

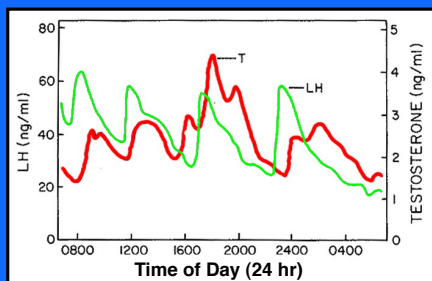
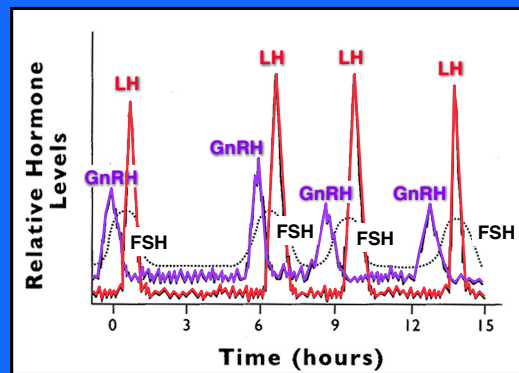
Animal Science 434

Lecture 13: Spermatogenesis

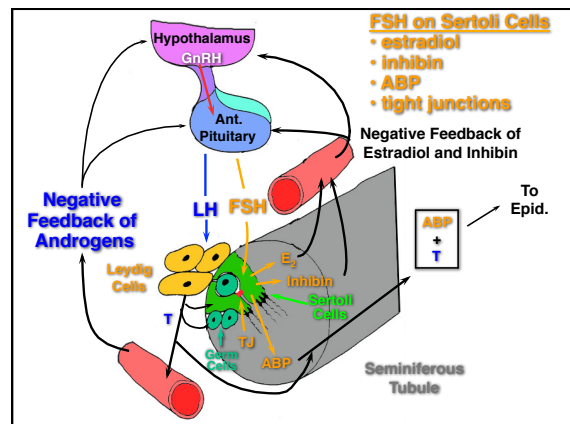
Production of Fertile Sperm

- hormonal regulation of the testis
- mitotic division of spermatogonia
- meiotic divisions of spermatocytes
- morphologic transformation of spermatids into spermatozoa

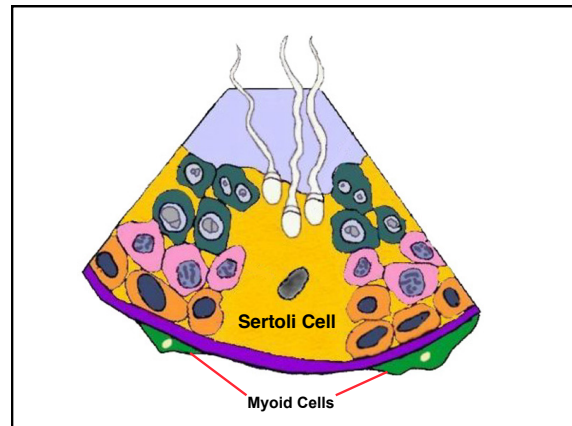
Hormonal Regulation of the Testis



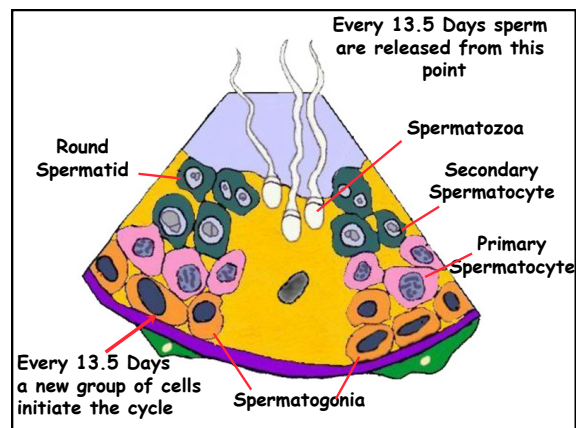
Pulses are important !



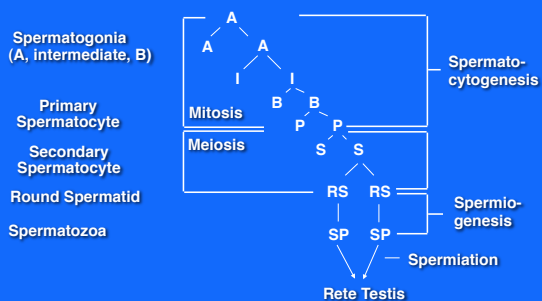
Spermatogenesis



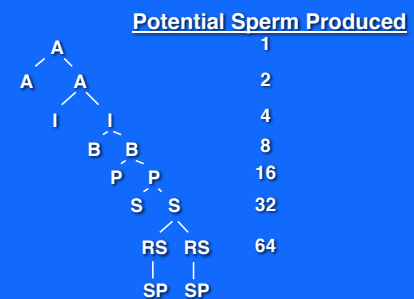
Sertoli Cell



Typical Sequence of Spermatogenesis



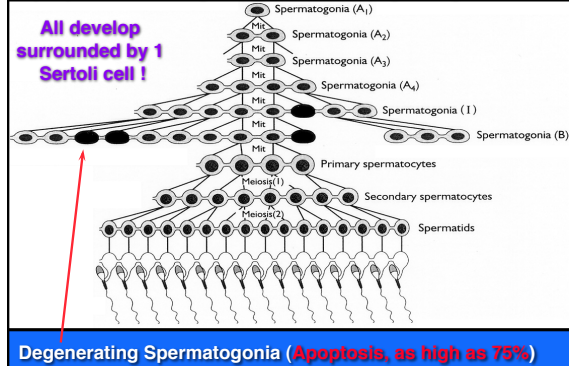
Many Sperm are Produced



Mitotic Divisions

- species dependent
 - between 2 and 6 divisions (4 to 64 potential daughter cells produced)
- classifications vary among species and investigators
 - $A_1, A_2, A_3, A_4, B_1, B_2, P$
 - A_4, A_5, B, P
 - $A_5, A_6, A_1, A_2, I, B, P$
- cytoplasmic bridges form between daughter cells

Cytoplasmic Bridges Present Among Daughter Cells



Germ Cells / Sertoli Cell

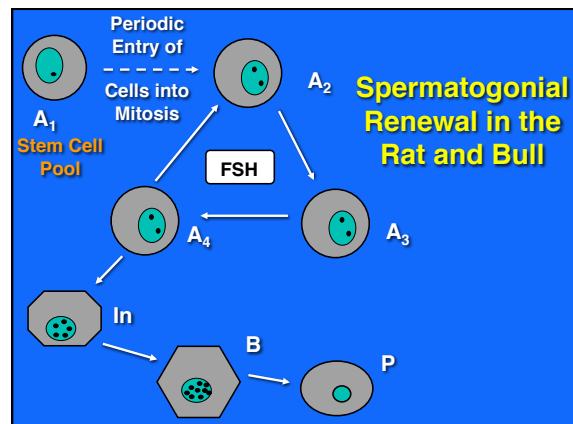
Species	Primary Spermatocytes	Round Spermatids	Max. Potential Spermatids
Equine	3.0 ± 0.2	10.9 ± 0.9	64
Bovine	1.2 ± 0.1	5.2 ± 0.6	64
Human	1.3 ± 0.1	4.2 ± 0.2	16

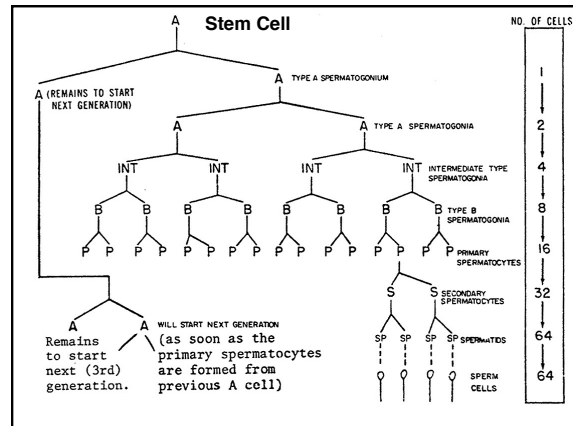
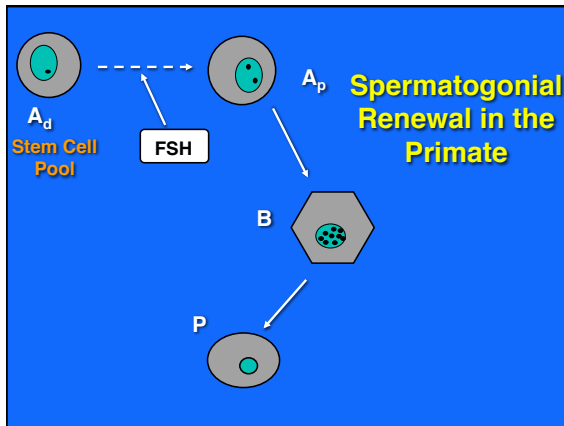
Apoptosis of Germ Cells

- