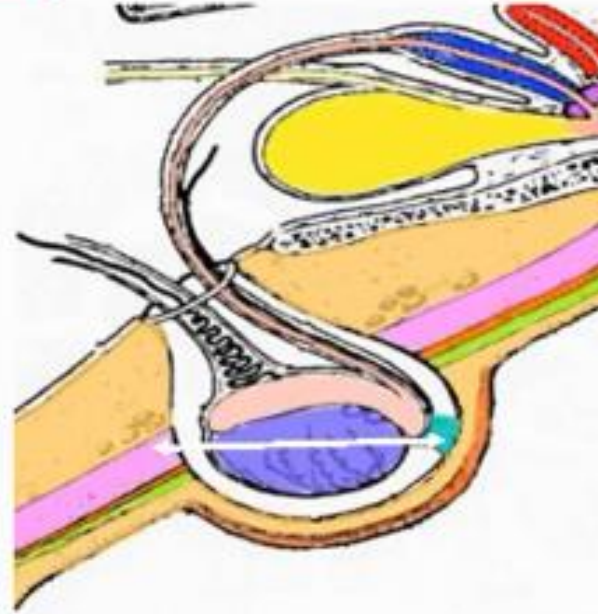


Testis

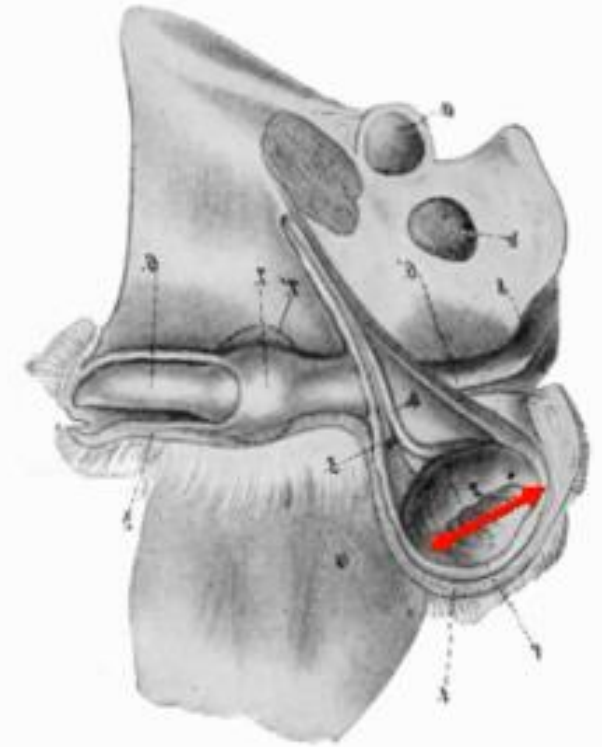
Position



Vertical
(Bull, Buffalo-bull,
Ram, Buck)



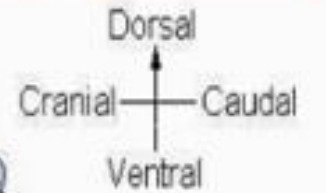
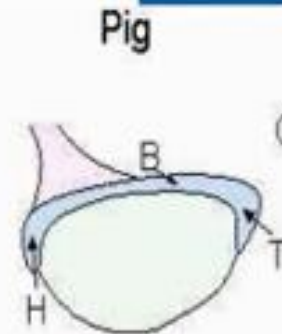
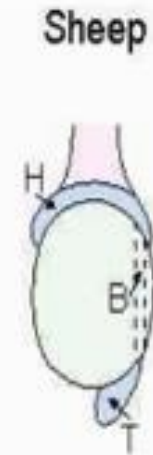
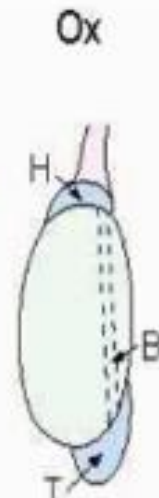
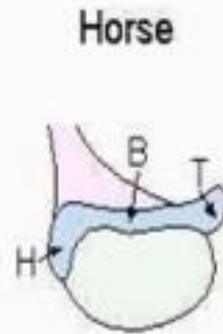
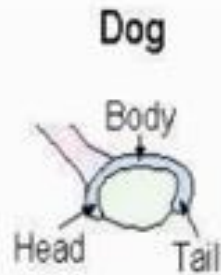
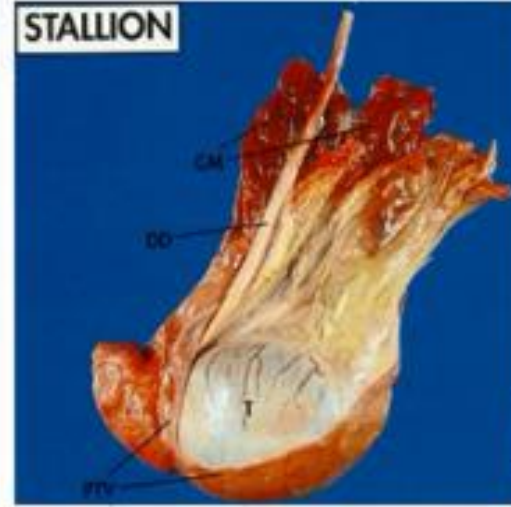
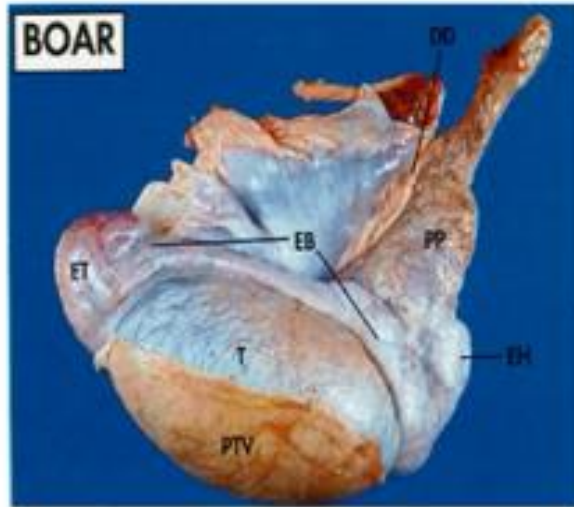
Horizontal
(Stallion)



Oblique
(Cranioventral) (Boar,
Camel-bull, Tom-cat,
Dog)

Testis

Position of the testicles



Testis

Seminiferous tubules

Rete Testis

Mediastinum

Boar 6000 m

Bull 5000 m

Ram 4000 m

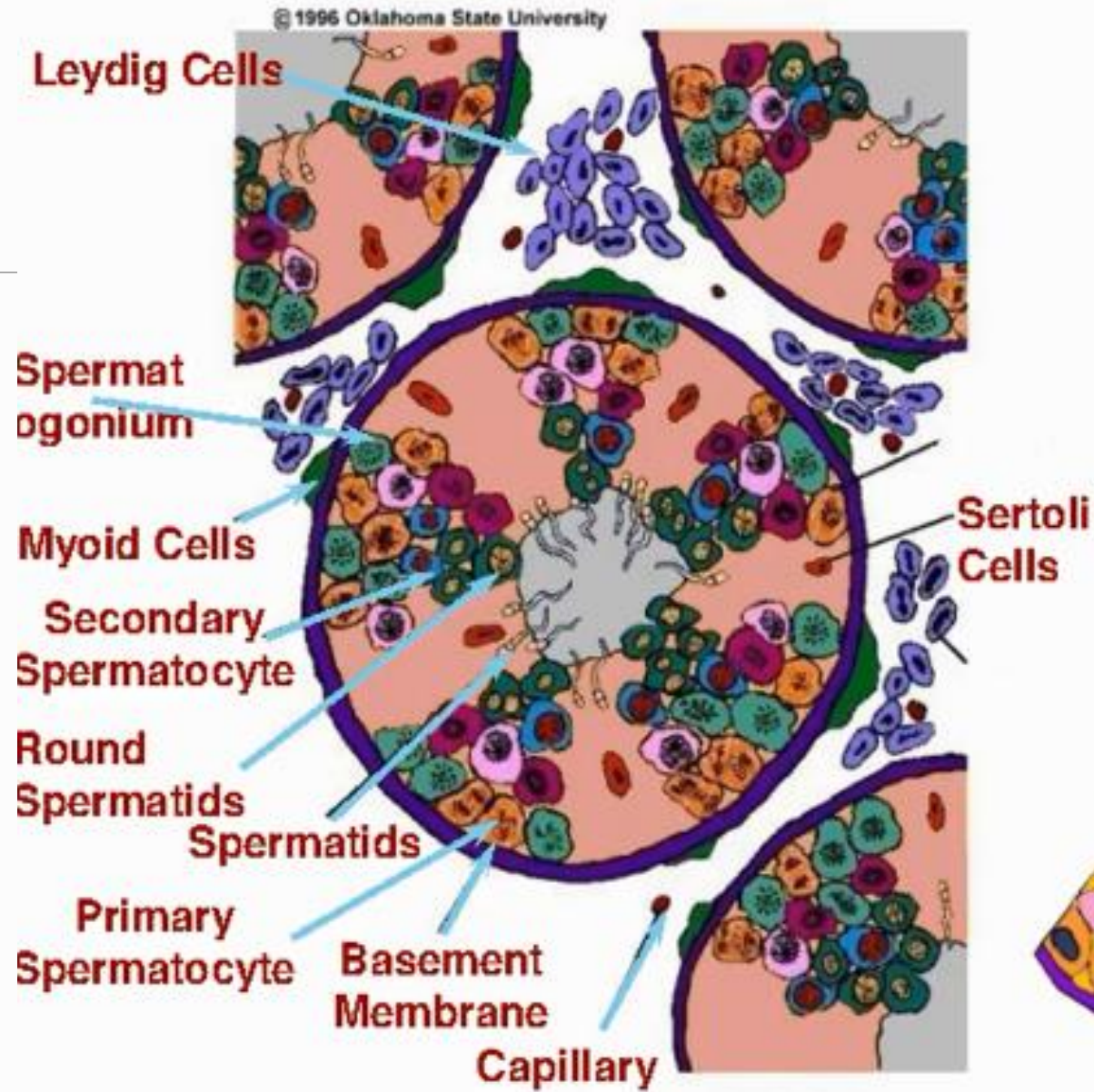
Dog 150 m

Tom-cat 25 m

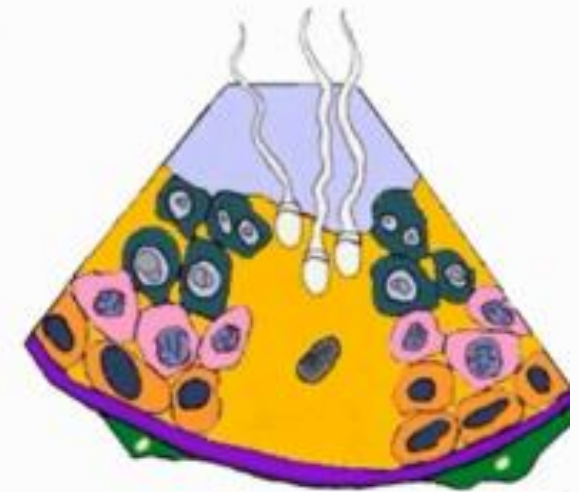
Seminiferous Tubule



Testis

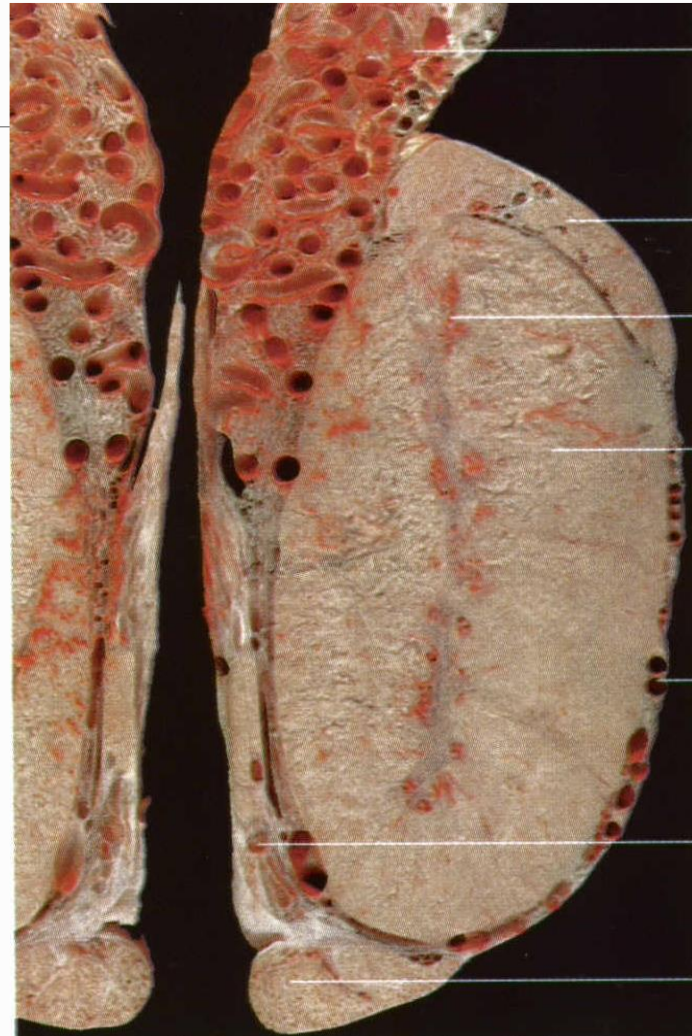


Randy Bradley



A

Testis



Testicular artery and pampiniform plexus

Head of the epididymis

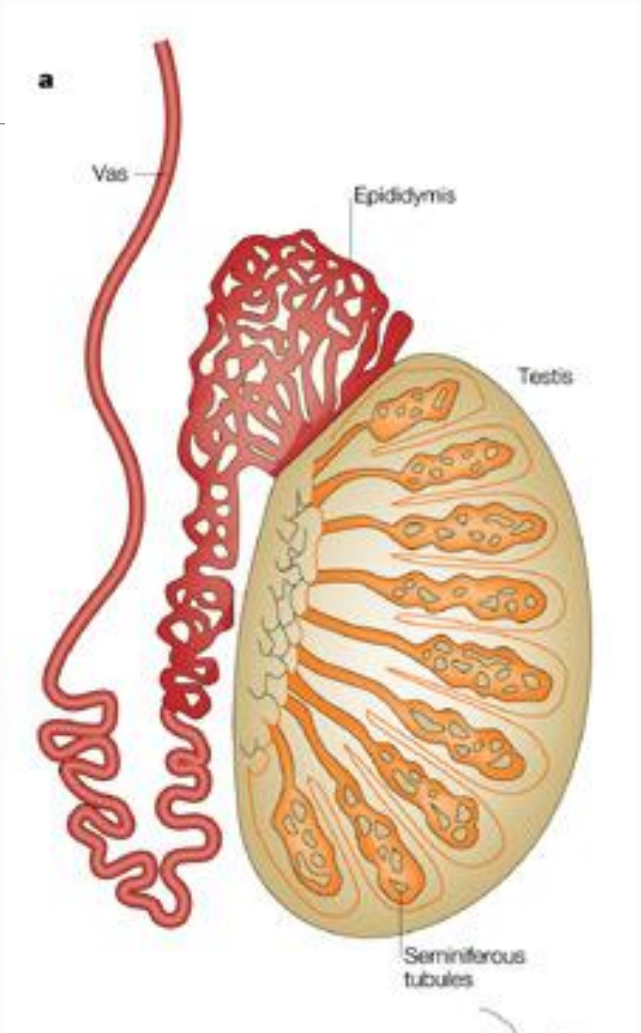
Mediastinum with testicular network

Testis

Testicular artery

Body of the epididymis

Tail of the epididymis



a

Vas

Epididymis

Testis

Seminiferous tubules

Epididymis

Epididymis

Length of the epididymis

Bull 35-40m Boar, Ram 50m Stallion 50-75m

Parts of the epididymis



Head (Caput)

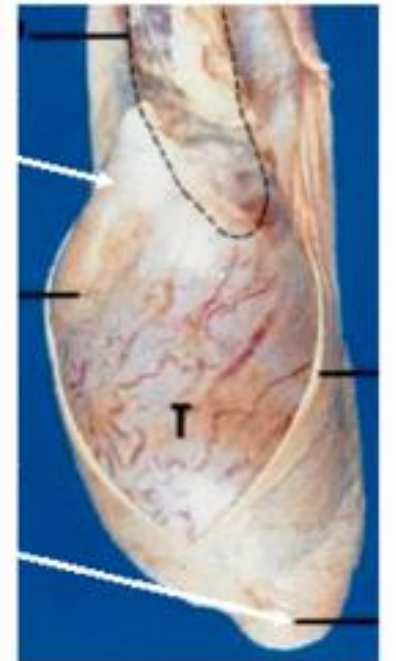
More or less flattened and broad

Body (corpus)

Intermediate narrow and long part

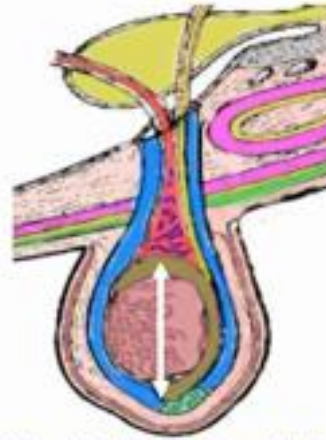
Tail (cauda)

Distal enlarged part (usually extrude out of testicular margin)



Epididymis

Position of the epididymis in relation to the testis

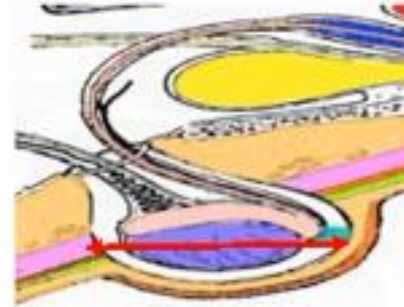


Vertical (Bull, Buffalo-bull, Ram, Buck)

Proximal extremity and reflected in the cranial border

Caudal border

Distal extremity

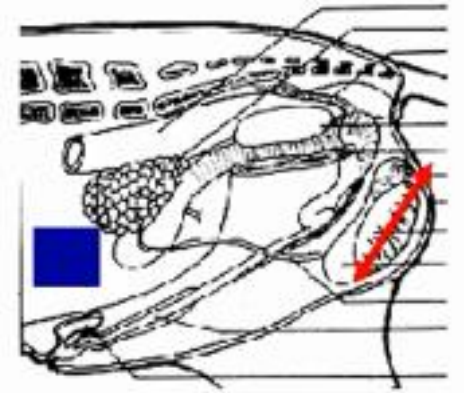


Horizontal (Stallion)

Cranial extremity

Dorsal border

Caudal extremity



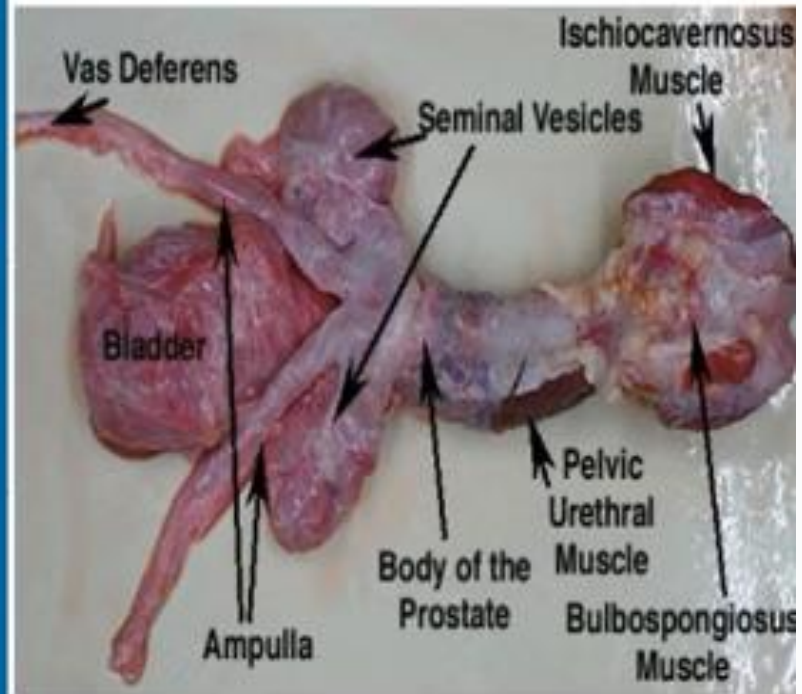
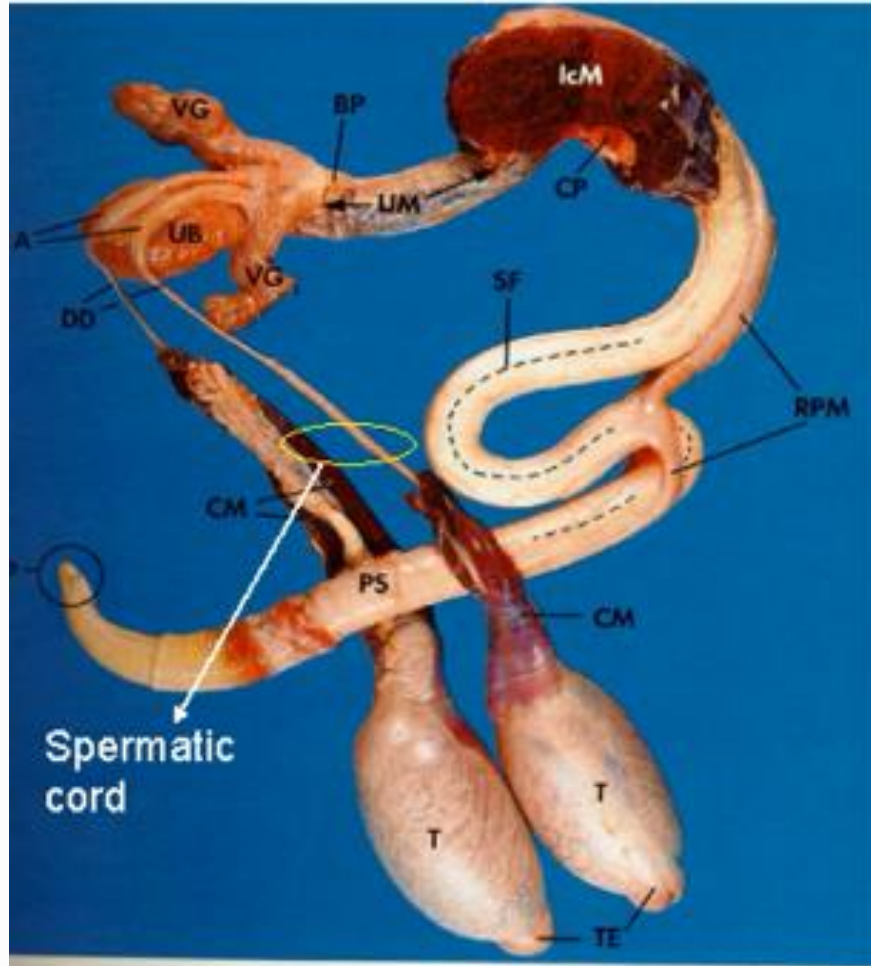
Oblique (Cranioventral) (Boar, Camel-bull, Tomcat, Dog)

Cranioventral extremity

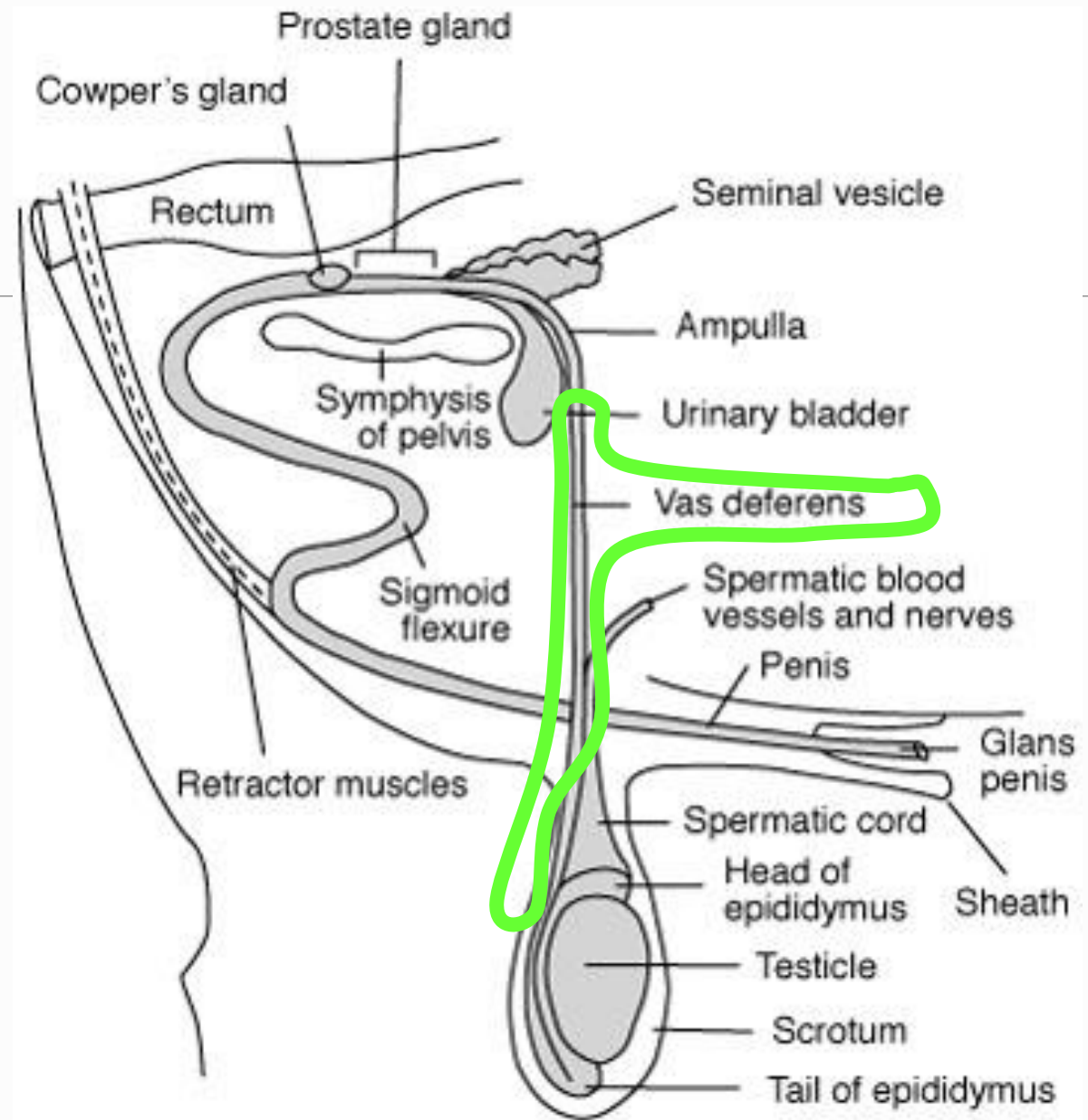
Cranial border

Caudodorsal extremity

Vas deferens or ductus deferens



Vas Deferens



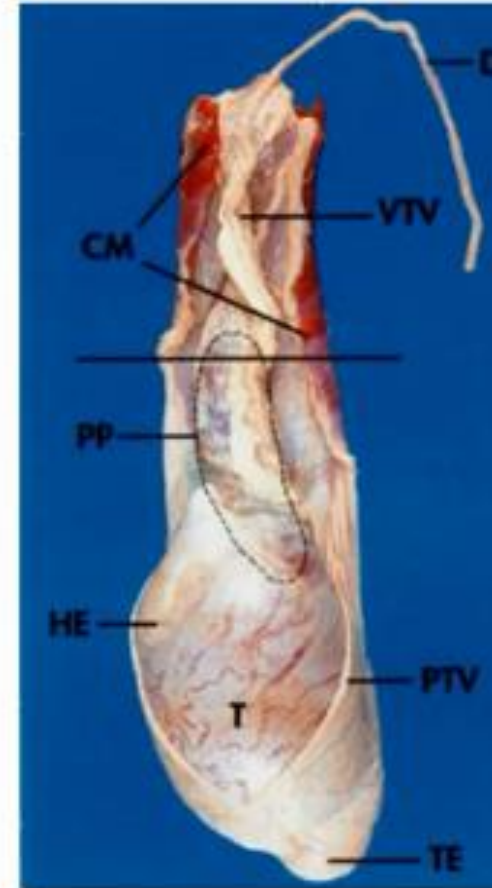
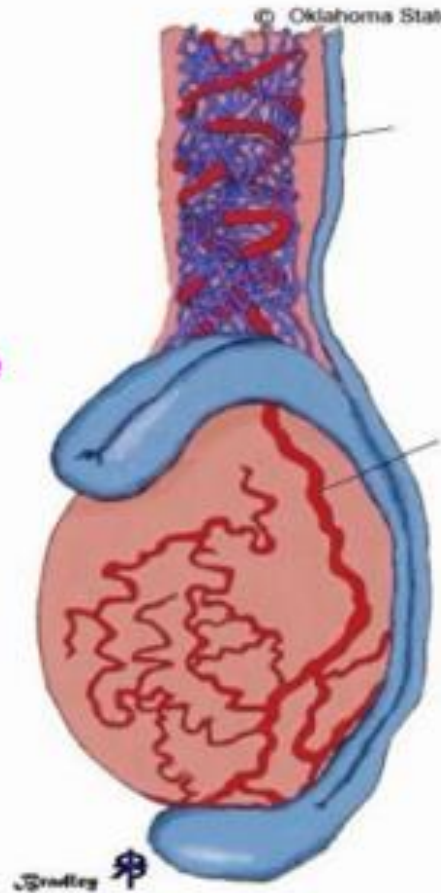
Spermatic cord

Content

- 1- Spermatic artery
- 2- Spermatic vein
- 3- Spermatic nerve
- 6- internal cremasteric muscle
- 4- Lymphatic vessels
- 5- Tunica vaginalis (visceral)
- 7- Vas deferens

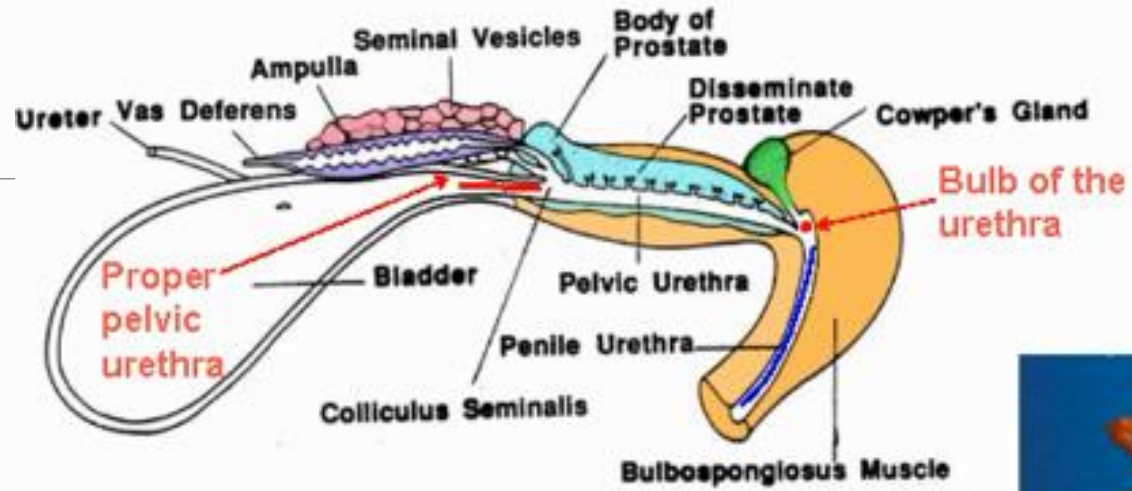
Length

Stallion < Ram, Buck, Bull, buffalo-bull < Dog, Tom-cat, Boar, Camel

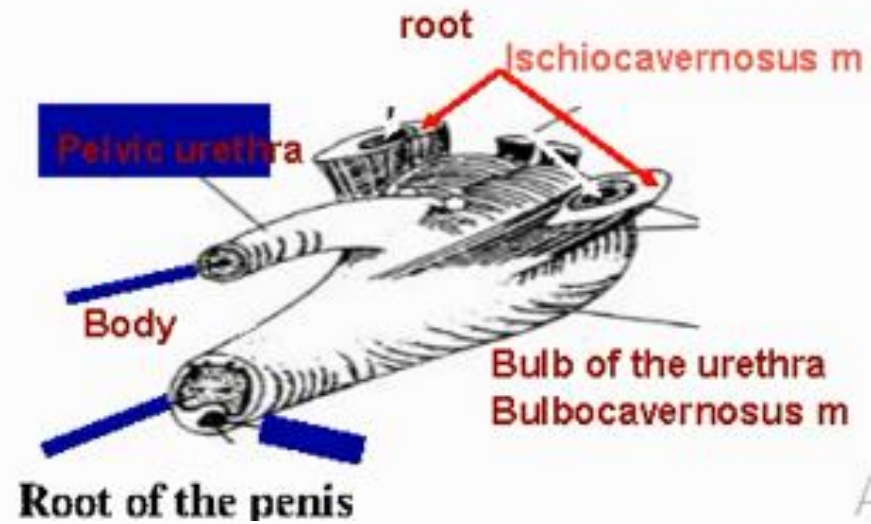
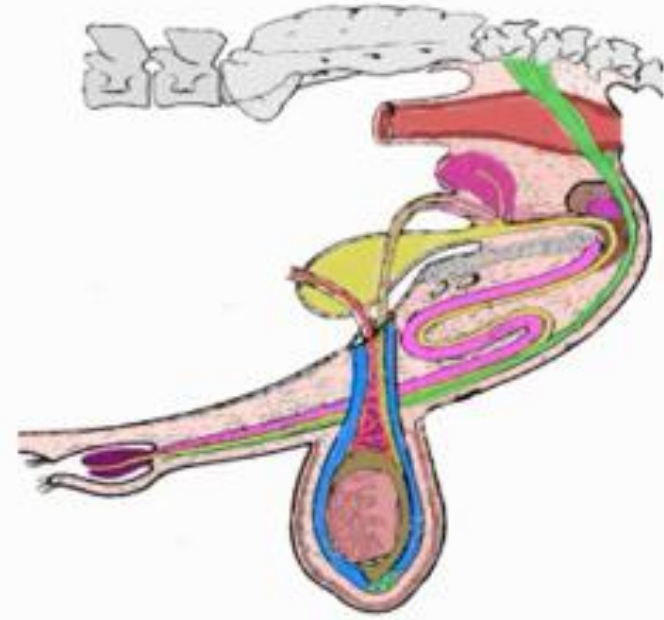
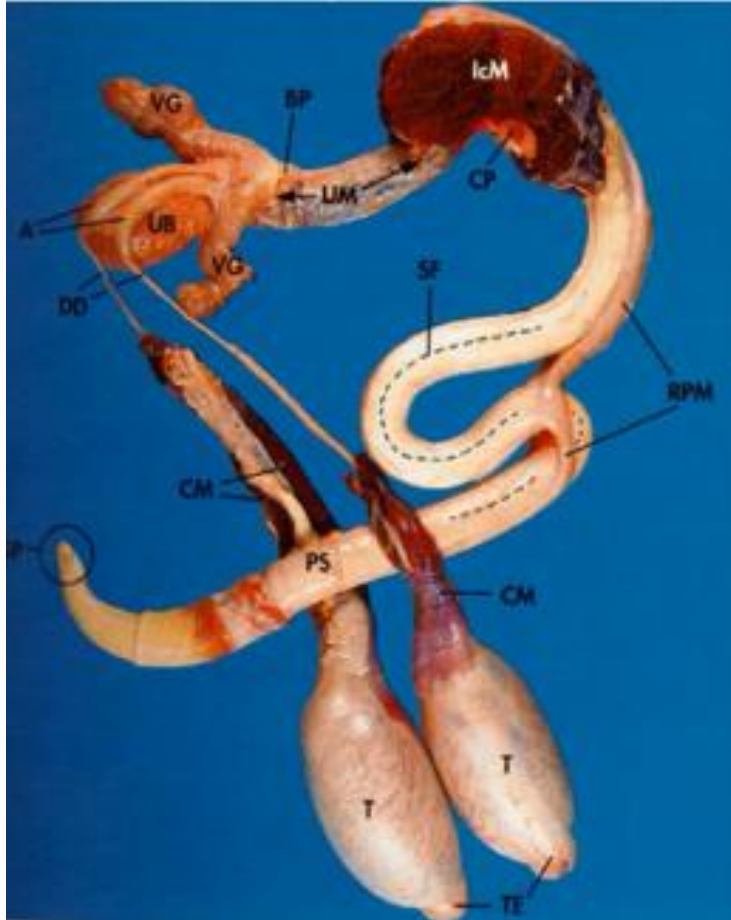


