

ORENBURG STATE MEDICAL UNIVERSITY

DEPARTMENT OF HISTOLOGY,
CYTOLOGY AND EMBRYOLOGY

MALE REPRODUCTIVE SYSTEM

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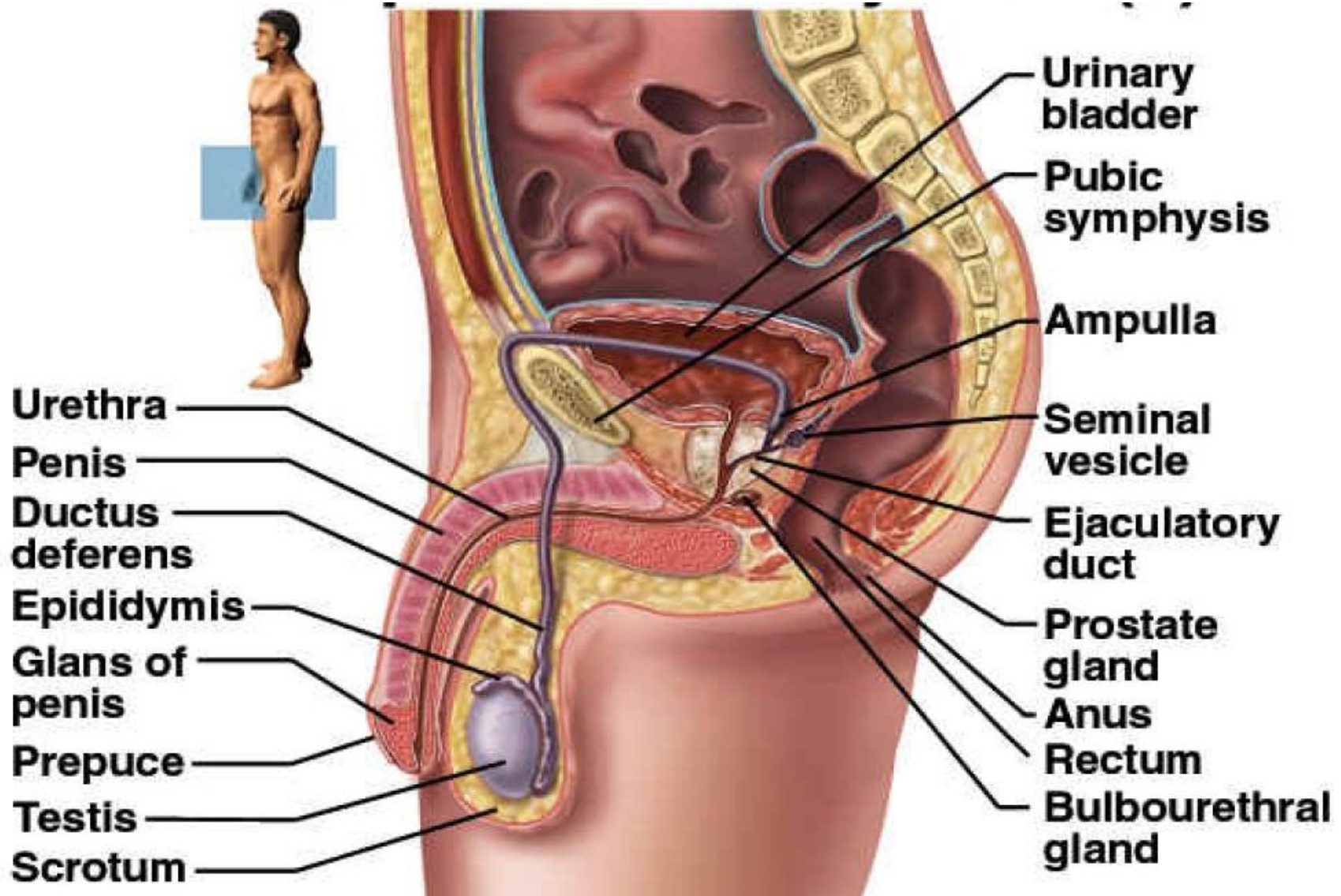
Plan:

- General structure of the male reproductive system
- Functions of the male reproductive system
- Structure of testes
- Structure of the seminiferous convoluted tubules
- Sertoly cells
- Leydig cells
- Spermatogenesis
- Hormonal regulation

General structure of the male reproductive system

- Testes
- Epididymis
- Vas deferens
- Prostate
- Seminal vesicles
- Bulbourethral glands
- Urethra
- Penis

General structure of the male reproductive system



Functions of the male reproductive system:

- Reproductive
- Endocrine
- Exocrine
- Participation on the formation of the psycho-emotional sphere of the men sexual orientation

Testes (structure)

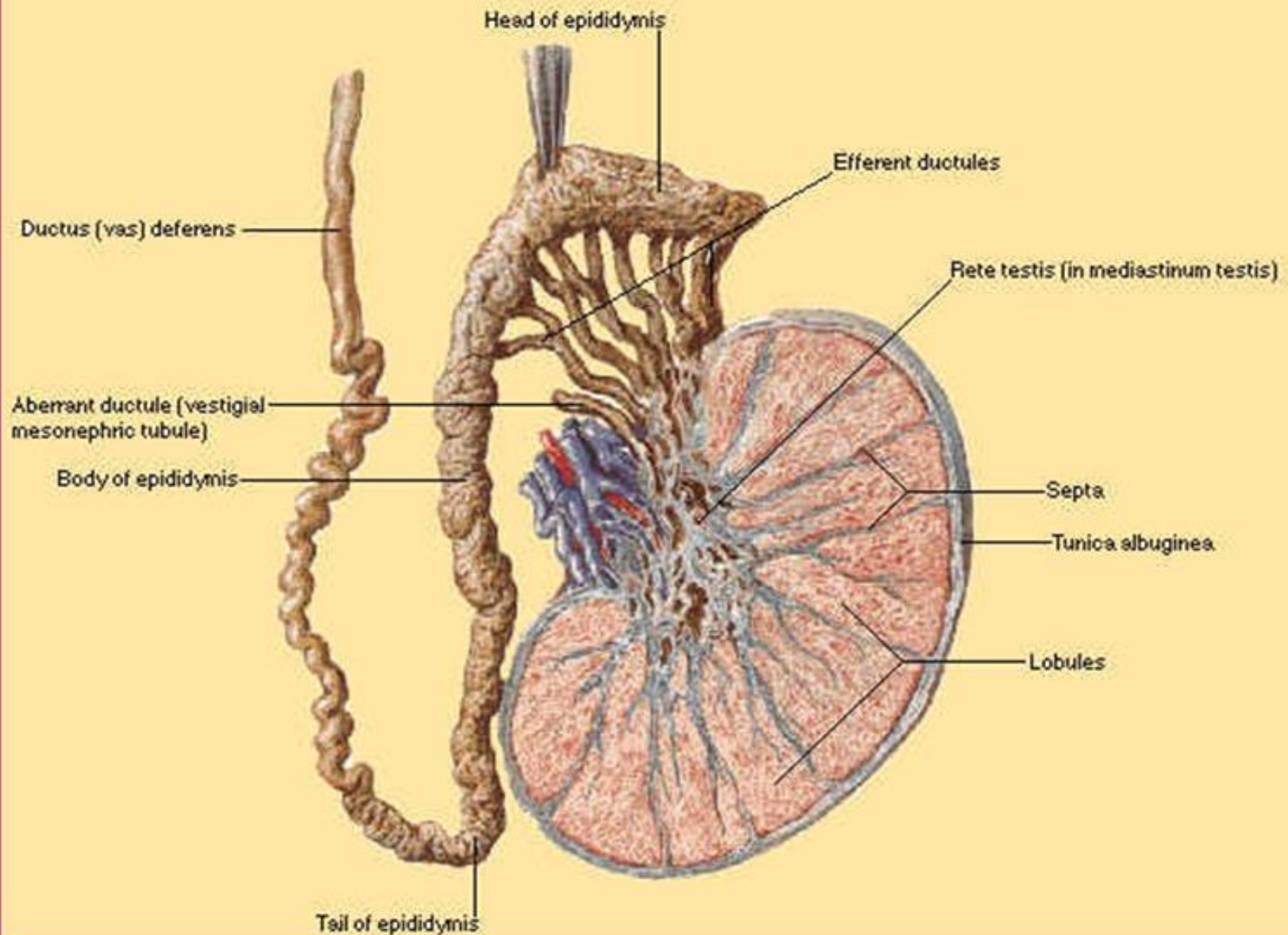
Stroma

- Tunica vaginalis
(loose CT + BV + N + mesothelium)
- Tunica albuginea
(dense CT + BV + N)
- Interlobular septae
(loose CT + BV + N)

