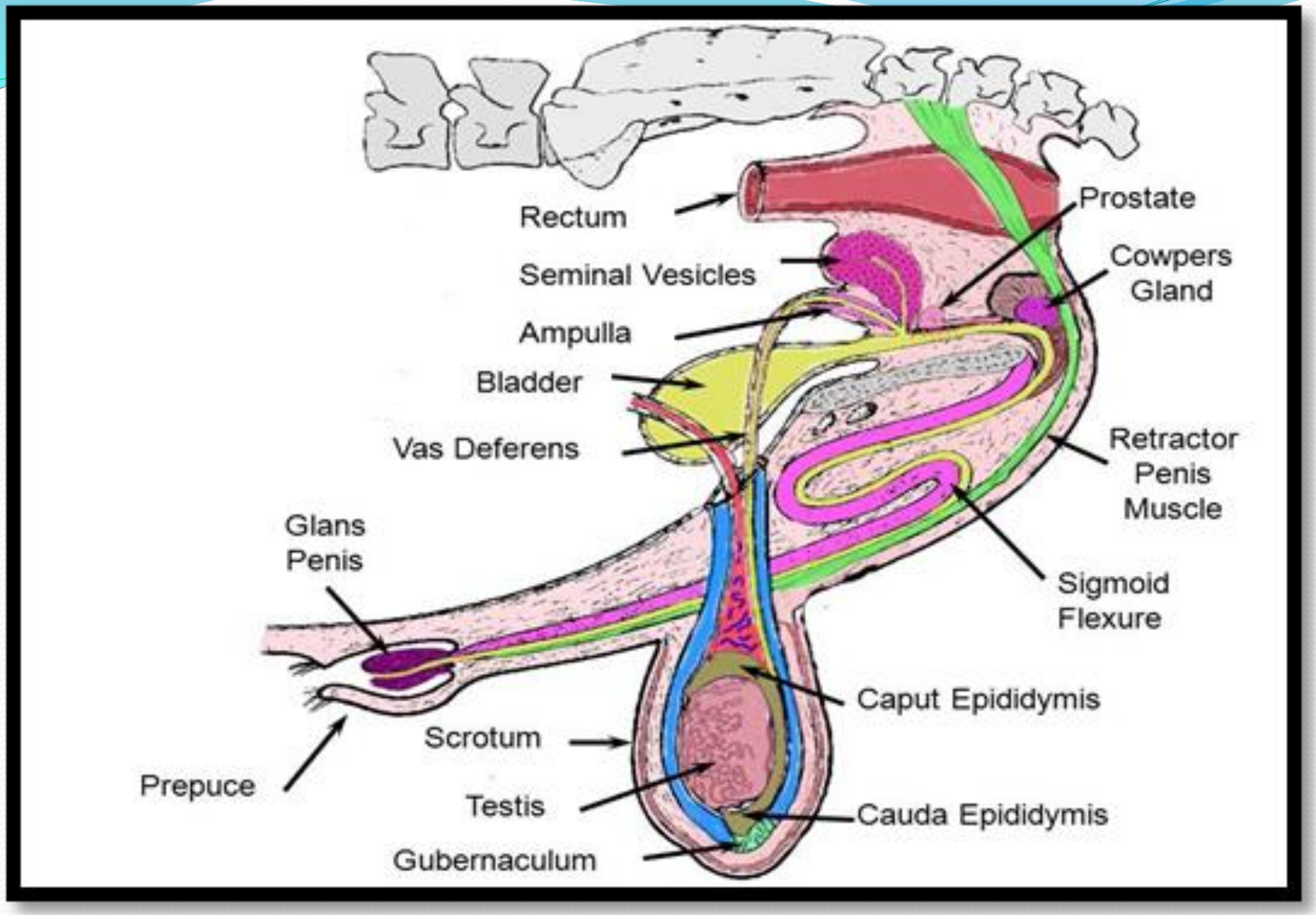
Andrology
male reproductive system

- ***Andrology :***
- It is the science which deals with male genital system, sexual behavior, and breeding performance.
- ***Sexual behavior:***
- Mean different movement performed by male before, during, and just after copulation.
- ***Libido:***
- Sexual desire or sexual drive of male.

Functional Anatomy of Male Genital System

- **The male genital system composed of:**
- **Primary (Glandular) part :**
- 2 testes & associated structures(scrotum &spermatic cord)
- **Secondary (Tubular) part** :
  - efferent ductules .
  - epididymis .
  - vas deference .
  - urethra .
  - Penis.
- **Accessory genital glands :**
  - seminal vesicle .
  - prostate gland.
  - bulbourethral gland .


Rectum
Prostate
Seminal Vesicles
Cowpers Gland
Ampulla
Bladder
Vas Deferens
Retractor Penis Muscle
Glans Penis
Sigmoid Flexure
Caput Epididymis
Scrotum
Prepuce
Testis
Cauda Epididymis
Gubernaculum

- ***Scrotum:***
- It composed of two lobed sacs (coetaneous pouch) contain both testes.
- *Position*:
- Prenial region (bet. Inguinal region and anus): as in dog, tom cat, boar and camel.
- Inguinal region (bet. Thigh of animal): as in stallion, bull, ram, buck.
- ***Layers of scrotum:***
- Skin.
- Tunica dartos.
- Scrotal fascia:
- External spermatic fascia: from external oblique abdominal muscle.
- Cremastric muscle: from internal oblique abdominal muscle.
- Internal spermatic fascia: from transverse abdominal muscle.
- Tunica vaginalis.

- ***Skin:***
- The most outer layer of scrotum.
- It is thin and elastic to facilitate shrinkage(wrinkling) for elongation and expansion.
- Contain large numbers of sweat gland for maintenance of proper testicular temperature (evaporation of sweat → heat transfer).
- Scrotum of bull, buffalo bull covered by thick tough of hair.
- ***Tunica dartos:***
- It is continuation of subcutaneous fascia and formed of s.m.f.
- It separate scrotum into two pouches each one contain one testis.
- The s.m.f. of tunica dartos can maintain sustained contraction.
- →**During cold temperature**: allow testes to be held close to the body (decrease surface area to prevent excessive loss of temperature).
- →**During summer**: tunica dartos relaxes and the surface area of scrotum increased to facilitate cooling.
- Development and maintenance of contractile activity of tunica dartos are under androgen control.

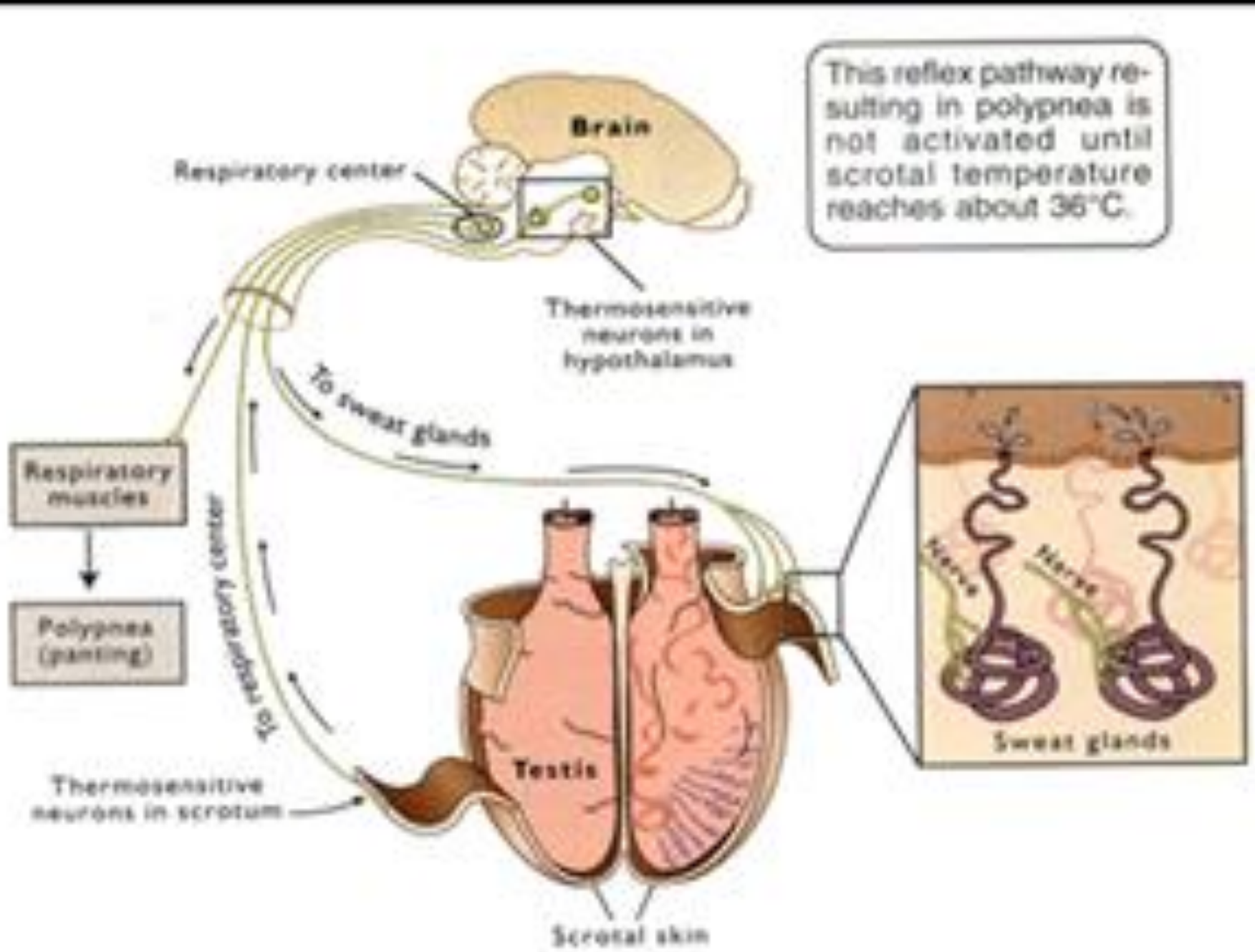
- ***Scrotal fascia:***
- It is elastic tissue lie below tunica dartos and outside parietal layer of tunica vaginalis.
- It has protective function and give rise the main mobility of testis within scrotum.
- ***Tunica vaginalis:***
- It is extension of peritoneum.
- Consists of:
- **Thin visceral serous membrane** which contain testes and epididymis.
- **Parietal fibrous layer** close to scrotal fascia.
- In-between two layers there is serous cavity (vaginal cavity) which contain serous fluid to facilitate movement of testis within scrotum.

- ***Function of scrotum:***
- Protection of testes.
- Thermoregulatory mechanism.
- Sweat glands – evaporative cooling

Intersting fact

relaxation of tunica dartos & cremastermuscle

The scrotum of the horse is relatively short and non-pendulous in nature, when compared with
that of other farm livestock such as the bull or the ram


This reflex pathway resulting in polypnea is not activated until scrotal temperature reaches about 36°C.
Brain
Respiratory center
Thermosensitive neurons in hypothalamus
To sweat glands
Respiratory muscles
Polypnea (panting)
To respiratory center
Thermosensitive neurons in scrotum
Testis
Scrotal skin
Hairs
Hairs
Sweat glands

- ***The testes:***

They are two in number.

- They are suspended by spermatic cords.
- They are the primary organs of reproduction in males, just as ovaries in females.
- They are considered primary because they produce male gametes (spermatozoa) and male

sex hormones (androgens).

- Each testicle has **two surfaces, two borders and two ends.**

- Location of the testicles is outside abdominal cavity {descend from site of origin near kidney ,down into the scrotum} descending occure becouse of shortening of the gubernaculum
- Both gonadotropic hormon and androgen regulate descent of the testes
- which essential for normal sperm formation, which occurs only at 2 – 6 degrees below body temperature.
- This descent occure in mid-pregnancy in cattle ,just before birth in horse
- One or both testicles occasionally fail to descend into the scrotum during embryological development and are retained in the body cavity. This condition is known as ***chryptorchidism***. Hormone production by chryptorchid males is near normal and the male develops and behaves like a normal male, but will generally be subfertile. This condition is genetically inherited, therefore such males should not be used for breeding.
- Cryptorchidism may be unilateral or bi lateral

Structure of the testes

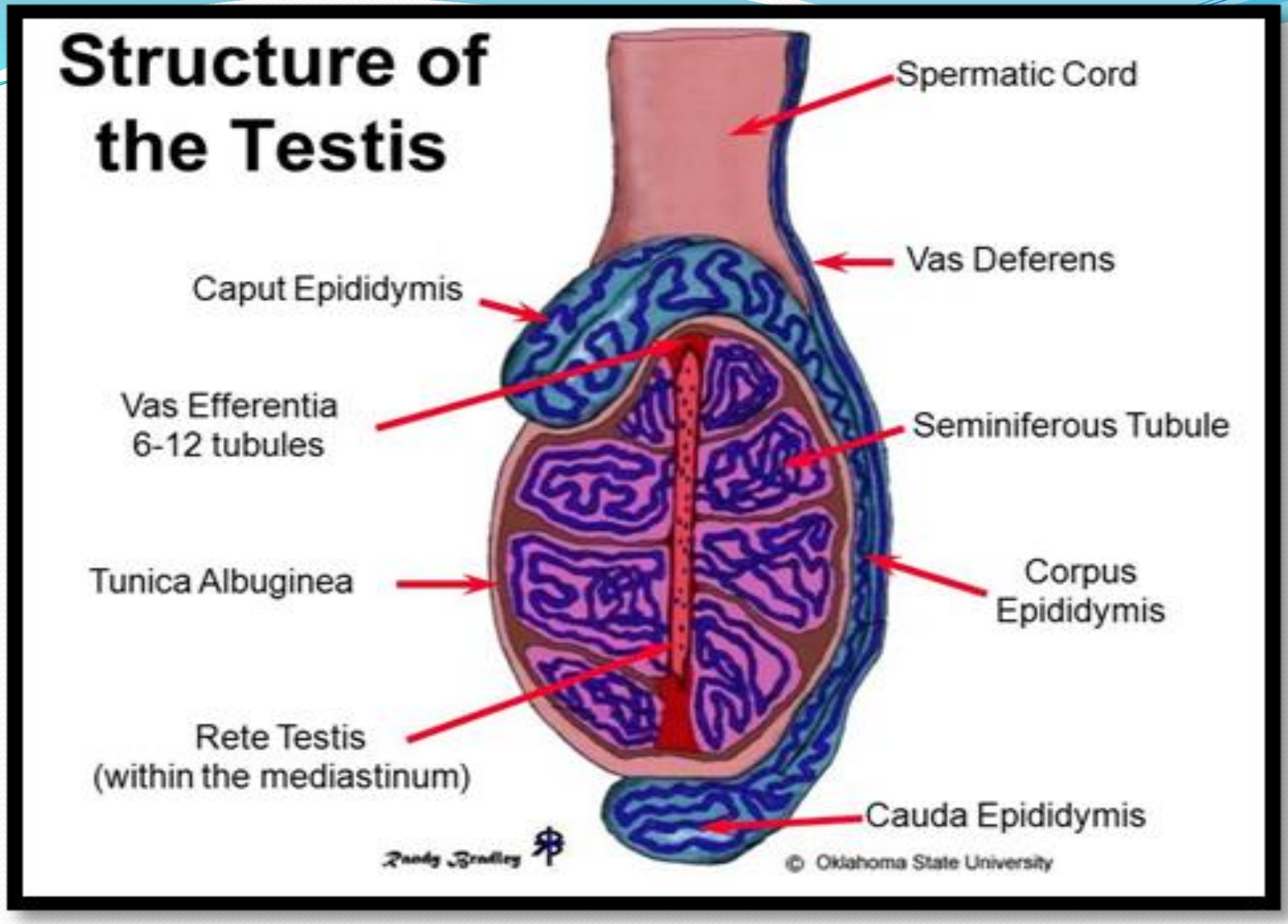
Along the caudal border, a mass of tissue projects from the tunica albugenia into the testis known as **mediastinum testis** (Fig. 3).