Urethra

1- Pelvic urethra 2- Bulb of the urethra 3- Penile urethra



Penis



Body of the penis

1-Cavernous tissue

Corpus cavernosum
Corpus spongiosum

2-Fibroelastic tissue

Tunica albuginia of penis
Superficial longitudinal



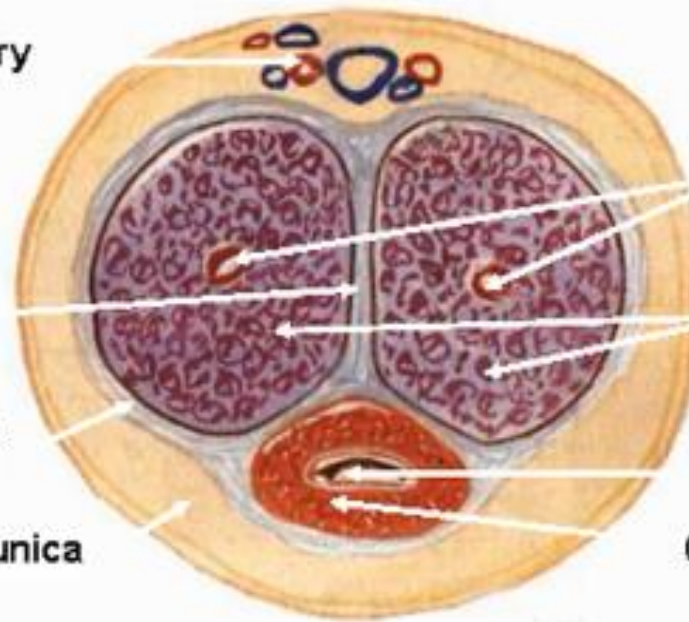
Tunica albuginia of urethra

Dorsal artery
and vein

Penile
septum

Deep tunica
albuginia

Superficial tunica
albuginia

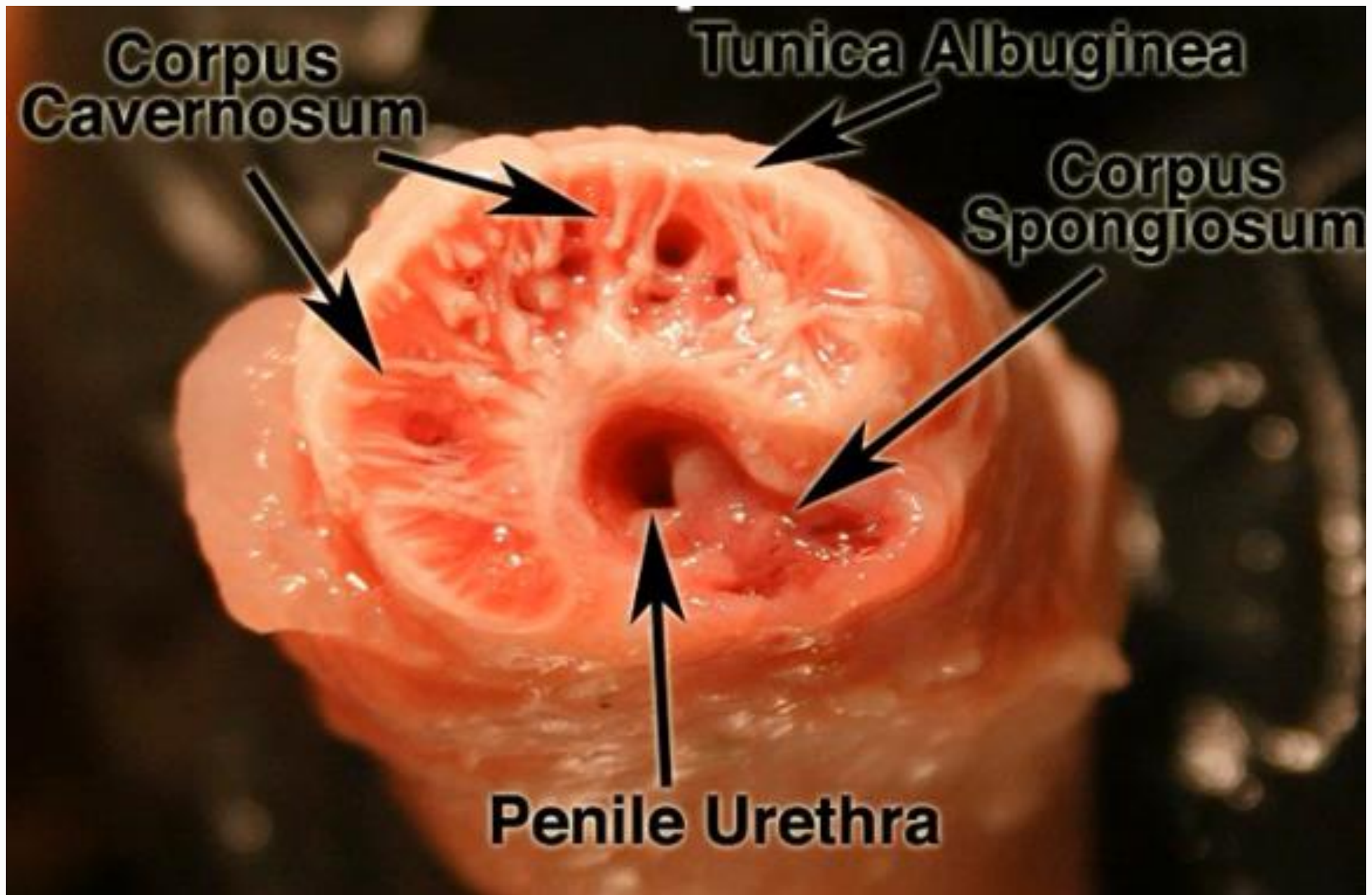


Large vein

Corpus cavernosum

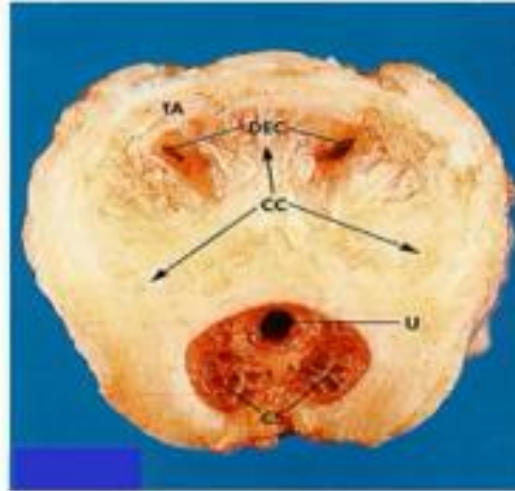
Urethra

Corpus spongiosum

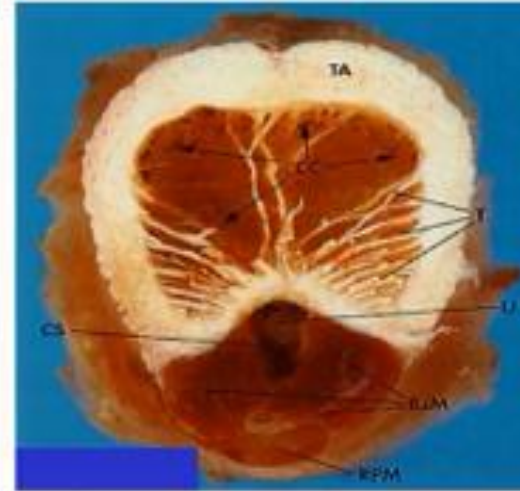


Classification of the penis

Fibroelastic



Musclocavernous



- Major tissue
- Texture in non erected state
- Increase in diameter and length after erection
- Increase in rigidity after erection
- Time for full erection
- Presence of sigmoid flexure

Fibroelastic

Firm

Minor

Minor

Short

Present

Bull, Buffalo-bull, Ram, Buck, Camel-bull, Boar

Cavernous

Soft compressible

Huge increase .

Great increase

Long

Absent

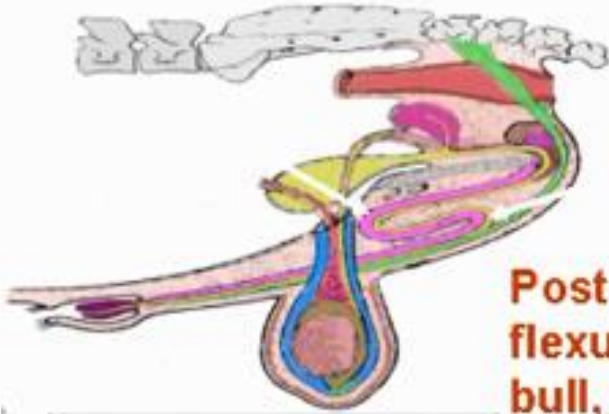
Stallion, Tom-cat, Dog



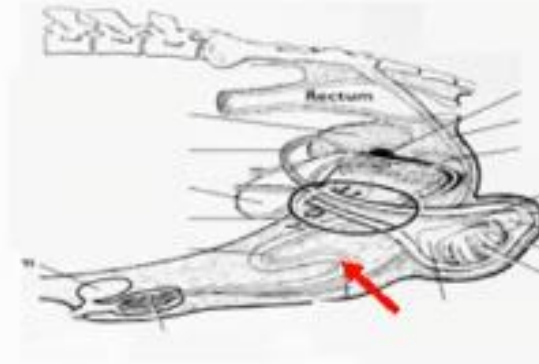
A

Sigmoid Flexure

It is a S shape curvature in the fiberoelastic non erected penis



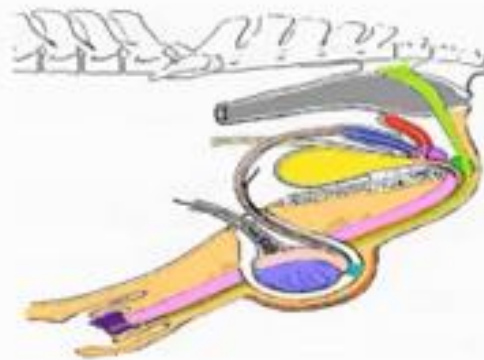
Post scrotal sigmoid flexure (bull, buffalo-bull, Ram, buck)



Pre scrotal sigmoid flexure (boar, camel-bull)

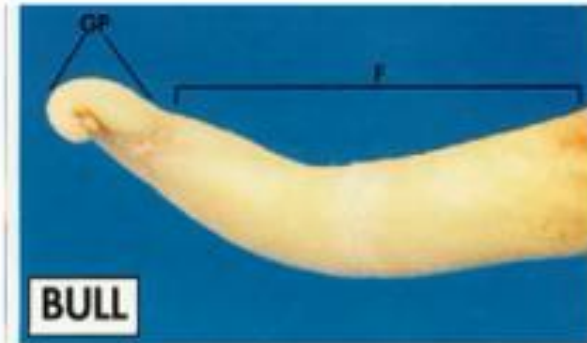


No sigmoid flexure in musclocavernosus penis (stallion, tom-cat, dog)

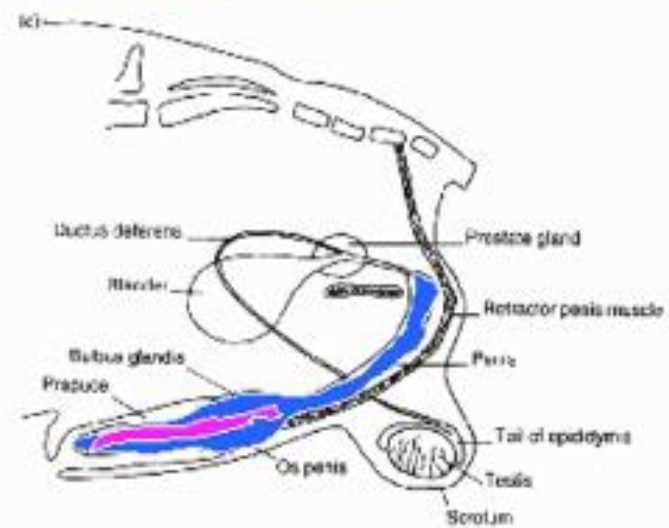


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Glans penis



Glans penis

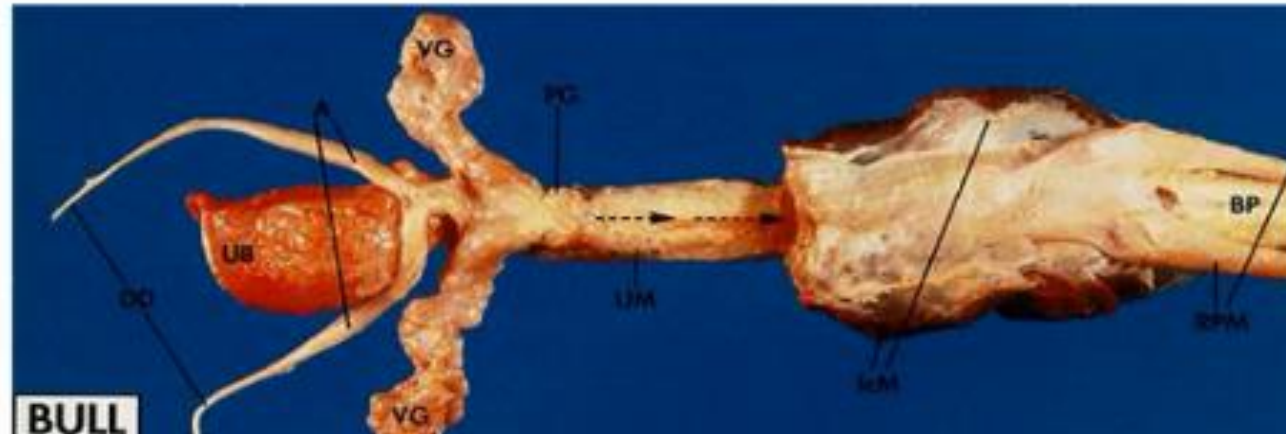
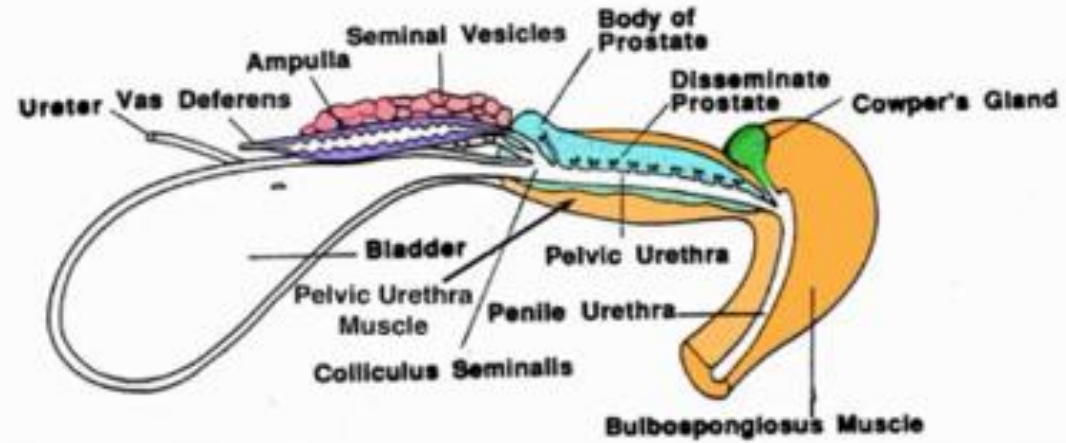


Accessory genitalia glands

- There are three accessory glands:
 - 1. **Seminal Vesicles** – secrete a fluid high in sugars (fructose) to nourish the spermatozoa – feels like a bag of grapes (palpation)
 - This fluid also dilutes sperm at ejaculation and serves to activate motility
 - Rich in proteins, fructose, enzymes.
 - Secretes prostaglandins, causing uterine contractions
 - 2. **Prostate glands** – forms bulk of fluid in semen
 - Creates a basic pH of 7.5-8 – protects sperm
 - 3. **Cowper's gland** – lubricating substance
 - Cleanse male and female reproductive tracts prior to passage of spermatozoa
- These secretions are released almost instantaneously
- Male sex hormones are crucial for this process.

The accessory glands

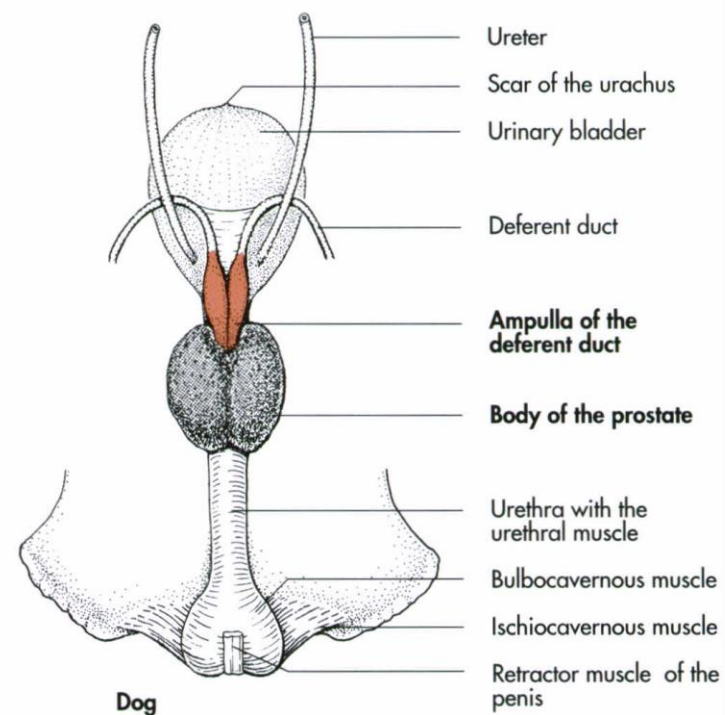
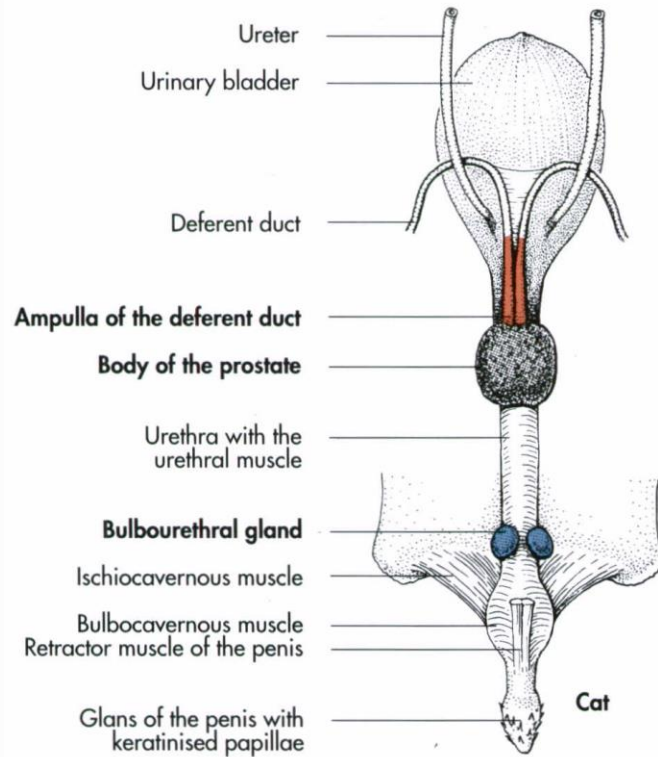
Pelvic Genitalia of the Bull



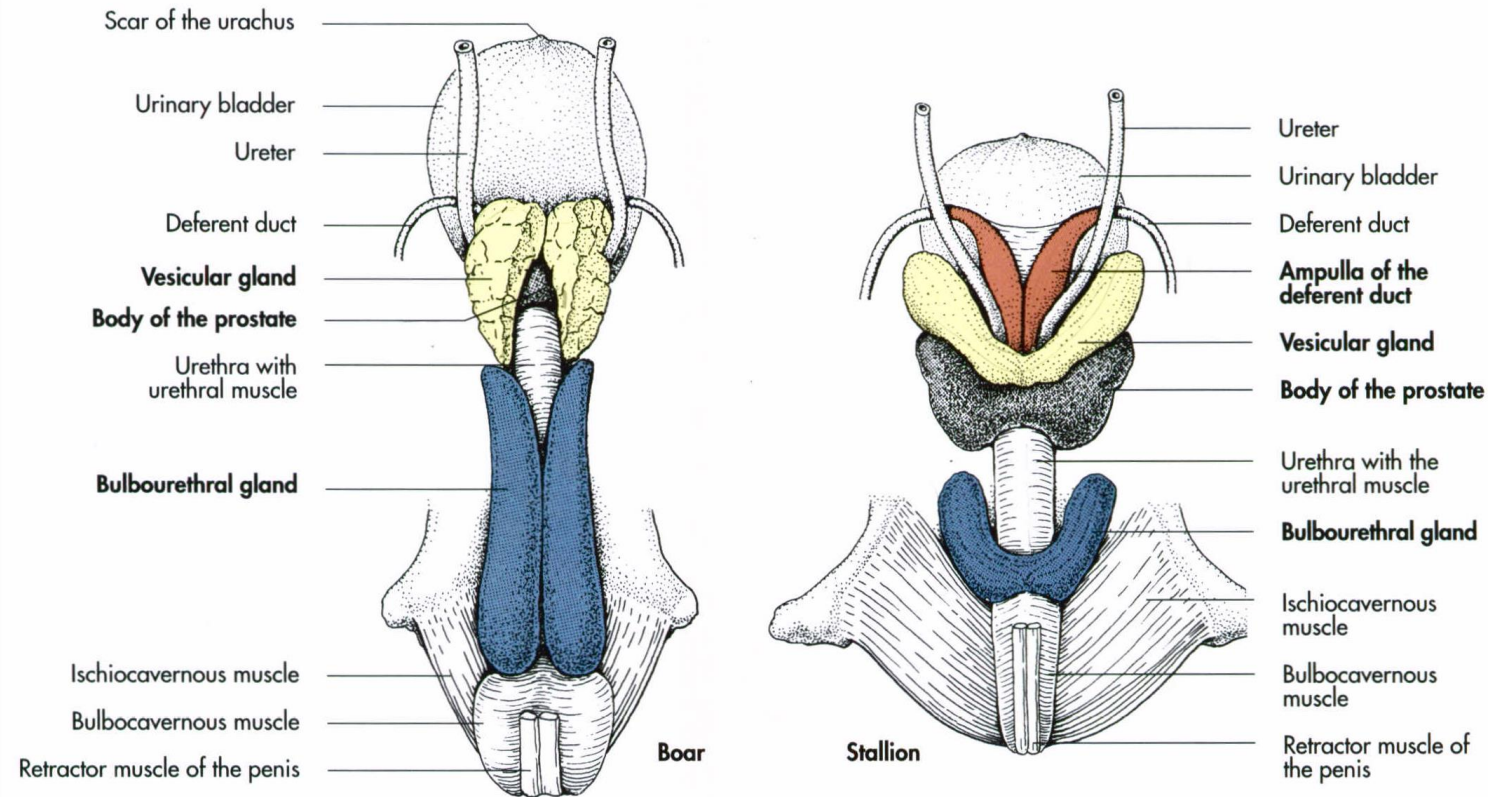
Accessory genitalia glands

	Bull, Buck, and Ram	Stallion	Boar	Dog	Tom	Llama/Alpaca
Testis orientation	Vertical cauda down	Horizontal	Perineal cauda up	Horizontal	Perineal cauda up	Perineal cauda up
Ampullae	+	+	-	+	-	+
Seminal vesicle	+	+	+	-	-	-
Bulbourethra	+	+	++	-	+	+
Prostate	+	+	+	+	+	+
Penis type	Fibroelastic sigmoid	Vascular	Fibroelastic sigmoid	Vascular	Vascular	Fibroelastic sigmoid
Semen deposition	Vagina	Uterus	Cervix/uterus	Vagina	Vagina	Uterus

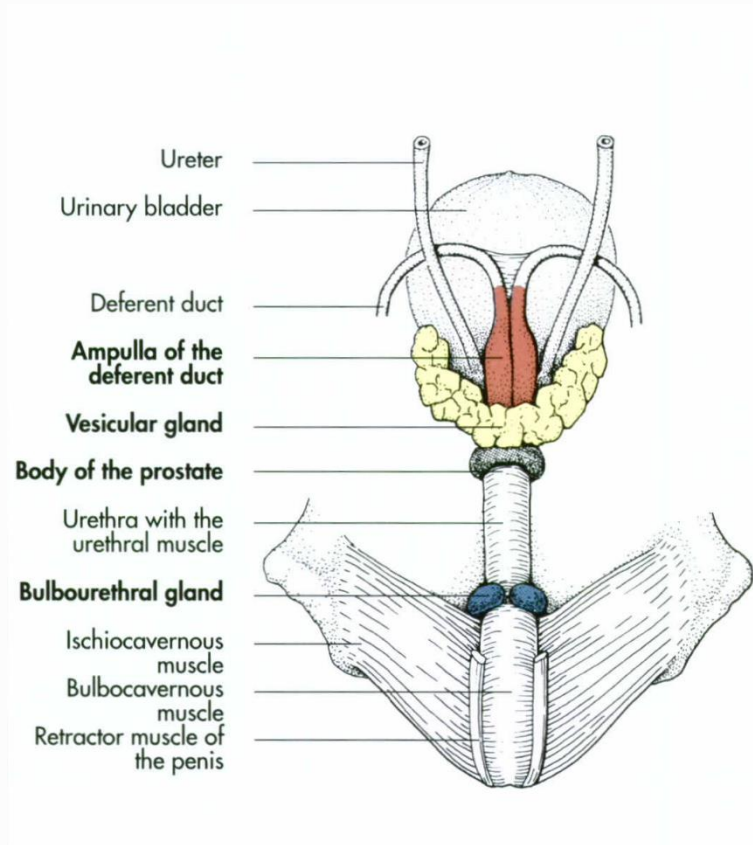
Accessory genitalia glands



Accessory genitalia glands

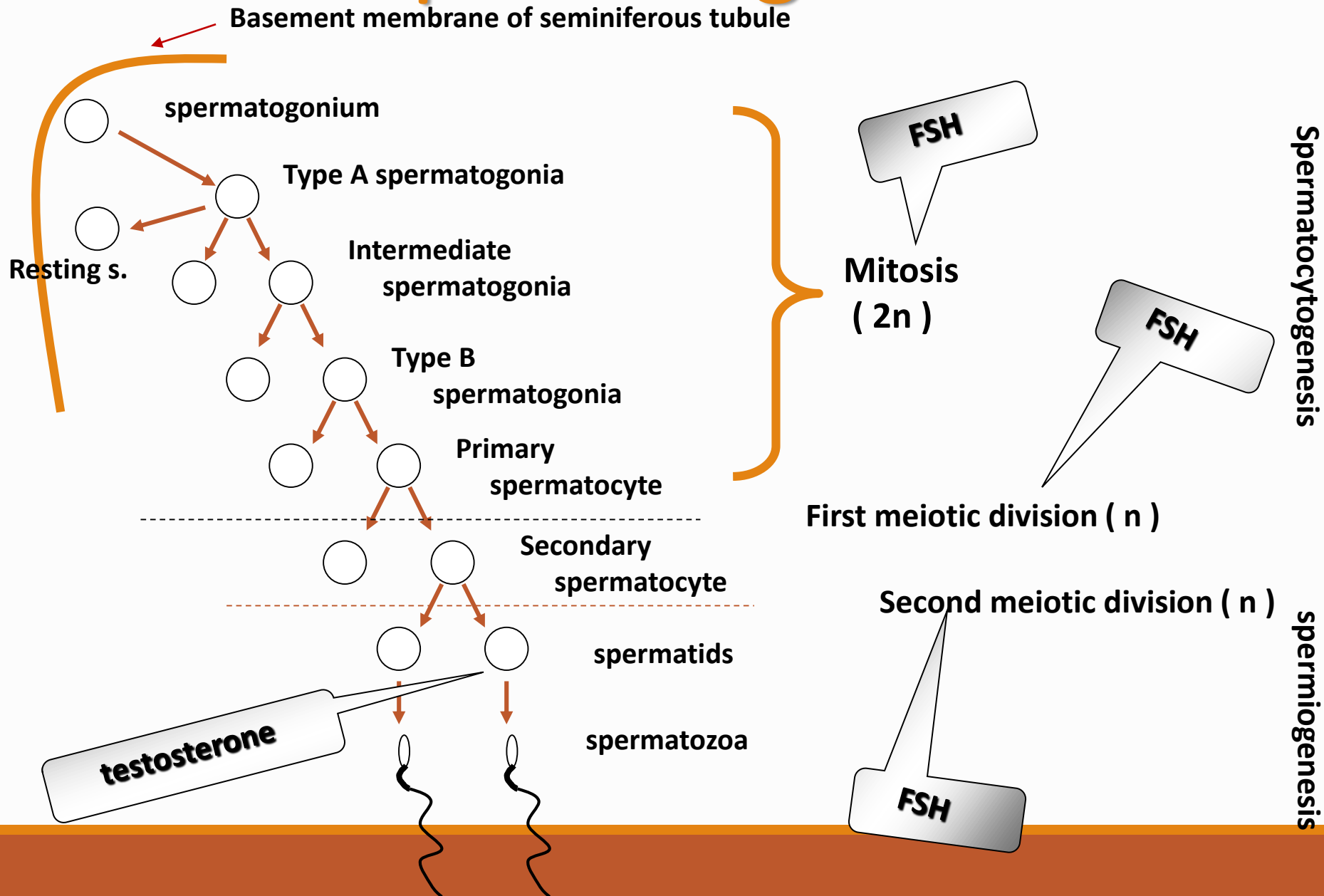


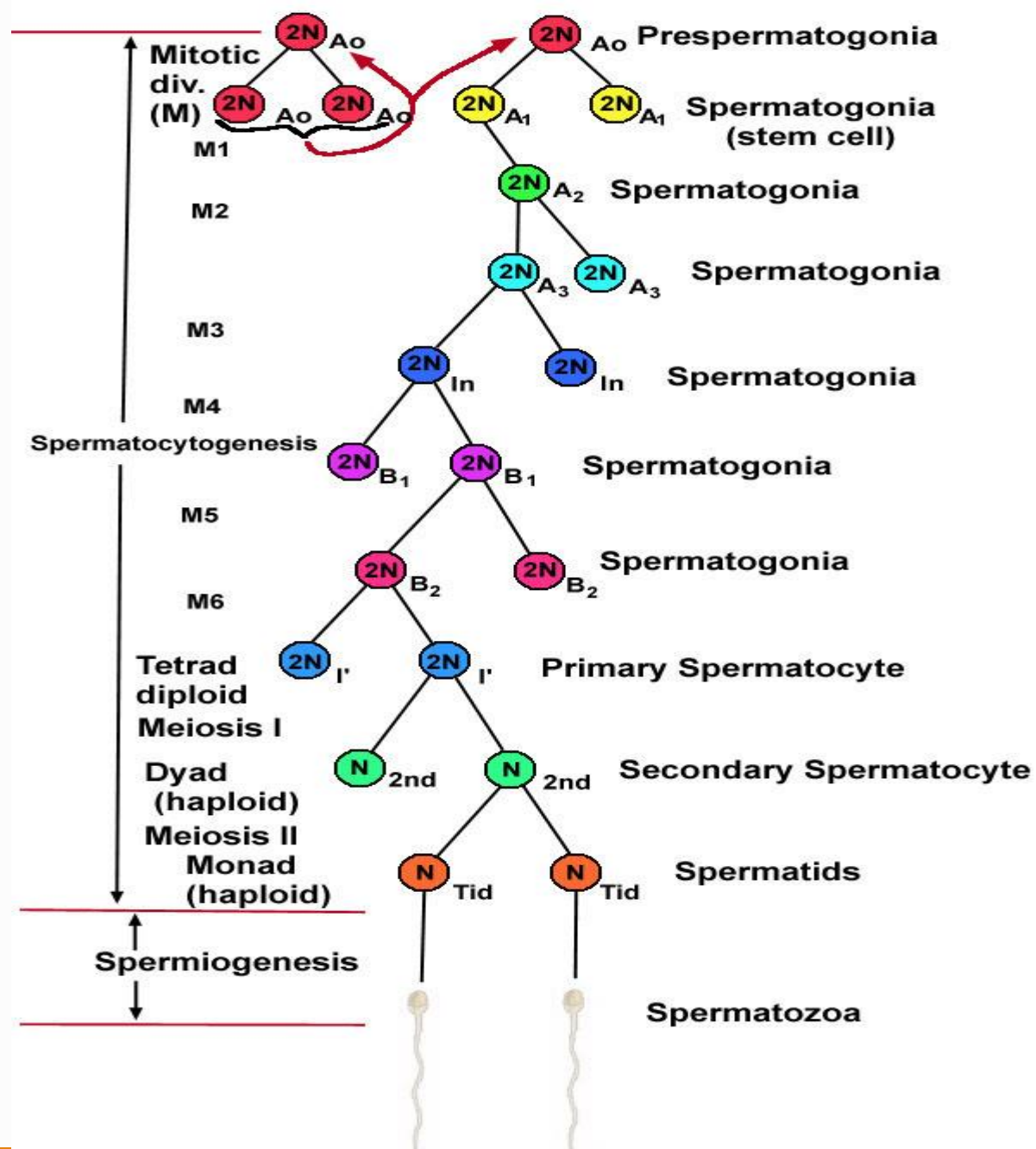
Accessory genitalia glands



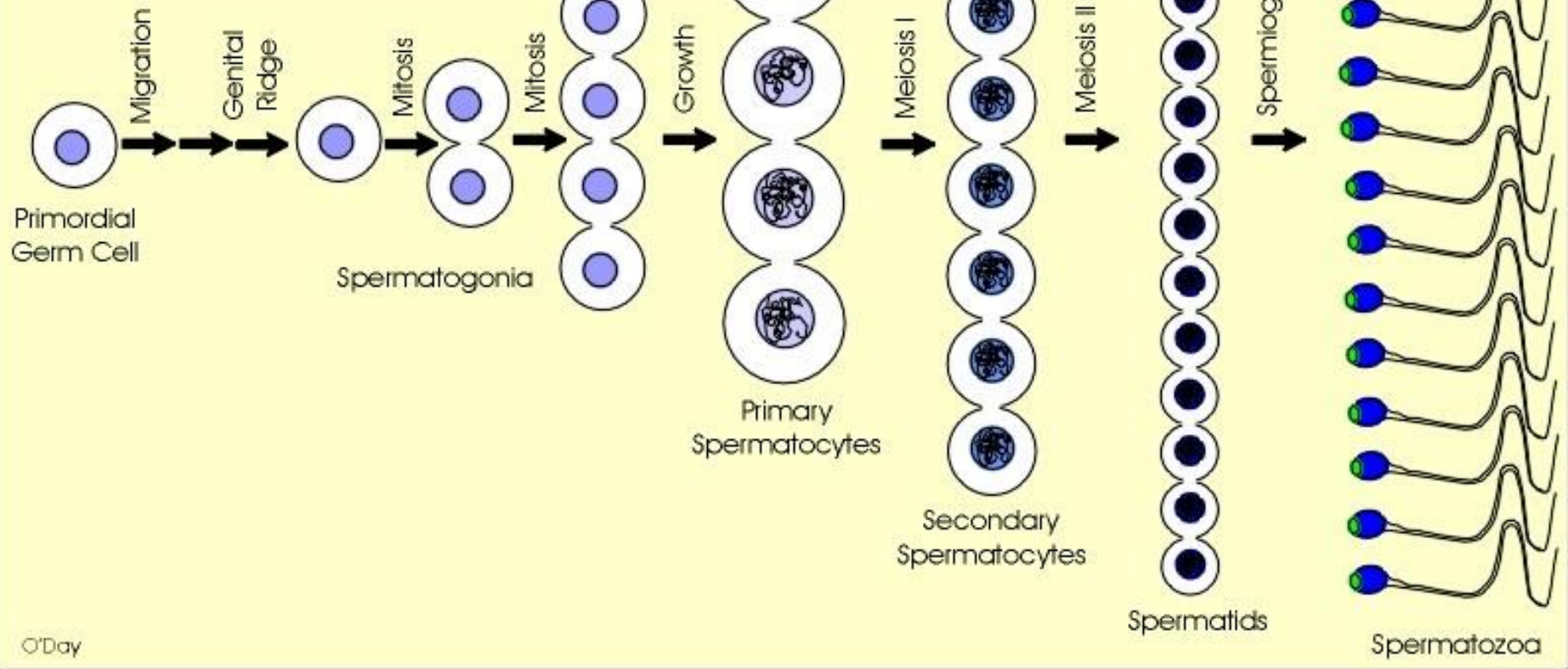
bull

spermatogenesis

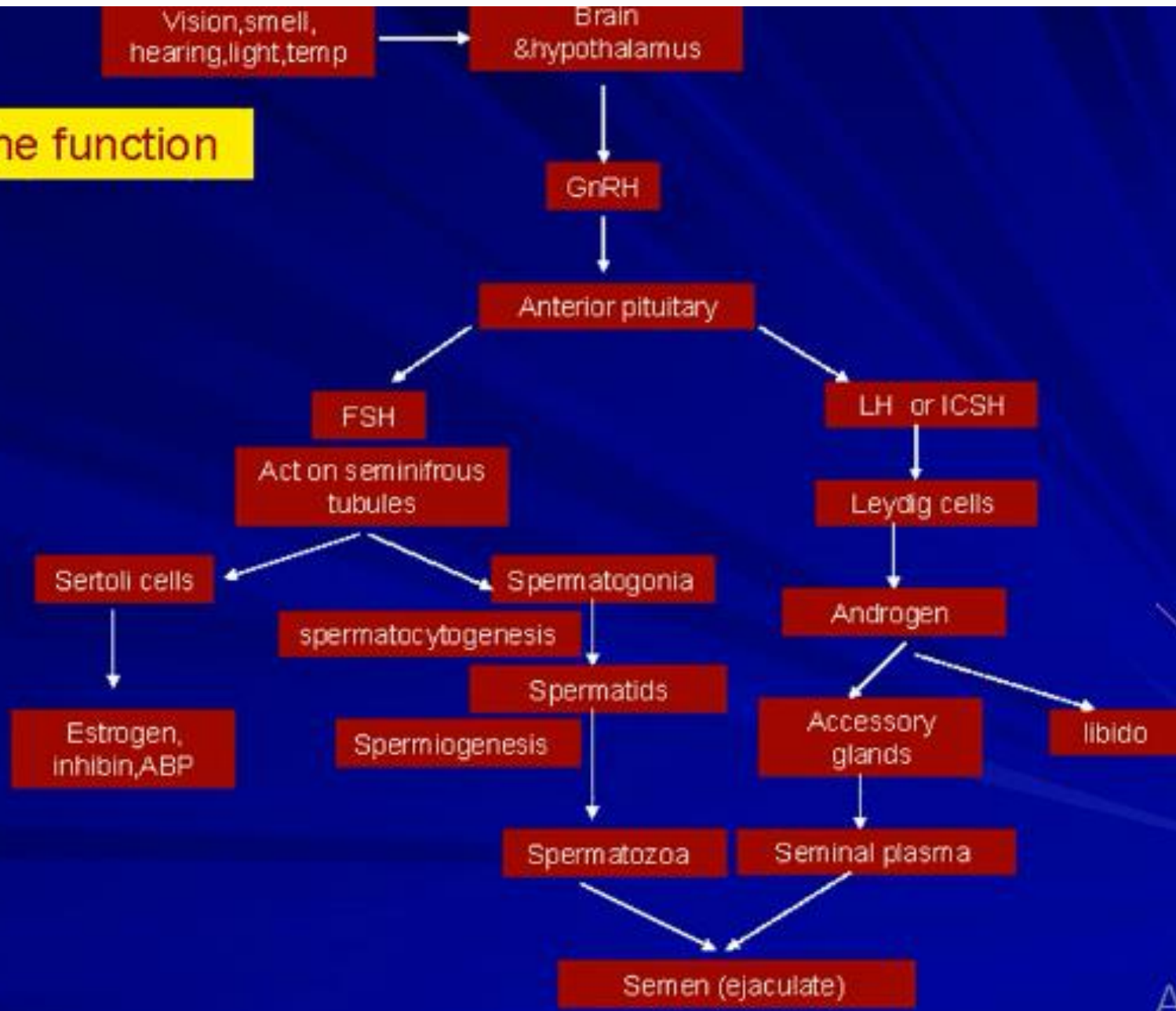




Spermatogenesis:
The Sequence of Events



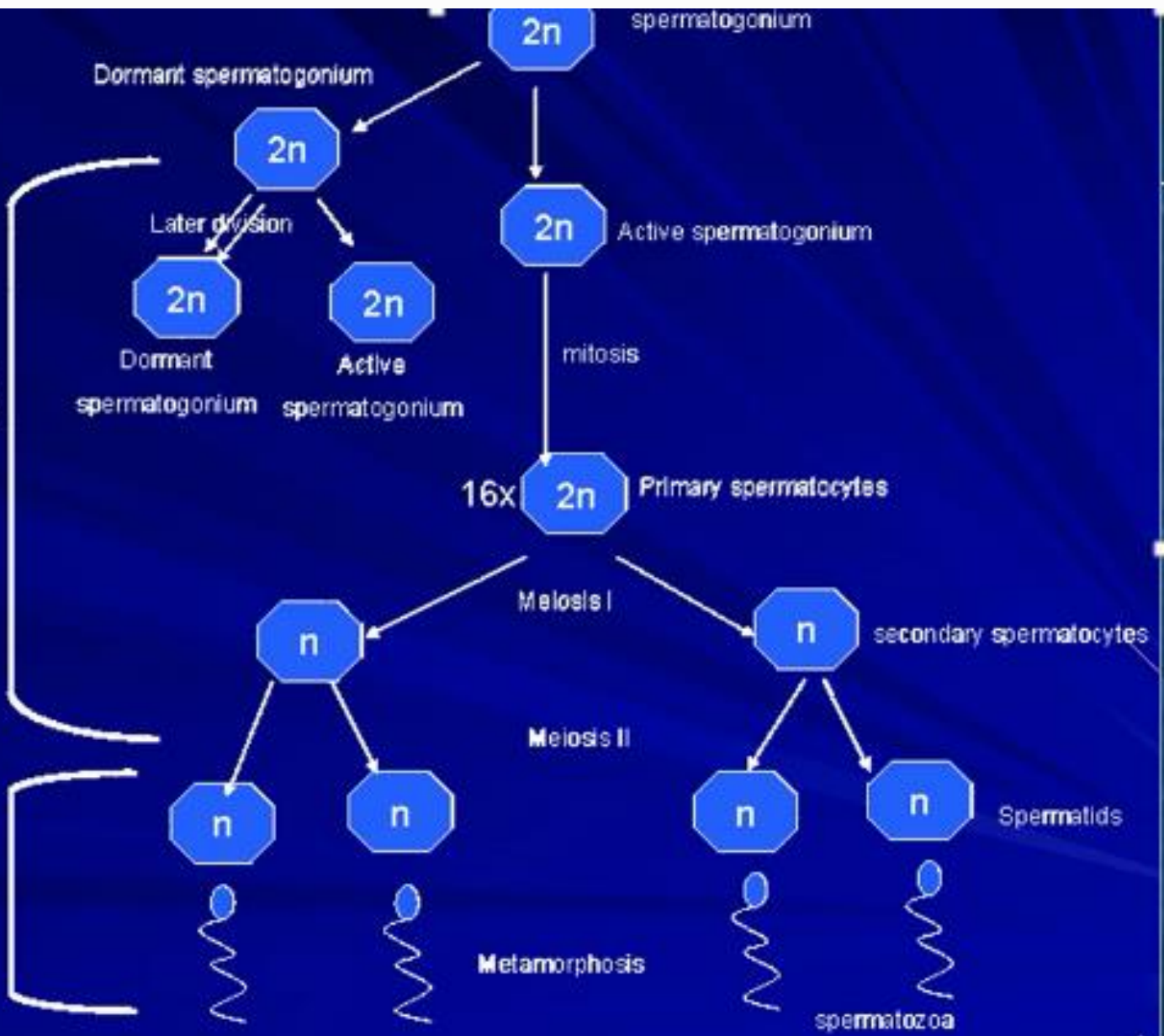
Endocrine function

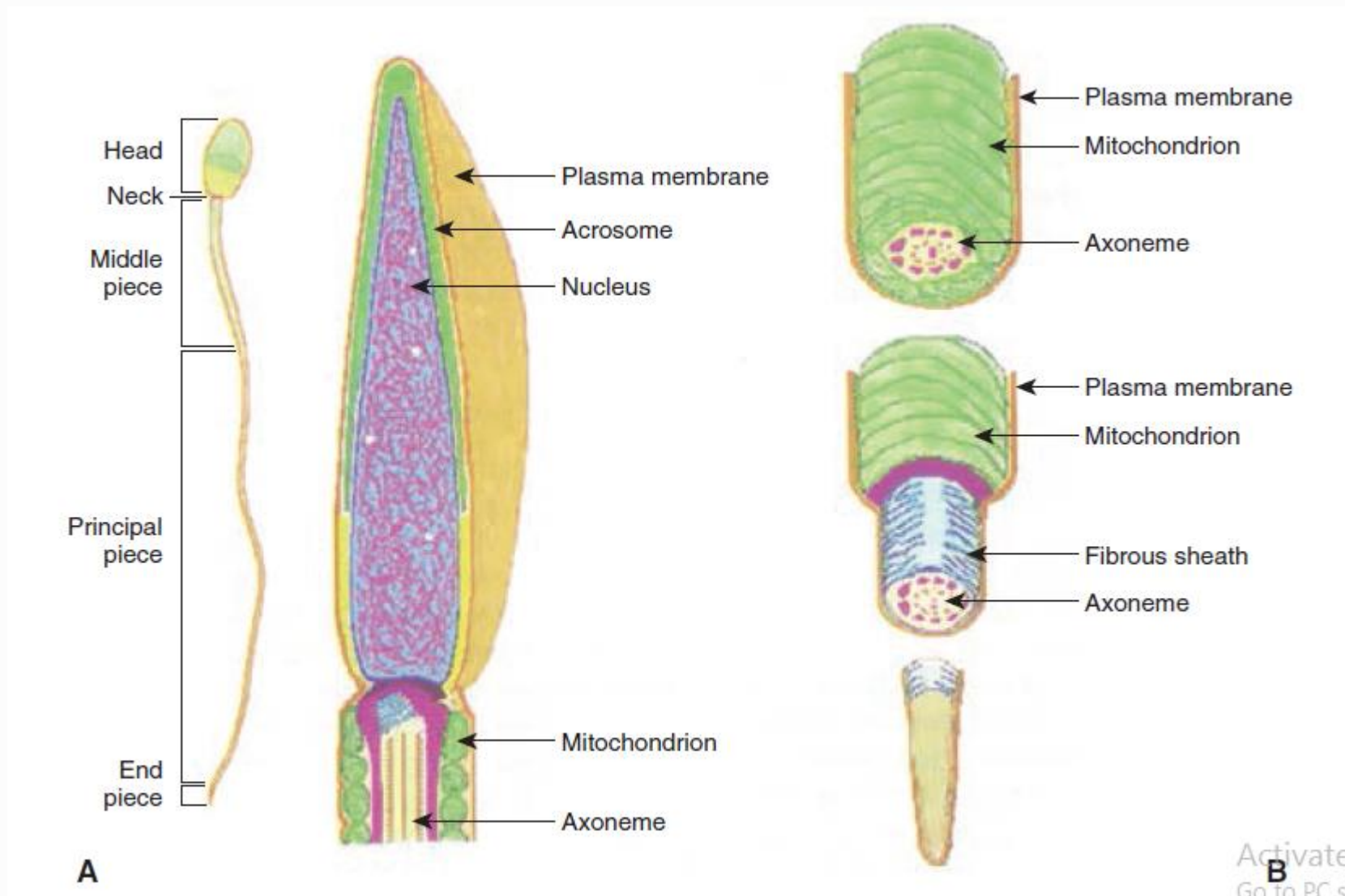


Exocrine function

Spermatocytogenesis 31-32 days

Spermiogenesis 15-17 days





A, Major elements of the mammalian spermatozoa. B, Middle piece (*top*), principal (*middle*), and end piece (*bottom*) of a spermatozoon viewed in cross section.

Bull



Boar



Ram



Horse



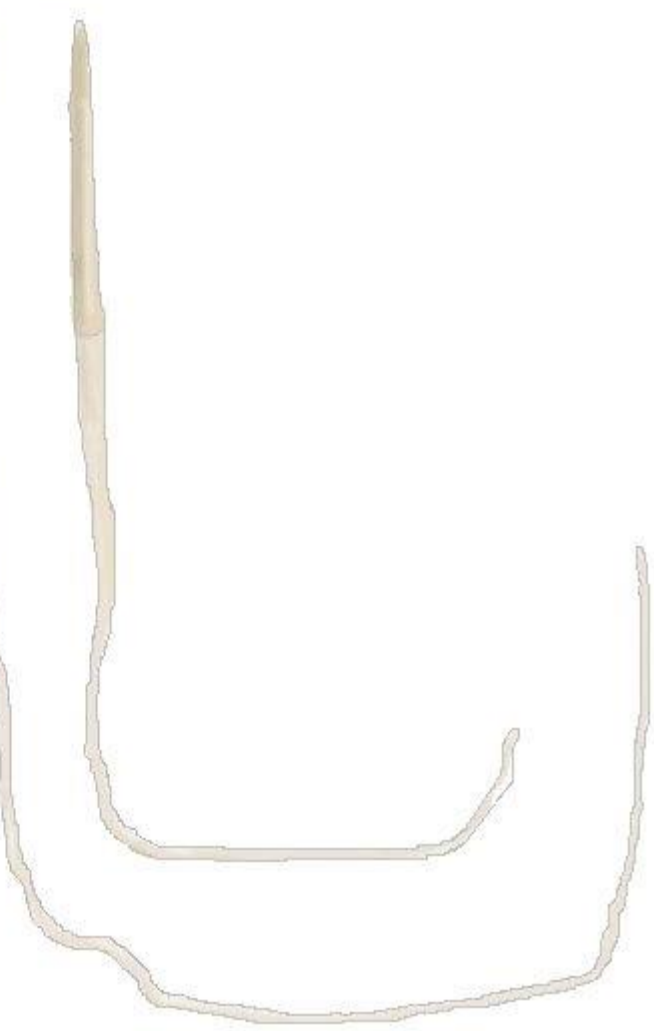
Man



Rat



Cock

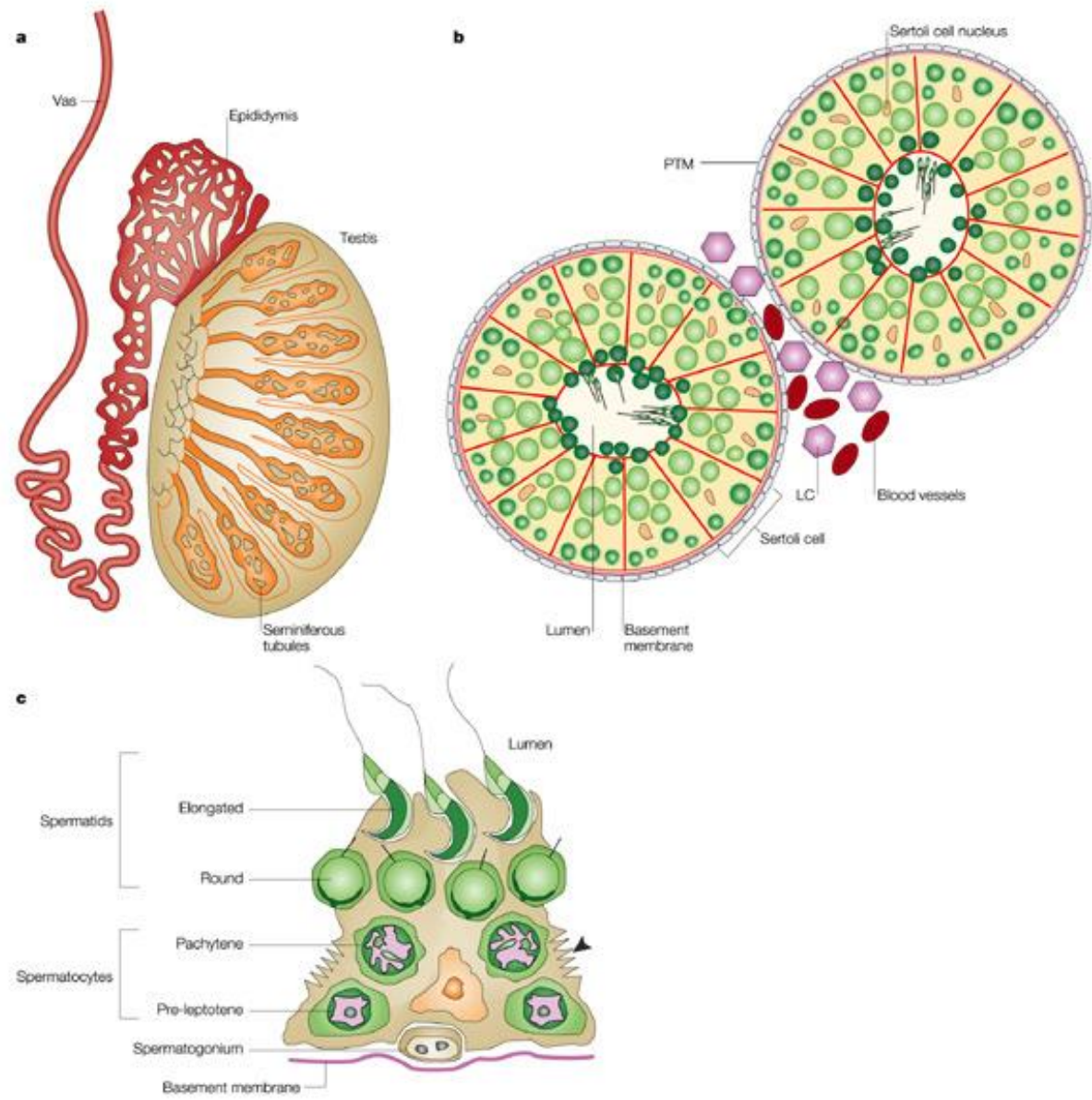


	Vol (ml)	Cons. 10 ⁹ /ml	Num 10 ⁹	Vital sperm %	Norm sperm %	Ejac Per week
Bull	6	1.2	7	70	89	4
Ram	1	3.0	3	75	90	20
Stallion	60	0.15	9	70	70	3
Rooster	0.5	3.5	1.8	85	90	3
Dog	5	0.3	1.5	85	80	3
cat	0.04	1.7	0.057	78	90	3



Effects of Thawing Semen

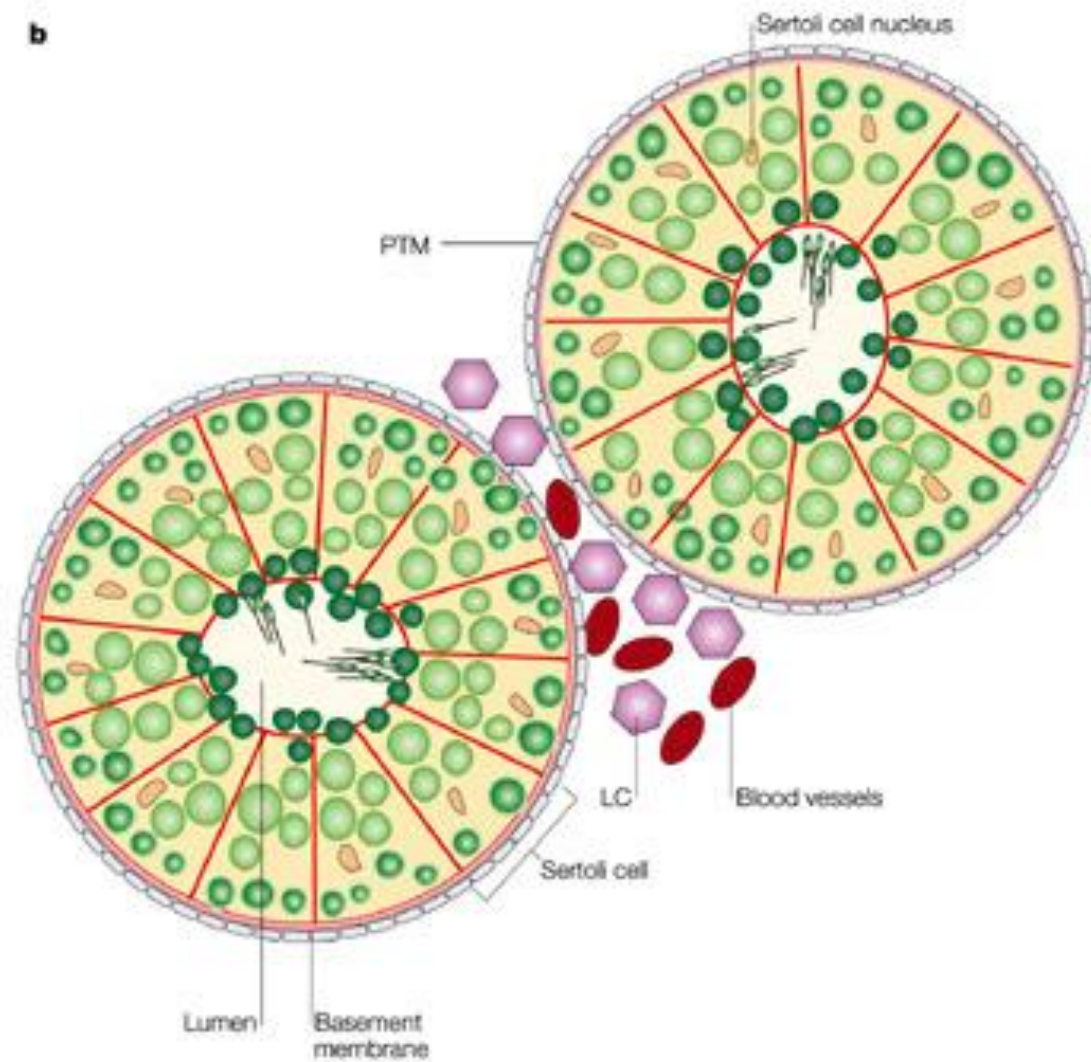
@CarbonateAtlas



Blood Testis Barrier

- Sertoli cells have a “tight junction” barrier which serves to prevent the body from destroying the sperm.
- The BTB is a physical barrier between the testes and the seminiferous tubules.

b



Blood Testis Barrier

- Anything that destroys the BTB will lead to an impairment of meiosis and spermatogenesis.
- BTB Destroyers include:
 - Heat
 - Heavy Metals
 - Pesticides
 - Low amounts of FSH and/or Testosterone

Role of Hormones in Reproduction

- **Hypothalamus :**
GnRH (Gonadotrophin Releasing Hormone)
- **Hypophysis :**
 - **Gonadotrophins :**
FSH (Follicular Stimulating Hormone)
LH (Leutenizing Hormone) in females
ICSH (Interstitial Cell Stimulating Hormone)
in males

Role of Hormones in Reproduction

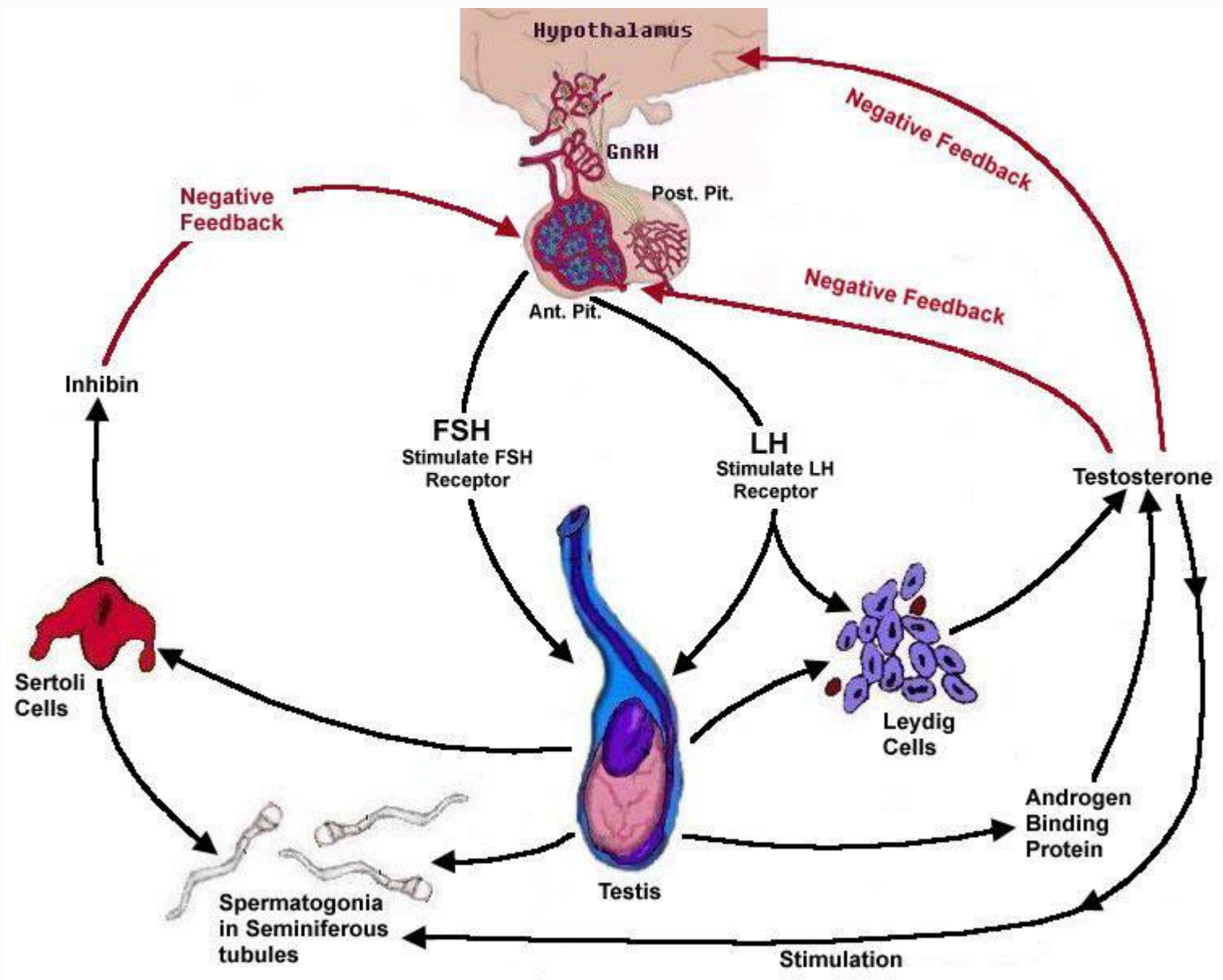
- Prolactin
- Oxytocin

Brain :

- Opioid Peptides
- Pineal Gland

Ovary :

- Estradiols
- progesterone



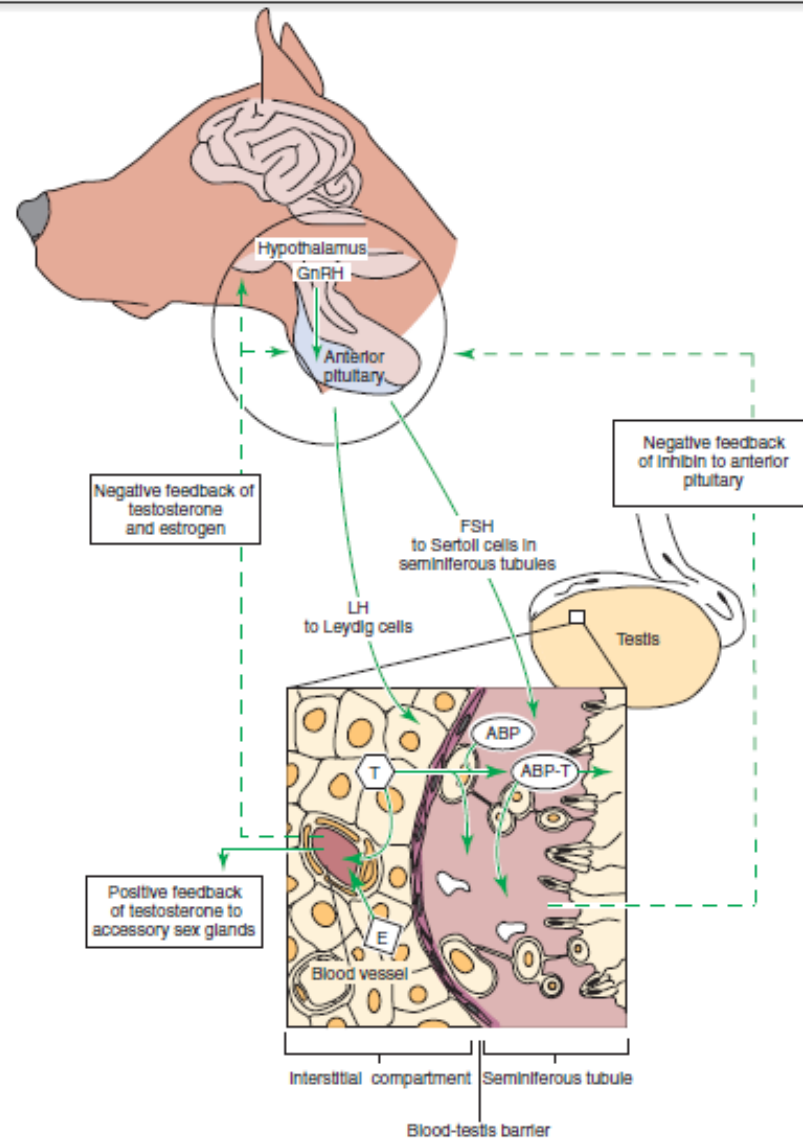
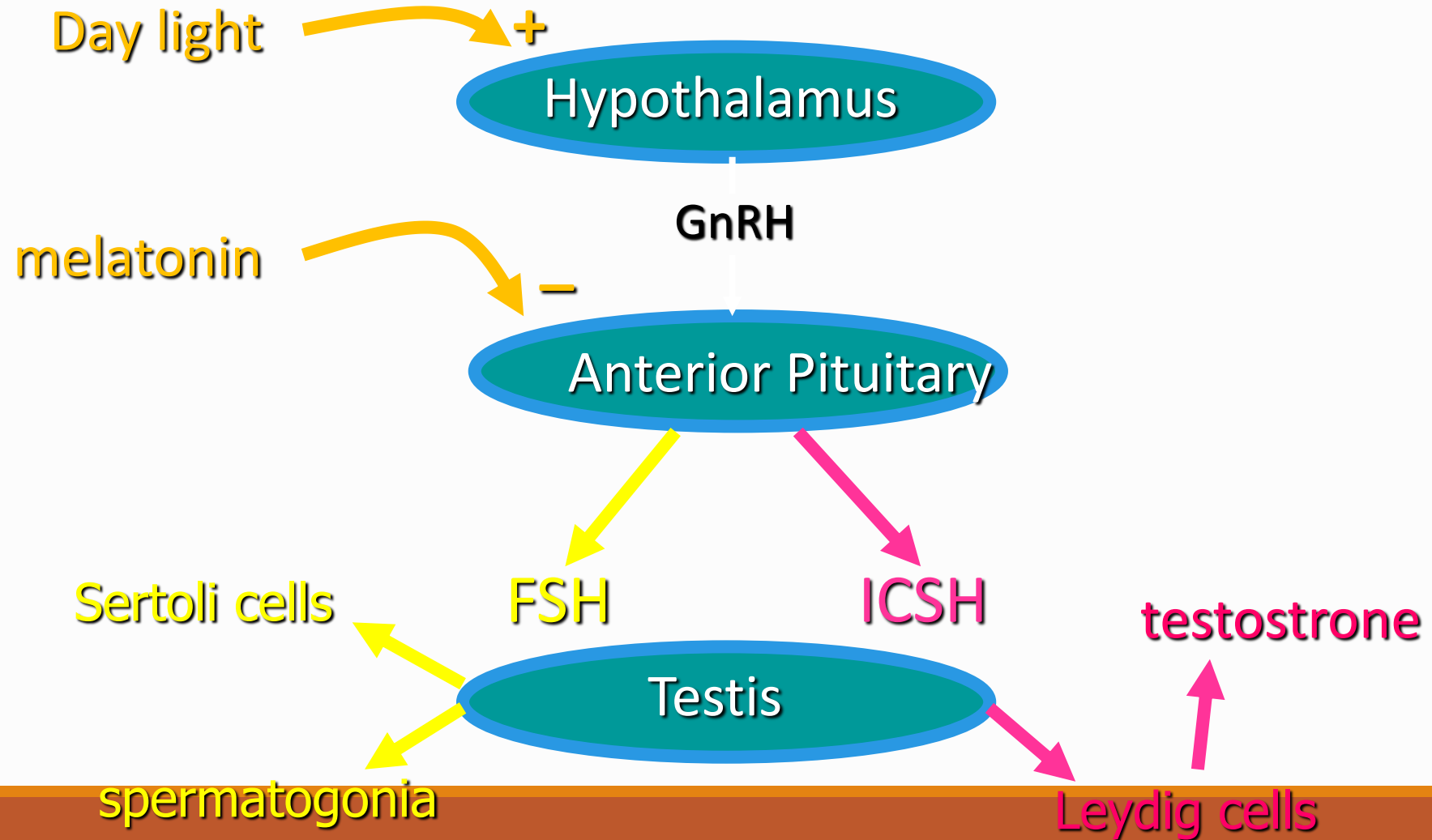


FIGURE 40-5 The reproductive system of male mammals is regulated by intricate feedback mechanisms that involve the hypothalamus, anterior pituitary, and testes. *GnRH*, Gonadotropin-releasing hormone; *FSH*, follicle-stimulating hormone; *LH*, luteinizing hormone; *ABP*, androgen-binding protein; *ABP-T*, androgen-binding protein-testosterone; *E*, estrogen; *T*, testosterone.

Puberty & Sexual maturity



Puberty & Sexual maturity

Sexual behavior

First ejaculation

First sperms in semen

First sperms in urine

First potent sperms in semen

Puberty & Sexual maturity

First potent sperms

Bull : 28 – 32 weeks

Ram : 6 – 9 weeks

Stallion : 13 months

Dog : 6 months

Cat : 5 months

First age for copulation

18 – 24 months

10 – 14 months

18 – 24 months

14 months

12 months

Testicle size

Testicular size is an important trait of medium to high heritability that provides an accurate estimate of the amount of sperm producing parenchyma in the testis.

Because of the influence of testicular size, there is a wide range in daily sperm production among domestic species. For example, daily sperm production has been calculated to be 0.37×10^9 in the dog and 16.2×10^9 in the boar.

Testicle size

	Body Weight (kg)	Pair Testes Weight (Grams)	Spermatogenic Efficiency ^a	Daily Spermatozoa Production ($\times 10^9$) ^b
Alpaca	65	20	NA	NA
Boar	150	750	23	17.3
Bulls	600	600	11	6.6
Dog	15	30	17	0.5
Lama	115	30	NA	NA
Ram	100	550	21	11.6
Stallion	500	350	16	5.6
Tom	5	20	16	0.3

NA, Not available.

^aSpermatozoa produced per gram of testicular parenchyma ($\times 10^6$).

^bSpermatozoa produced daily by the two testes.

Testicle size



FIGURE 40-3 Measurement of scrotal circumference in a bull by using a scrotal tape.



FIGURE 40-4 Measurement of total scrotal width in the stallion using calipers. (From Brinsko SP, Blanchard TL, Varner DD, et al: *Manual of equine reproduction*, ed 3, St Louis, 2010, Mosby.)

Sexual Behavior

Pre-copulatory behavior

Copulatory behavior

mounting

intromission

ejaculation

Post-copulatory behavior

dismount

refractory period

memory

Role of testosterone

On male reproductive system :

- converting spermatid to immotile spermatozoa
- action of cremaster and dartus muscles
- activation of all accessory glands
- activation of sexual behavior

Role of testosterone

On the other organs :

- nitrogen metabolism ; increasing protein making
- muscle growth
- stimulation of osteoblast cells
- keeping Ca^{++} & P04^- in bones
- increasing basal metabolism (10 – 15 %)

Role of testosterone

- increasing Na and water reabsorption
- increasing RBC production
- larynx hypertrophy
- skin thickening
- hair growth in face , under the shoulders , around penis
- hair alopecia