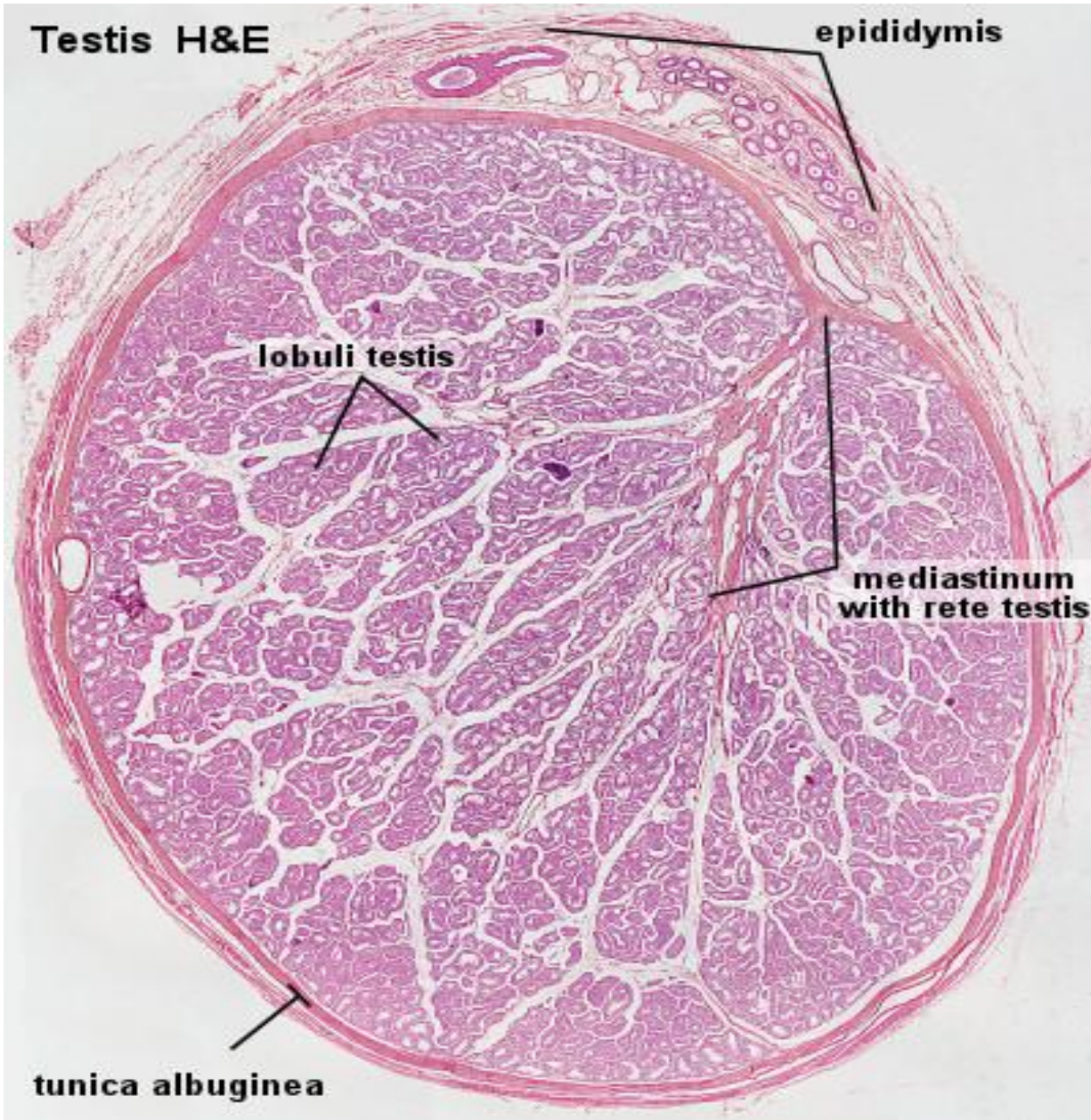
Parenchyma

1. Tubules of the testis:
 - Convoluted tubules
 - Straight tubules and tubules of the rete testis (simple cuboidal epithelium, basement membrane+ loose CT + BV + N)
2. Endocrine parenchyma
(interstitial (Leydig cells)+ fenestrated capillaries)

Testis, Epididymis & Ductus Deferens



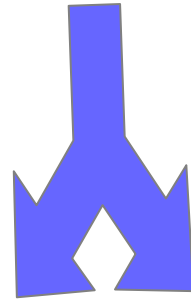
Testis (structure)



3-4 convoluted tubules
build the lobule of the
testis;

there are about 250-300
lobules per each testis.

Seminiferous tubule (structure)



Fibrous — myoid
external covering of
the seminiferous
tubule

Epithelio —
spermatogenic layer
(contents of the
seminiferous tubule)

Fibrous — myoid external covering of the seminiferous tubule

1. Internal fibrous layer (lie close to the BM of the Sertoli cells)
 - loose CT (many collagenous fibers) + BV + N
2. Myoid layer
 - myoid cells
 - BM of the myoid cells
3. External fibrous layer
 - loose CT (many myofibroblasts) + BV + N

Epithelio — spermatogenic layer

Sustentocytes (Sertoli cells) — on the basement membrane

Cells of the spermatogenic differone:

Spermatogonia (type AP, AD, type B)

Spermatocyte I

Spermatocyte II

Spermatides

Spermatozoons

(Sperm)

Basal compartment

Luminal compartment

Sustentocytes (Sertoli cells)

Constitute the true epithelium of the seminiferous epithelium.

Shape - tall, columnar

Ability for replication - none

Organelles: sER and rER, and stacks of annulate lamellae, numerous spherical and elongated mitochondria, a well-developed Golgi apparatus, and varying numbers of microtubules, lysosomes, lipid droplets, vesicles, glycogen granules, and filaments. In the basal cytoplasm in man, characteristic inclusion bodies (of Charcot-Böttcher) are found.

Nucleus is euchromatic, generally ovoid or triangular and may have one or more deep infoldings. Its shape and location vary.

A sheath of 7- to 9-nm filaments surrounds the nucleus and separates it from other cytoplasmic organelles.

Sustentocytes (Sertoli cells)

1. Basal polus:

Rests on the BM and includes nucleus and most of the organelles

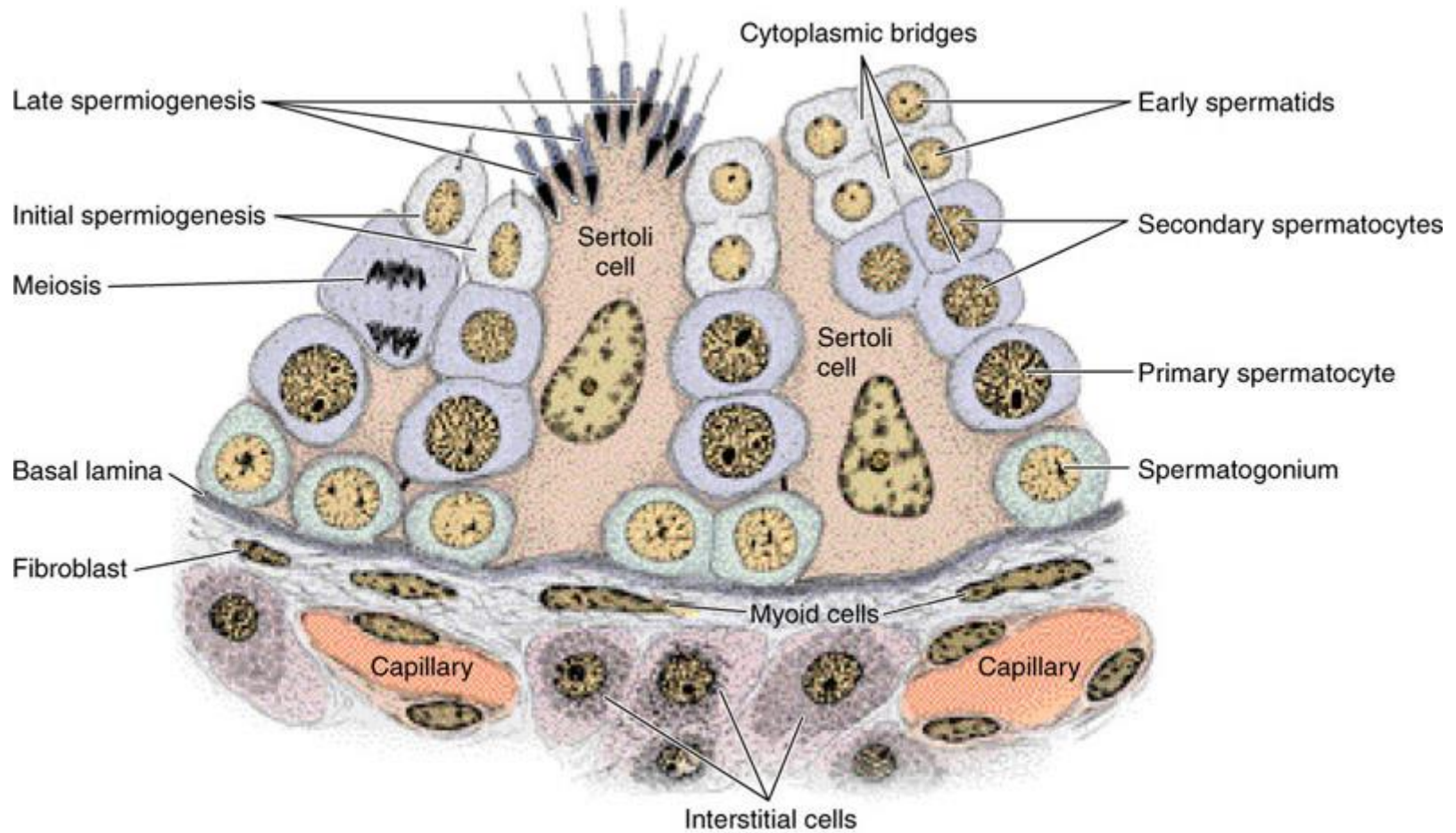
2. Luminal polus:

Progection of the cytoplasm into the lumen of the CST, includes multiple elements of the cytoskeleton

3. Invaginations of the cytolemma — includes cells of the spermatogenic differone

4. Sertoli cell — to Setoli cell junctions

Sustentocytes (Sertoly cells)



Sertoli cell-to-cell junctional complex.

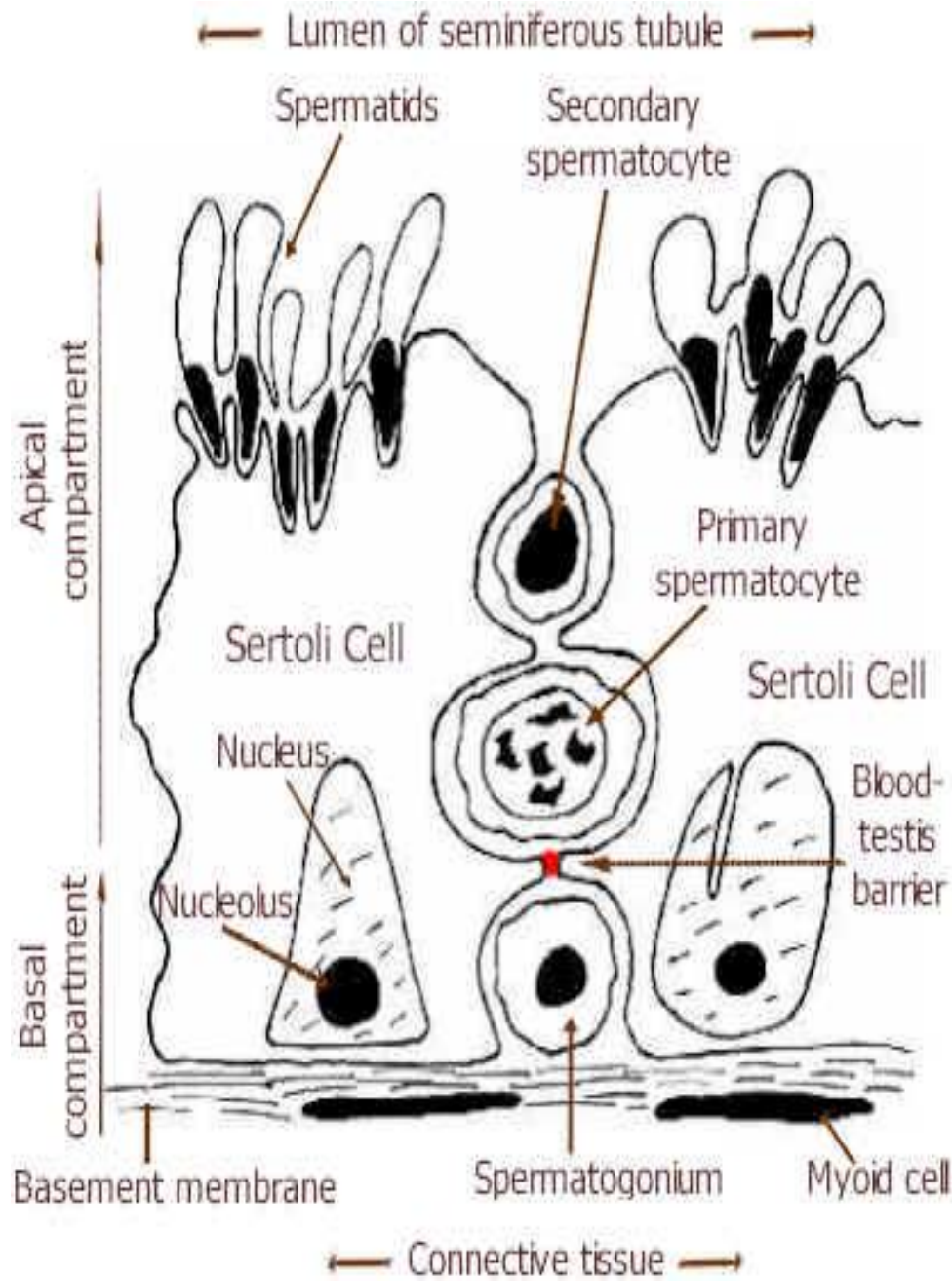
- tight junction (zonula occludens) and gap junctions between Sertoli cells,
- desmosome-like junctions between Sertoli cells and early stage spermatogenic cells,
- hemidesmosomes at the Sertoli cell–basal lamina interface.

The Sertoli cell–to–Sertoli cell junctions divide the seminiferous epithelium into two epithelial compartments:

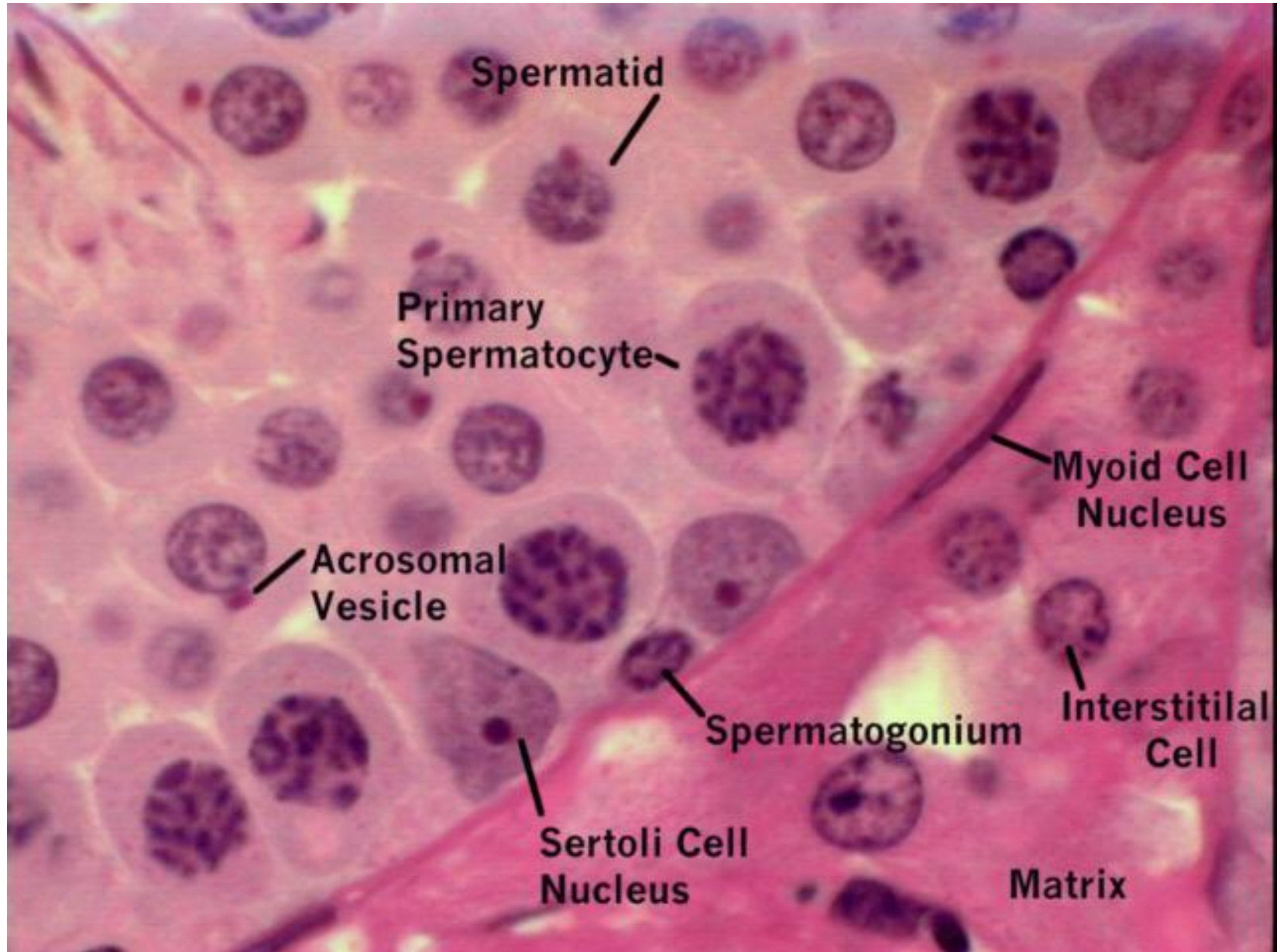
a basal epithelial compartment and

a luminal (apical) compartment.