- From mediastinum testis numerous **fibrous septa** radiate and divide the testis into anumber of chambers or **lobules** of testis (Fig. 3)..
- Each lobule contains some **seminiferous tubules** (Fig. 3).
- The seminiferrous tubule is made up of two types of cells: **Germ cells** (spermatogonia)which form spermatozoa and **Sertoli cells** which are also called **sperm mother cells or nurse cells** (Fig. 4)**.**

Seminiferous tubules join a network of tubules known as **rete testis.**

- About 12-15 tubules arising from rete-testis are called **vasa efferentia or efferent ducts.**
- These vasa efferentia unit in the head of epididymis and form a single duct called duct of **epididymis**
- **Leydig cells or interstitial cells** are found between the seminiferous tubules

LH stimulate leydig cell to produce testosteron


Structure of the Testis
Spermatic Cord
Vas Deferens
Caput Epididymis
Vas Efferentia
6-12 tubules
Seminiferous Tubule
Tunica Albuginea
Corpus Epididymis
Rete Testis
(within the mediastinum)
Cauda Epididymis
Randy Bradley
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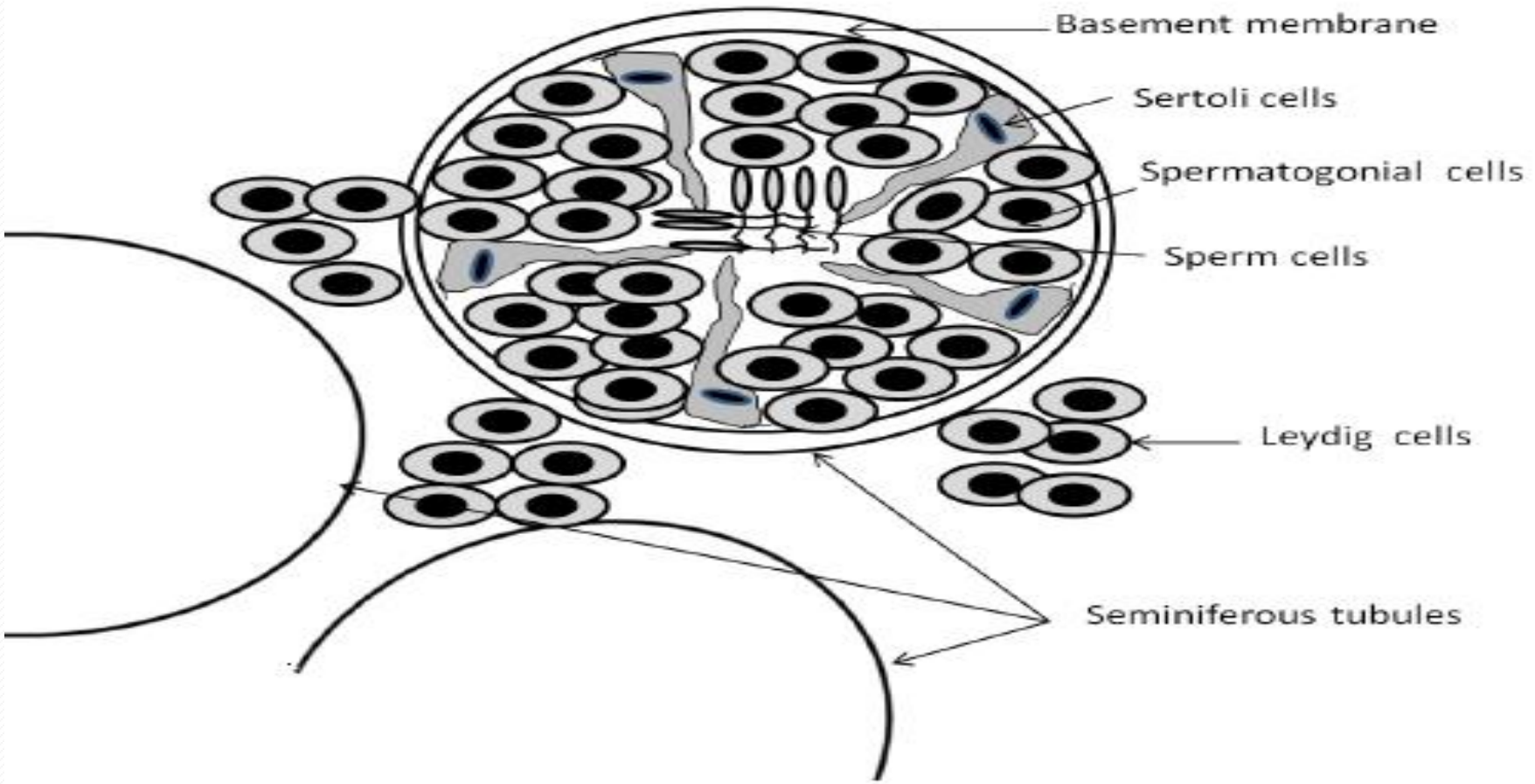

Basement membrane
Sertoli cells
Spermatogonial cells
Sperm cells
Leydig cells
Seminiferous tubules

•***Orientation of testes:***

Species	Orientation
Bull	Vertical
Ram	Vertical
Boar	Oblique
Stallion	Horizontal
Dog	Oblique

- ***<u>Position of testes:</u>***
- *Prenial (between inguinal region & anus):* Dog, Cat, Boar, Camel.
- *Inguinal (between two thigh of animal):* Stallion, Bull, Ram, Buck.

Function of testes:

1. Germ cells - produce sperm
2. Leydig cells - produce testosterone
3. Sertoli cells –

Nutritive to spermatozoa.

Protective to spermatozoa

Supportive to spermatozoa

Phagocytose regressive spermatozoa

Produce androgen binding protein.

- ***Spermatic cord***
- It is extended through inguinal ring to its attachment on dorsal pole of the testis.
- It suspend testis in scrotum .
- Divided into 2 parts :
    - vascular part :
        - pampiniform plexus (artery , vein) →counter current heat exchange
        - Testicular lymphatic vessels
        - Testicular nerve plexus .
    - Avacular part :
        - Vas deference .
        - Cremastric muscle:
- It is primary muscle supporting testes.
- It aid in control of testicular temperature (by elevation or down of testes) and facilitate blood movement in pampiniform plexus.

Temperature control

The higher temperature cause degeneration of cells lining the wall of seminefrous tubule .

The role of scrotum and spermatic cord in temperture control of the testes involved drawing the testes closer away from the body as ambient temp rises

Two smooth Ms are involved of tunica dartos and of spermatic cord ,are sensitive to temp

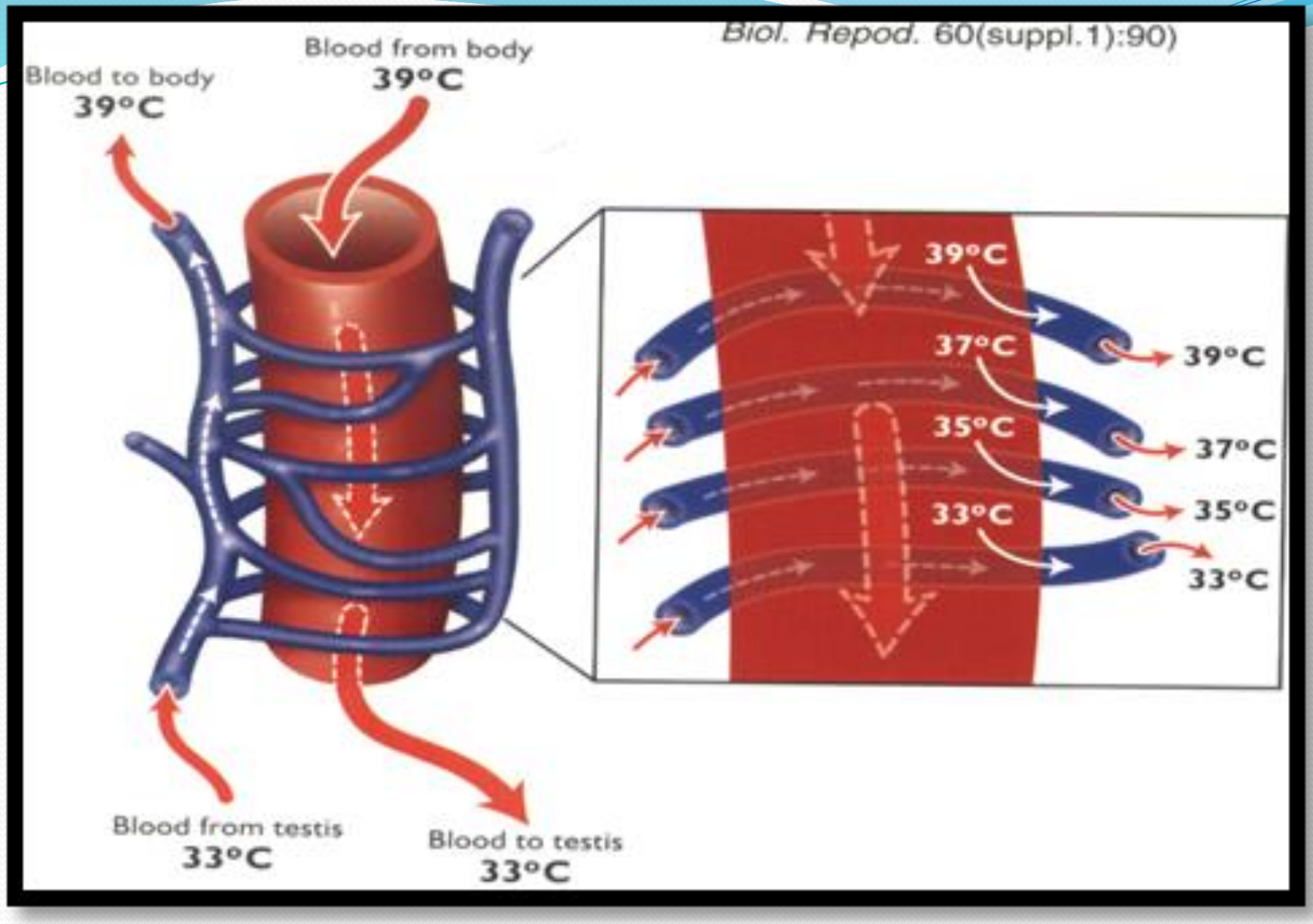
During cold temp contraction of these Ms cause the scrotum to pucker and spermatic cord to shorten ,leading testes closer to yhe body

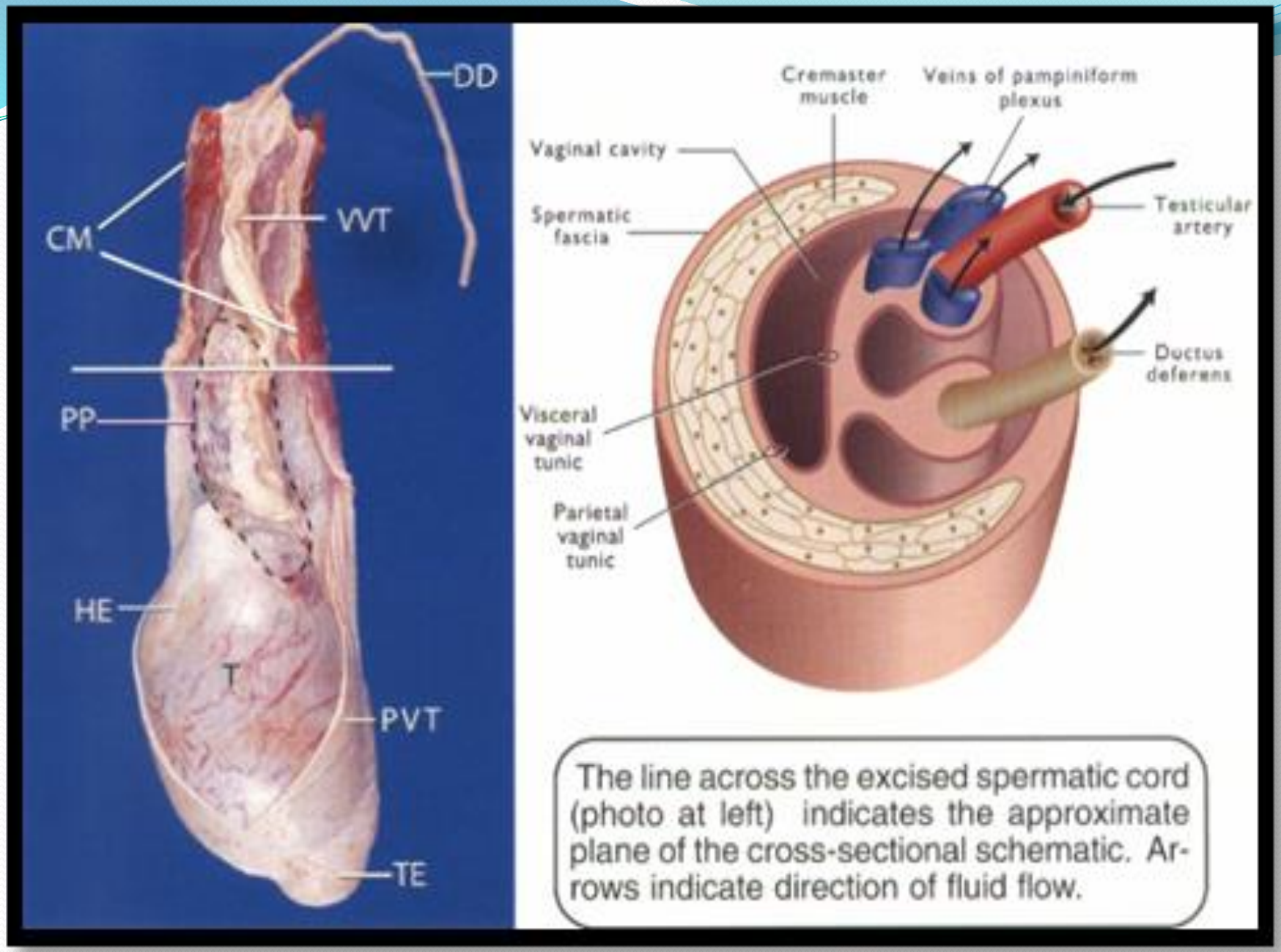
However in hot weather Ms relaxed leading scrotum to stretch and spermatic cord to be lengthen

Actual cooling of testes occure by 2 mechanism

The skin of scrotum has both sweat gland and sebaceous glandwhich are more active during hot weather

In addation to cooling occurs through heat exchange in circulatory system as arteries transporting blood at internal body temp transcend spermatic cord ,theier convoluted fold pass through anet work of veins, the pampinoformplexus cooling arterial blood then occurs before it reaches testes


Biol. Repod. 60(suppl.1):90)
Blood from body
39°C
Blood to body
39°C
39°C
37°C
35°C
33°C
39°C
37°C
35°C
33°C
Blood from testis
33°C
Blood to testis
33°C


DD
CM
VVT
PP
HE
T
PVT
TE
Cremaster muscle
Veins of pampiniform plexus
Vaginal cavity
Spermatic fascia
Testicular artery
Ductus deferens
Visceral vaginal tunic
Parietal vaginal tunic
The line across the excised spermatic cord (photo at left) indicates the approximate plane of the cross-sectional schematic. Arrows indicate direction of fluid flow.

***Epididymus*:**

- The epididymis is a compact, flat, elongated structure closely attached to one side of the testicle.
- It is divided into three regions :

--Head (caput) where 12 to 15 vasa efferentia merge into a single duct of epididymis.

- Body (corpus)
- Tail (cauda)
- The length of the duct is about 34 M in bull and longer in the ram,boar &stallion
- The lining of the epididymis contain cilia that play role in movement of sperm

- There is Smooth Ms which play important role in transportaion of sperm.

Factors contribute to movement of sperm through epididymis

Pressure from production of new spermatozoa

External pressure created by massaging effect on testes &epididymis that occure during normal exercise

The lining of the epididymis contain cilia that play role in movement of sperm

During ejaculation peristaltic contraction involving SM Ms of epididymis play role in movement of sperm

Function of epididymis

- **Transportation of spermatozoa:**

The ciliated epithelium and peristaltic contraction of smooth muscle fibre of epididymis help in transportation of spermatozoa through epididymis.

- **Concentration of spermatozoa:**

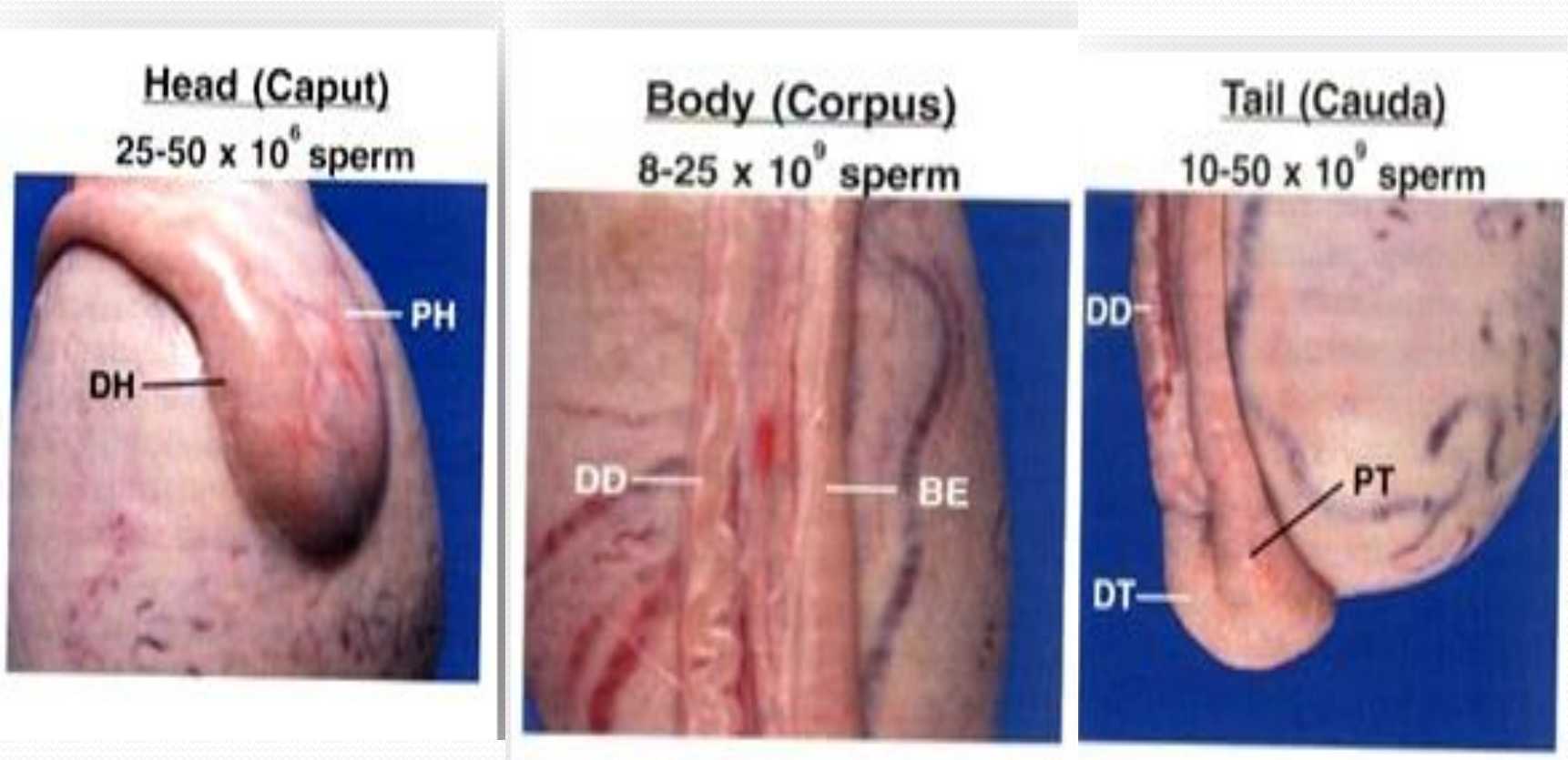
The head of the eididymis is the site of absorption of excess fluid. More than 90 % of fluid leaving testis is absorbed in the head of the epididymis

- **Storage**

The cauda of epididymis is the site of storage of spermatozoa. The conditions of cauda of epididymis are optimum for preserving the viability of spermatozoa for an extended period.

- **Maturation**

The freshly formed spermatozoa in testes have neither motility nor fertility i.e. they are immature spermatozoa. The maturation of spermatozoa occurs in the head and body of epididymis. The spermatozoa lose its protoplasmic droplet which forms during spermatogenesis.


Head (Caput)
25-50 x 10^6 sperm
PH
DH
Body (Corpus)
8-25 x 10^9 sperm
DD
BE
Tail (Cauda)
10-50 x 10^9 sperm
DD
PT
DT

- ***Vas deferens***
- The vas deferens, also known as ductus deferens.
- emerges from the tail of the epididymis as a straight tubule and passes as part of the spermatic cord through the *inguinal ring* into the body cavity.

The terminal portion of the vas deferens is little dilated and is known as **ampulla**

Ampulla is absent in dog and cat. The ampulla is **well developed** in **stallion** which secretes a sulphur containing base called **ergothionine** in the ejaculates.

- Ampulla secret fructose & citric acid for nutrition of sperm present .

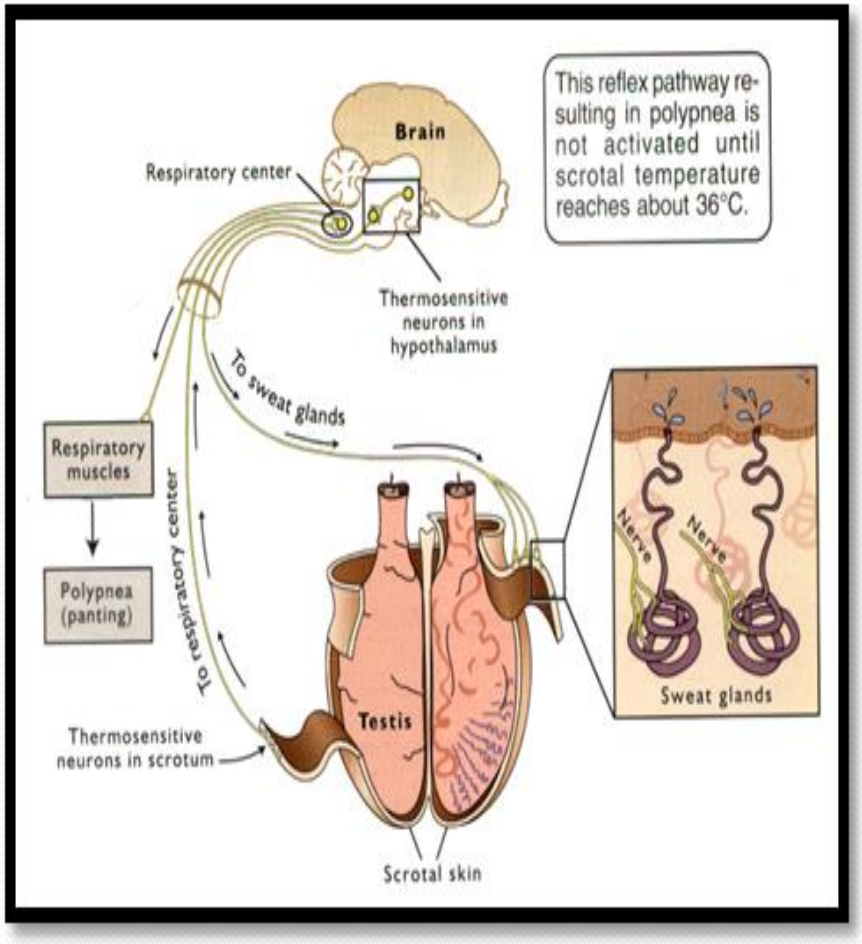
Functions

Transport of sperm from epididymis to urethra through peristaltic movement during ejaculation.

- ***Urethra***
- The two vas deferens eventually unite into a single tube .
- The urethra, which is the channel passing through the penis.
- The urethra in the male serves as a common passageway for semen from the reproductive tract and urine from the urinary tract.
- Divided into :
  - Pelvic urethra :extend from neck of bladder till ischial arch .
  - Extra pelvic urethra : - bulpar urethra : at ischial arch
    - penile urethra : within penis

Thermoregulatory mechanism:

- Begin after puberty under effect of testosterone.
- It aided by:
  - ✓ Pampiniform plexus.
  - ✓ Cremastric muscle.
  - ✓ Scrotum.
- During summer ……
- During cold temperature …….



Penis

Penis is the organ of copulation in male

Bull ,boar &ram have sigmoid flexure {S shape which permit the penis to be retracted completely into body}.

These 3 species and stallion have retractor penis Ms , pair of SM.Ms. Which will relax to permit of extension of the penis and contract to draw penis into the body

The glans penis{free end of the penis}is well supplied with sensory nerve and is homologous to the clitoris in femal.

In most species penis is fibro elastic containing small amount of erectile tissue,the penis of stallion contain more erectile tissue

Table 2. Difference between Fibroelastic Penis and Musculocavernous penis

	Fibroelastic	Musculocavernous
1	Thick fibrous tunica albuginea	Tunica albuginea is less pronounced
2	Less erectile tissue	More erectile tissue
3	Sigmoid flexure - present	Sigmoid flexure - absent
4	Little blood enters the penis during erection	More blood enters the penis during erection
5	Lengthening of penis is achieved mainly by straightening the sigmoid flexure of the penis	Lengthening of penis is achieved entirely by vascular engorgement

Fibro elastic found in ruminant and boar musclocavernous found in stallion,dog ,cat

prepuce

Prepuce is asheath which completely enclosed free end of penis

It can be divided into

Prepenile portion which is outer fold

Penile portion which is inner fold

The orifice of prepuce is surrounded by long tough hairs

Accessory glands

Vesicular{seminal} glands

Pairs of lobular glands having the appearance of cluster of grapes

The excertory ducts of the vesicular glands opens near bifurcation where ampulla emerge with urethera

They are of smilar length in bull ,boar &stallion

But width of this gland in bull is ahalf that of boar and stallion

function

Several organic compound found in secretion of seminal gland

Fructose and sorbitol {source of energy for bull and ram but are found in lower concentration in boar and stallion}.

Both phosphate and carbonate buffers are found in secretion and are important in regulation of PH of semen

Prostate gland

Is single gland located around urethera posterior to excertory duct of seminal gland

Prostate body are palpated in bull and stallion

In ram all of prostate is embeded in urethera muscle

Function:

It make small contribution to fluid volume of semen

Secretion of prostate are high in inorganic ions with Na ,Ca ,Mg &Cl

Bulbouretheral {cowpers gland}

Pair of glands located along the urethera near the point where it exits from the pelvis

In bull they embeded in bulbo spongiosum Ms

Function:

They contribute very little to semen volume

In bull the secretion flush urine residue from urethera before ejaculation

In boar {prevent semen from following back through cervix into vagina of saw}

Species	Ampulla	Prostate	Vesicular gland	Bulbourethral gland
Cattle/buffalo	(+)	++	+++	+
Sheep	(+)	++	+++	+
Horse	++	++	++	+
Pig	Absent	+	++	+++
Dog	Absent	+++	Absent	Absent
Cat	Absent	++	Absent	++

Ampullary glands are present in species marked (+) but are not anatomically prominent