Sustentocytes (Sertoli cells)



Sustentocytes (Sertoly cells)



Functions of Sertoli cells:

- Physical compartmentalisation of the spermatogenic epithelium
- “Nurse,” sustentocytes or supporting, cells for differentiating spermatogenic cells — physical and metabolic support
- Metabolism of testosterone and its transport to differentiating spermatogenic cells (produce androgen-binding protein (ABP))
- Secretion of inhibin, plasminogen activator, transferrin, ceruloplasmin, glycoproteins that function as growth factors or paracrine factors, such as the Müllerian-inhibiting factor (MIF), stem cell factor (SCF), and glial cell line-derived neurotrophic factor (GDNF).
- Phagocytosis and break down of the residual bodies formed in the last stage of spermiogenesis.
- Phagocytosis of any spermatogenic cells that fail to differentiate completely.

Blood-testis barrier:

Formed by tight junctions between Sertoli cells forming a physical boundary between the basal and luminal compartments of the seminiferous tubules.

As spermatogenesis progresses, genetically different, haploid spermatocytes are moved into the luminal compartment of the seminiferous tubules and become isolated and protected from the immune system.

Structure of the blood-testis barrier:

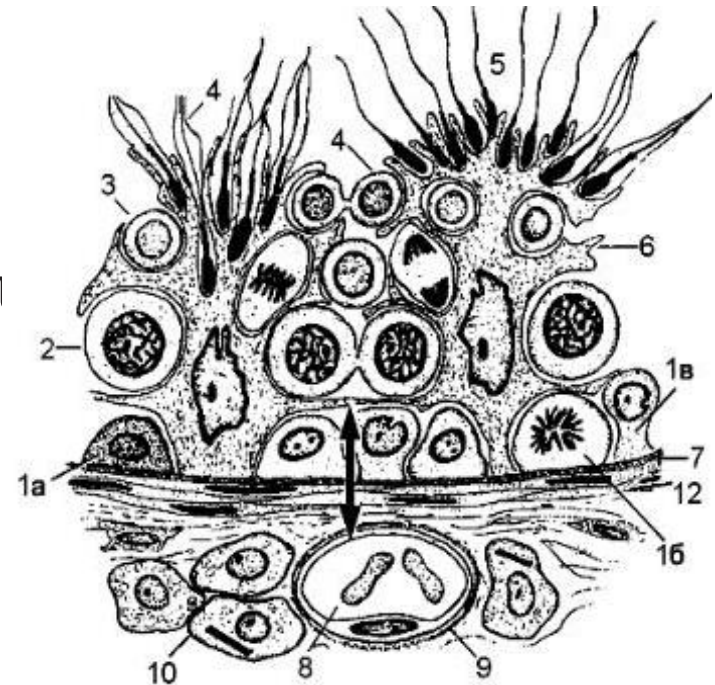
From the lumen of the blood capillary inwards:



- I. Cytoplasm of the endothelial cell
- II. Basement membrane of the endothelial cell
- III. External fibrous layer
- IV. Myoid layer
- V. Internal fibrous layer
- VI. Basement membrane of the convoluted testis

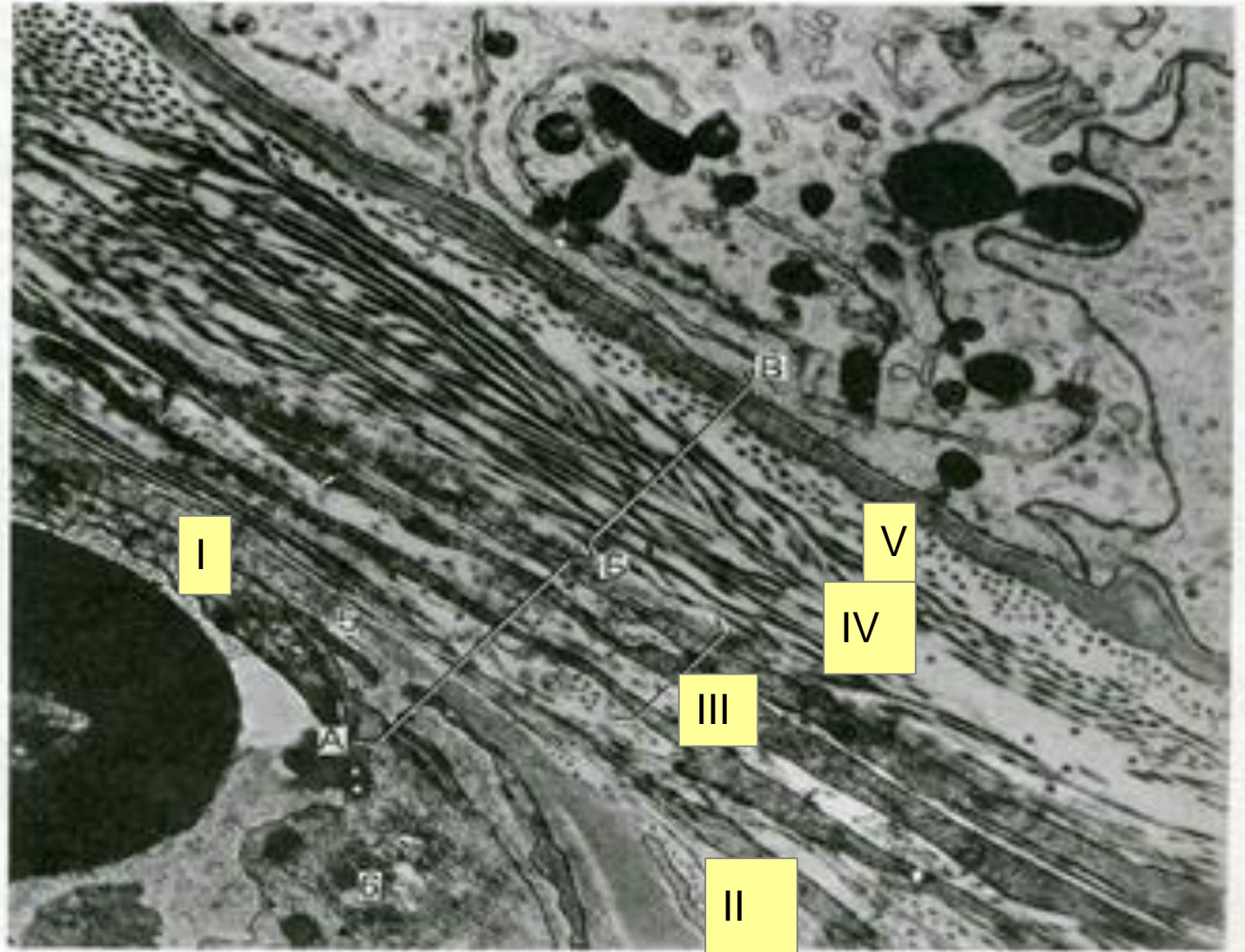


Spermatogenic epithelium



Structure of the blood-testis barrier:

Electron
microphotograph of
the hematotesticular
barrier
x24000, by A.F.
Afanasiev



Permeability of the blood-testis barrier

Permeable for:

- H₂O, electrolytes
- O₂, CO₂
- Steroid hormones connected with ACP
- Modified by Sertoli cells monomers of carbohydrates, proteins and lipids
- Liposoluble vitamins
- Alcohols and products of its fission

Impermeable for:

- Lymphocytes and other blood cells
- Substances with high molecular weight (i.e. antigens, antibodies, protein hormones)
- Bacteria
- Most of the medications

Why do we need blood tissue barrier?

The blood–testis barrier isolates the genetically different and therefore antigenic haploid germ cells (secondary spermatocytes, spermatids, and sperm) from the immune system of the adult male.

Antigens produced by, or specific to, the sperm are prevented from reaching the systemic circulation.

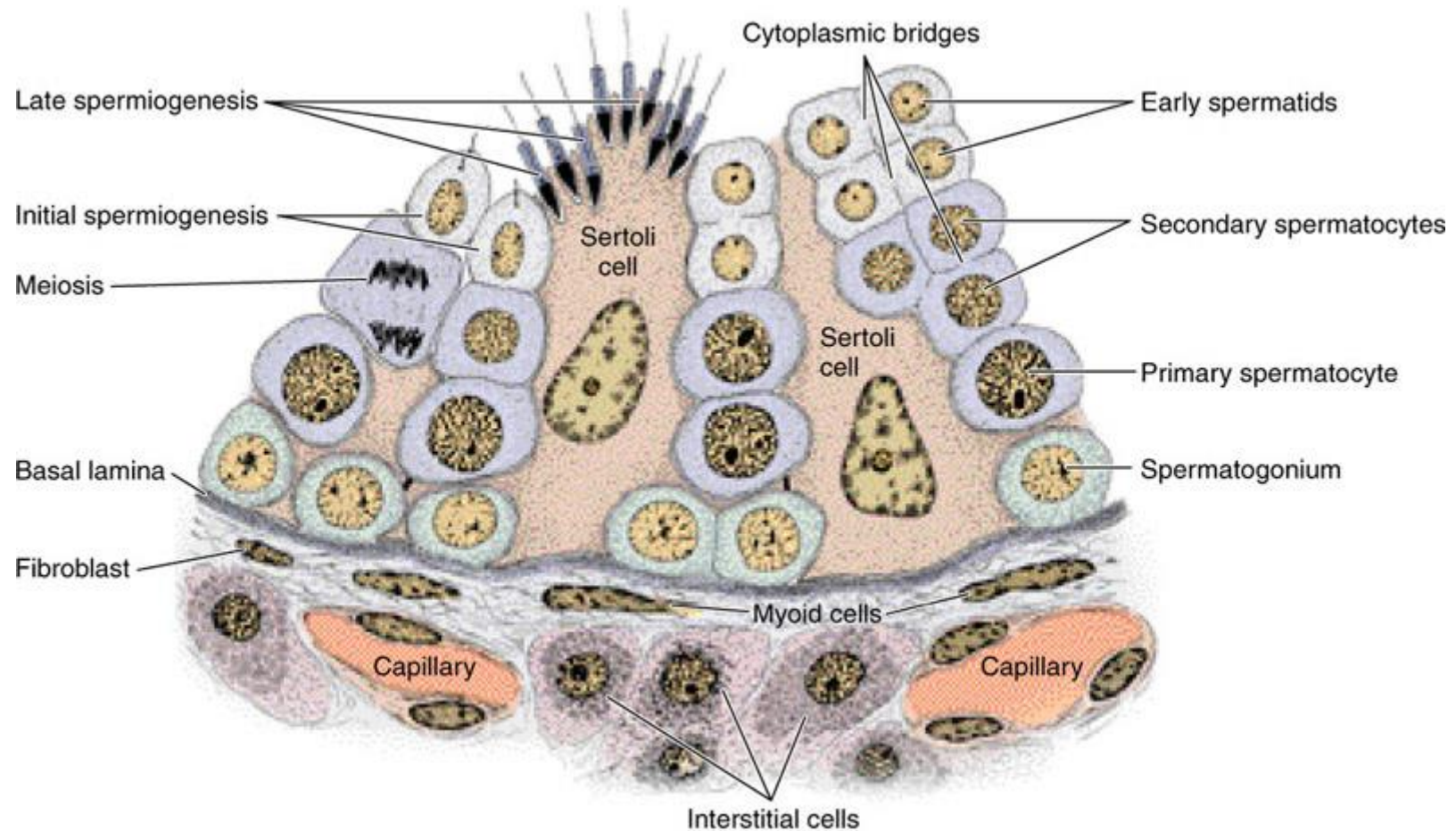
Interstitial (Leydig) cells

Large, round or polyhedral cells lying in the connective tissue between the seminiferous tubules.

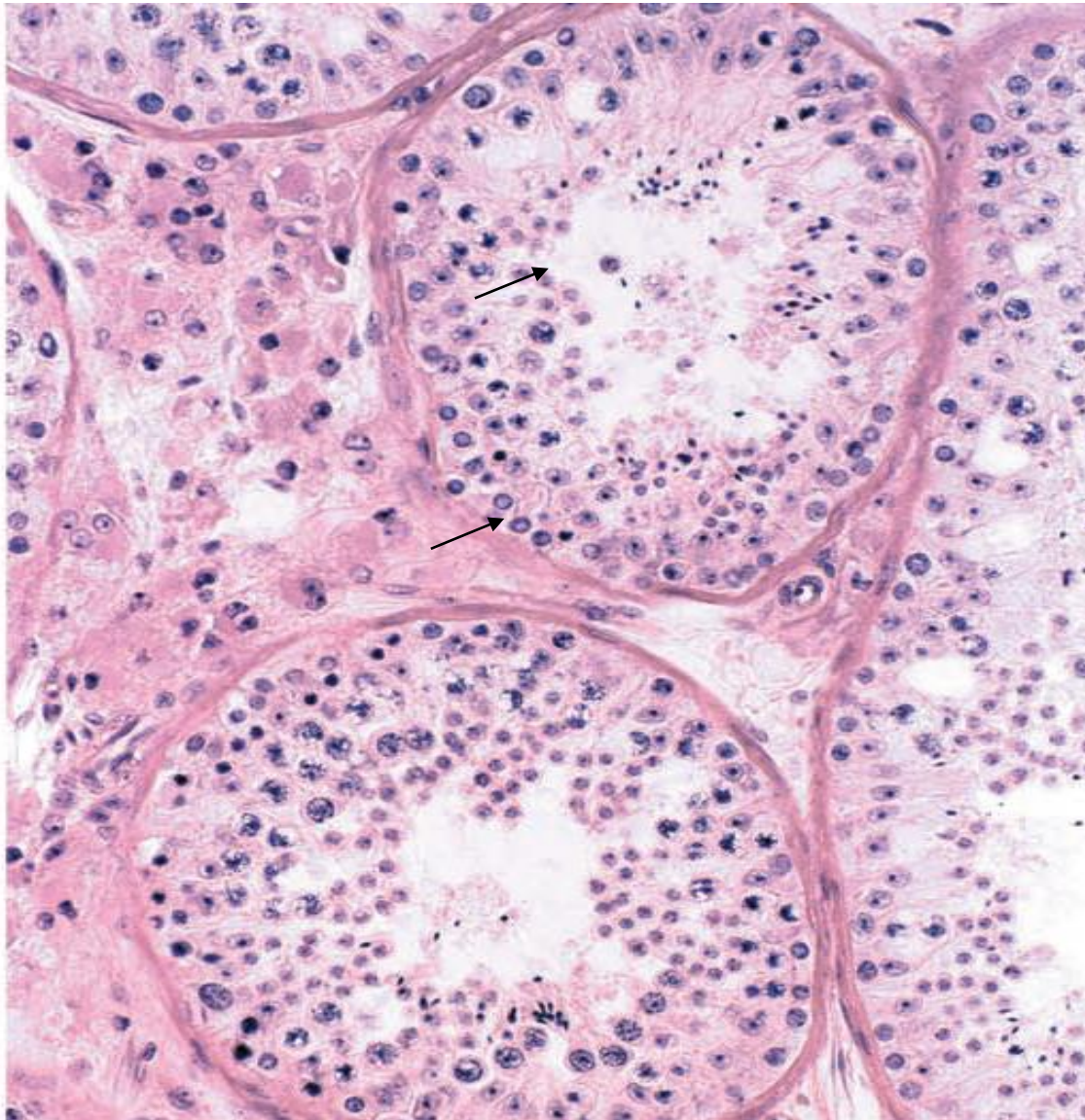
Main features:

- Eccentric nuclei
- Lightly eosinophilic foamy cytoplasm
- Elaborate smooth endoplasmic reticulum (sER)
- Mitochondria with tubulovesicular cristae
- Yellow enzyme granules, Rod-shaped crystalloids (Reinke's crystalloids), yellowbrown pigment (lipofuscin).

Leydig cells and interstitial tissue



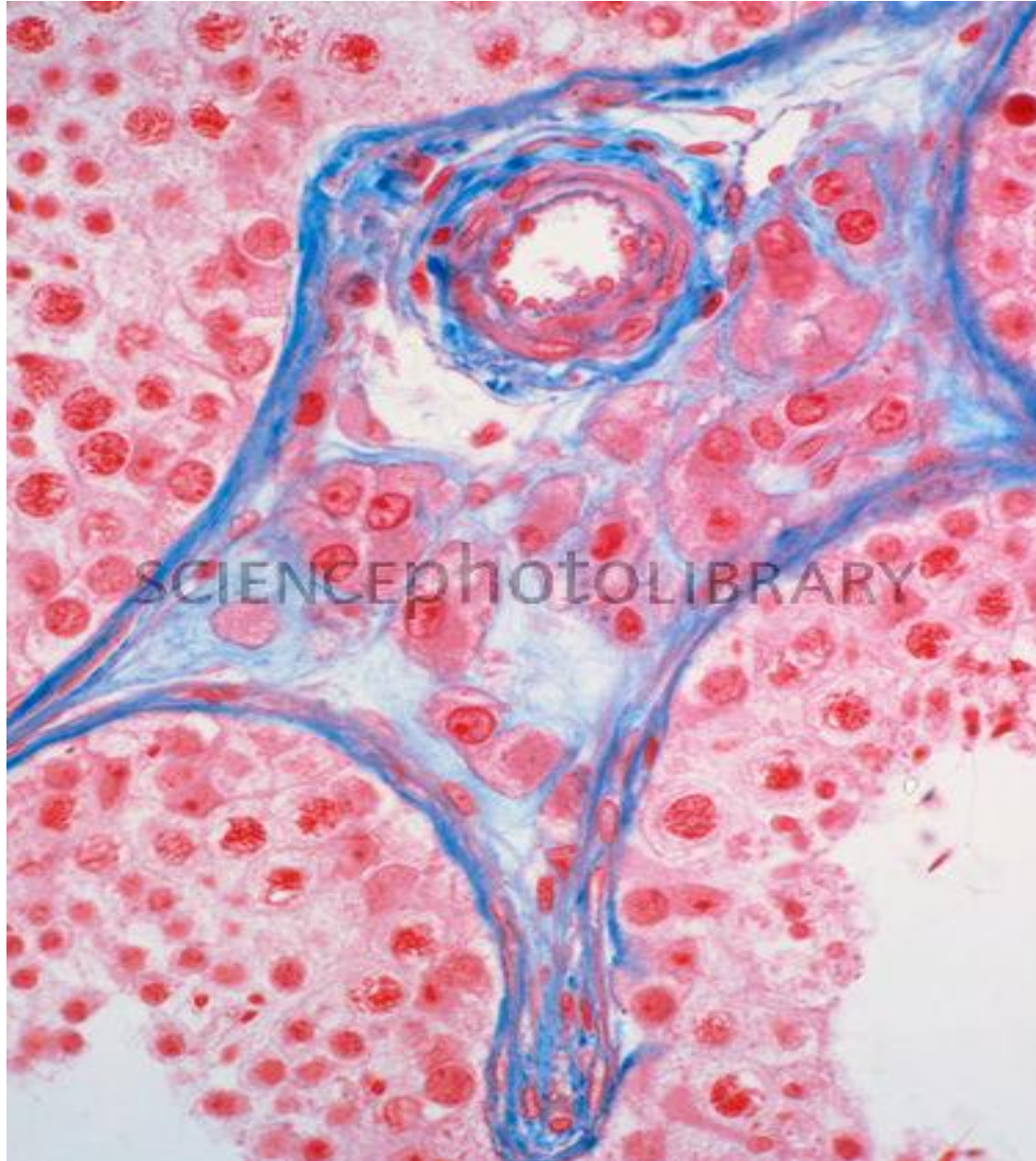
Leydig cells and interstitial tissue



Interstitial tissue lies in the spaces between coiling convoluted tubules.

Together with interstitial cells, the interstitial tissue contains collagen fibres, fibroblasts, macrophages, mast cells, blood vessels and lymphatics.

Leydig cells and interstitial tissue



Function of Leydig cells

Secretion of **TESTOSTERONE**
during all fetal life!!!

Effects of testosterone:

- **In the embryo**, secretion of testosterone and other androgens is essential for the normal development of the gonads in the male fetus.
- **At puberty**, initiates of sperm production, accessory sex gland secretion, and development of secondary sex characteristics.
- **In the adult**, **maintane** the spermatogenesis and secondary sex characteristics, genital excurrent ducts, and accessory sex glands.

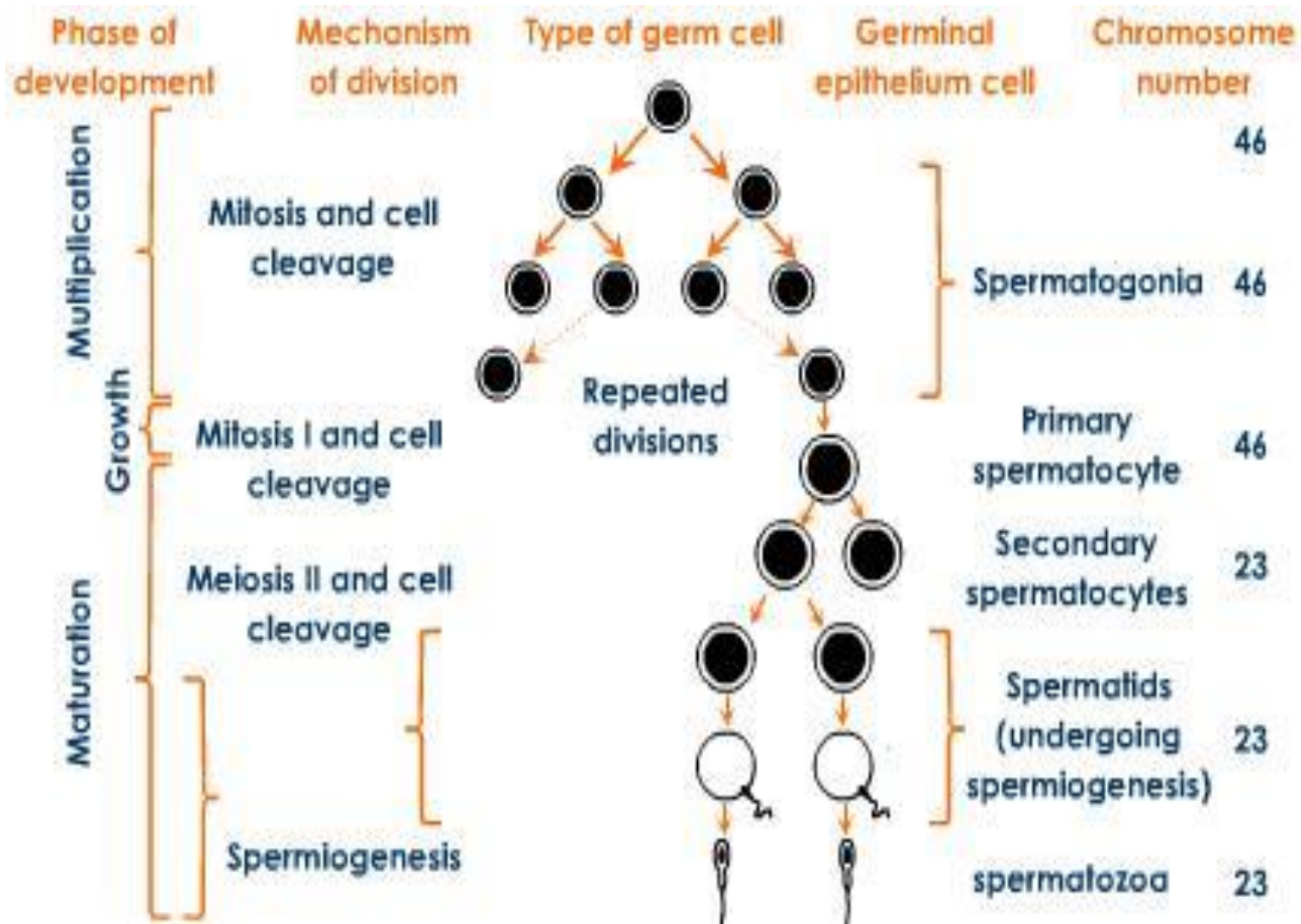
Process of spermatogenesis

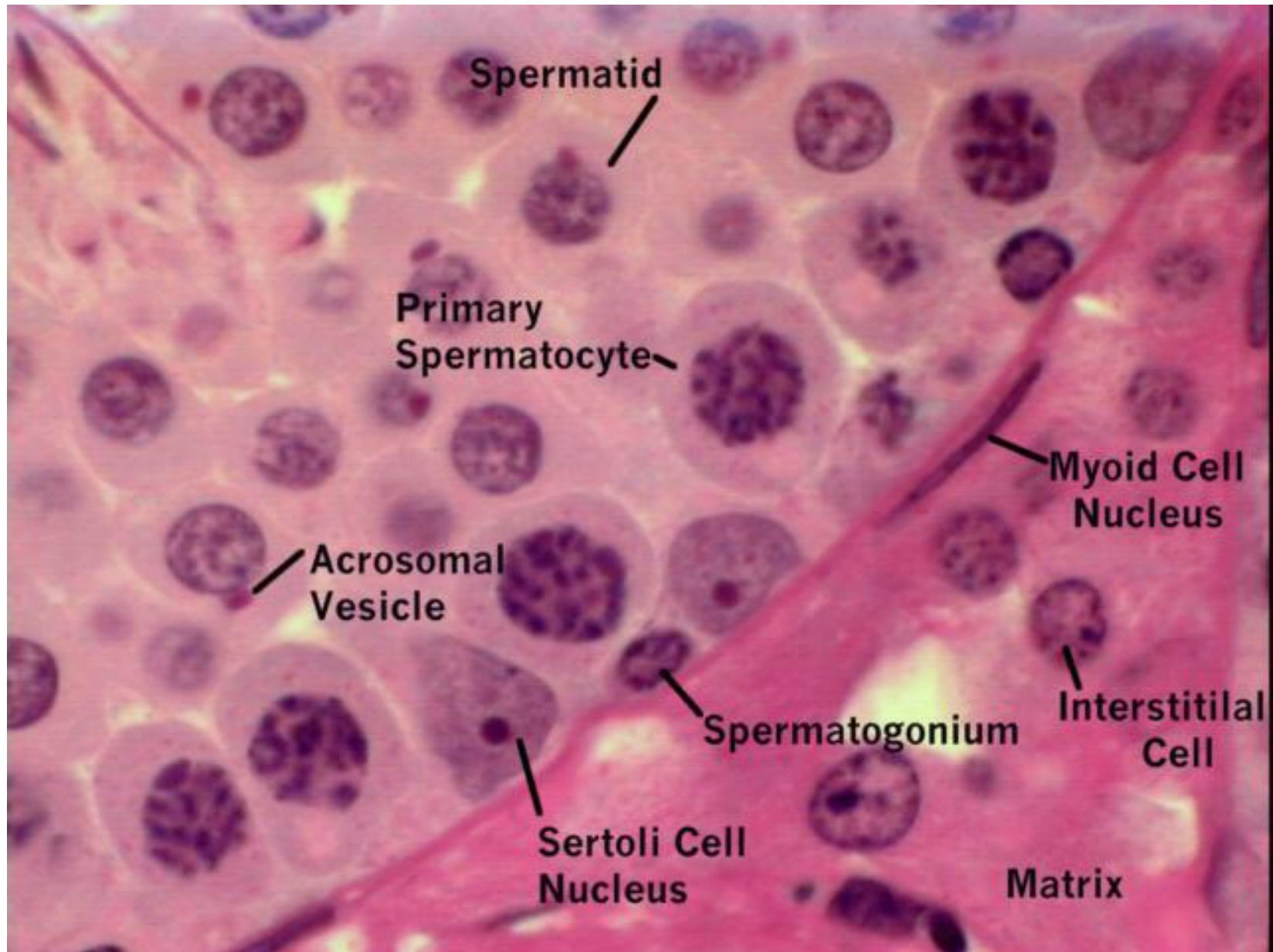
Spermatogenesis is the process in which spermatozoa are produced from male primordial germ cells by way of mitosis and meiosis.

1. Spermatogonia — spermatogonial stage (mitosis)
2. Spermatocytes I — spermatocyte stage (meiosis I)
3. Spermatocytes II — spermatocyte stage (meiosis II)
4. Spermatides — spermatid stage (spermiogenesis)
5. Spermatozoa — spermiation

Duration of spermatogenesis in humans is approximately 74 days!

Process of spermatogenesis





Cycle of the seminiferous epithelium in human testis

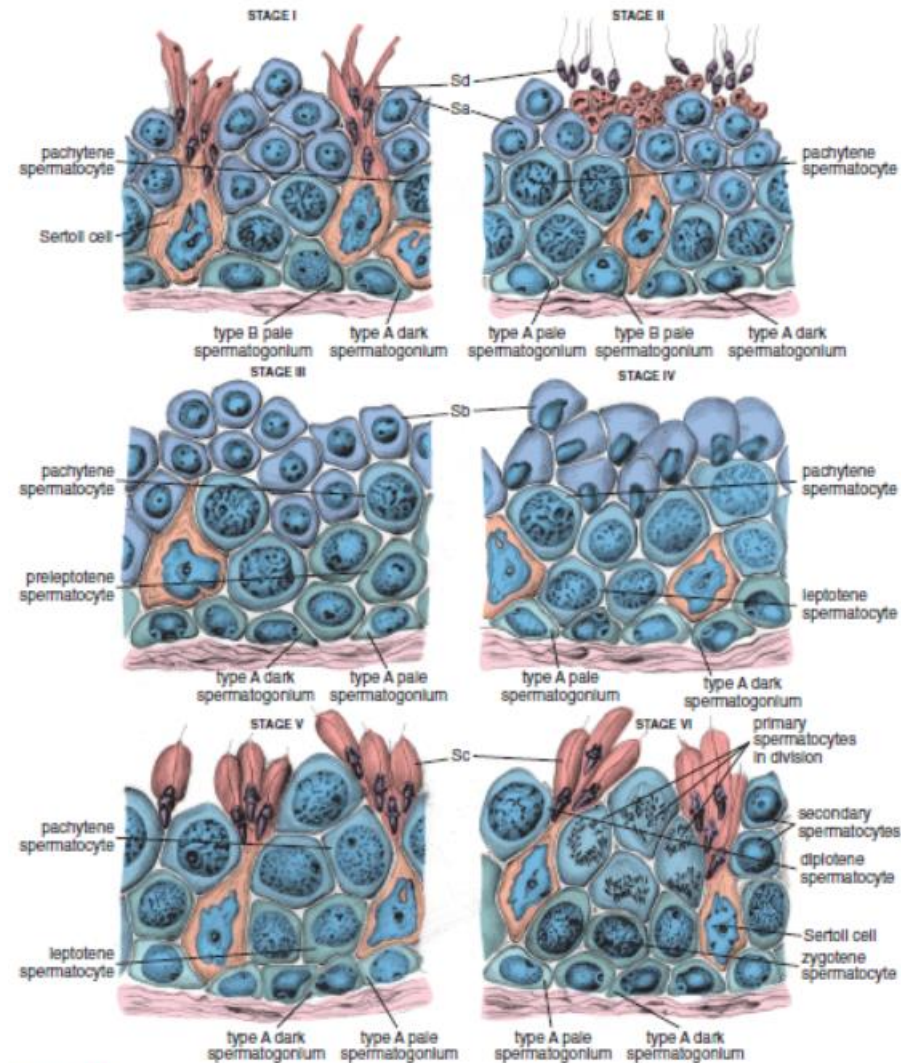
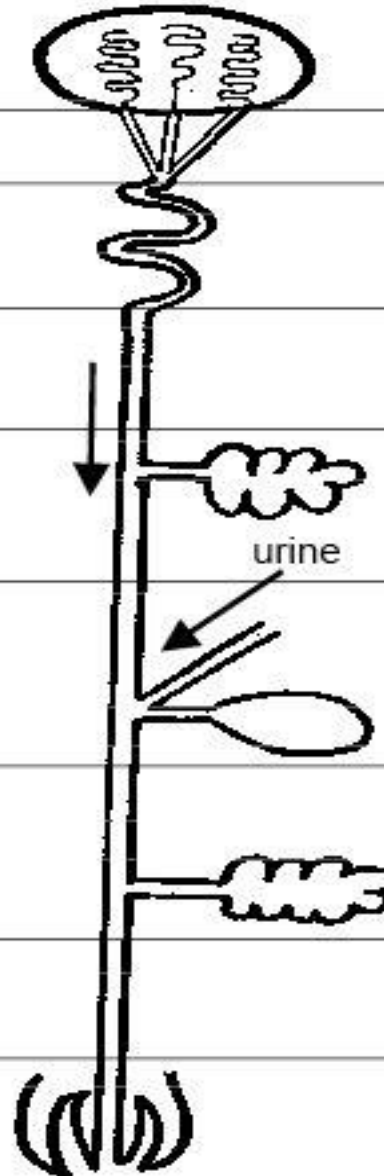


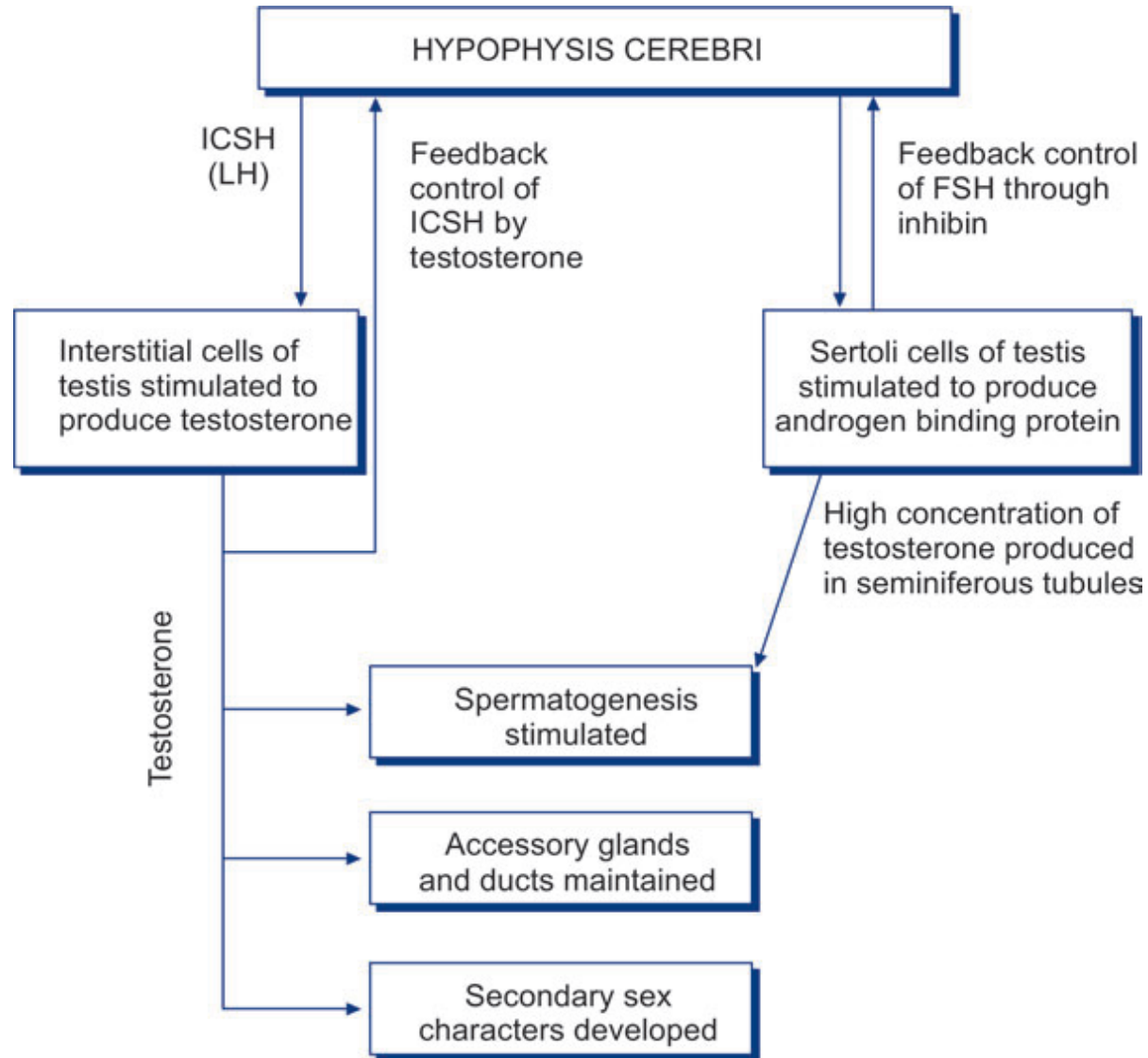
FIGURE 22-13 Schematic drawing of the stages of the human seminiferous epithelium. This diagram shows each of the six

Parts of the male reproductive system and it's functions

Testis with seminiferous tubules			Sperm production
Collecting ducts			Transport and storge
Epididymis			Transport, maturation and ejaculation
Vas deferens (sperm duct)			Transport and ejaculation
Seminal vesicles			Secrete liquid to transport sperm
Prostate gland			Secretes thin alkline solution to neutrolise urine and female system
Cowper's gland			Secretoins may lubricate, flush out urine or form a gelatinous plug
Urethra			Passage for urine and sperm
Penis			Copulation

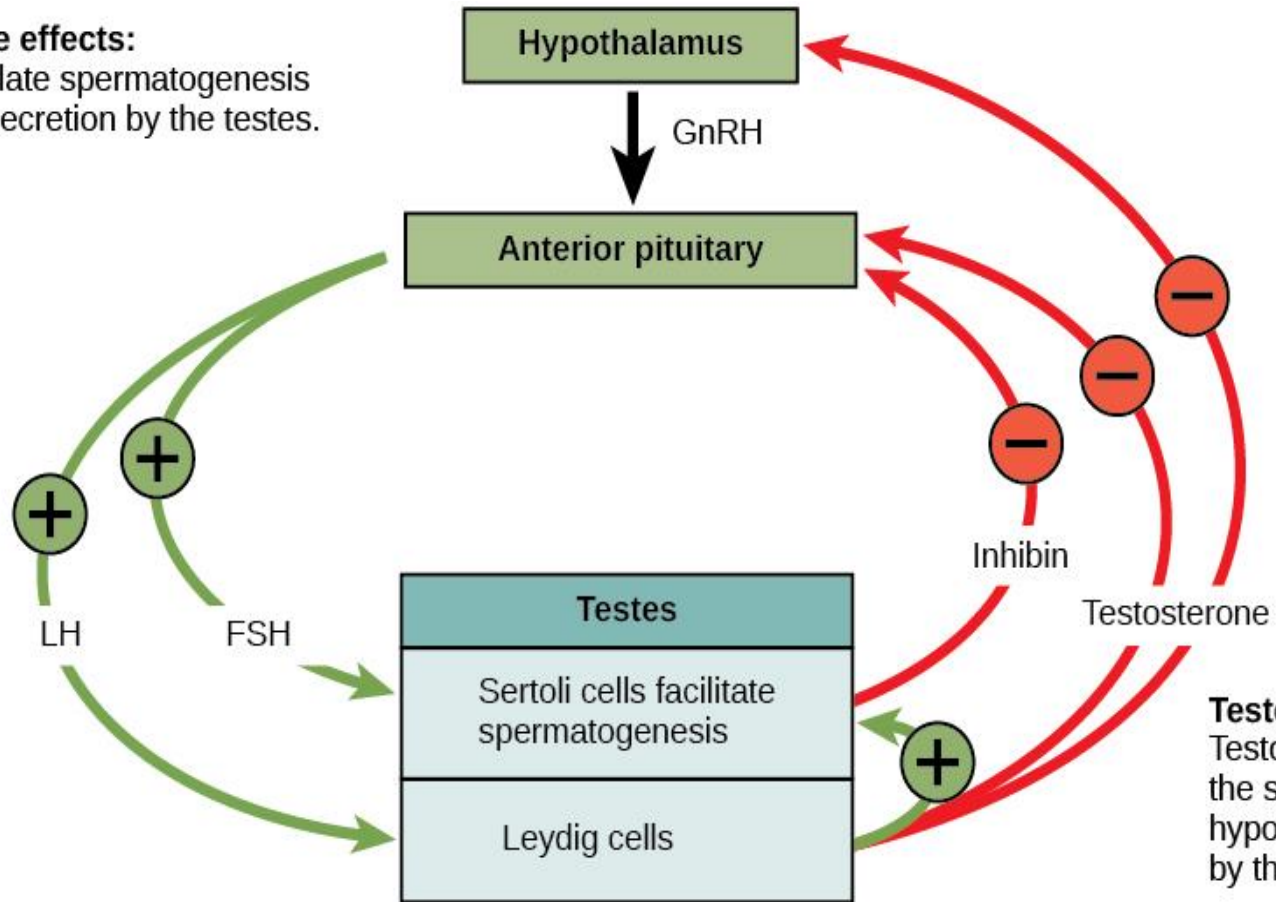


Hormonal regulation of the male reproductive system



Pituitary hormone effects:

LH and FSH stimulate spermatogenesis and testosterone secretion by the testes.



Testes hormone effects:

Testosterone and inhibin inhibit the secretion of GnRH by the hypothalamus and LH and FSH by the pituitary.

Thank you for attention!

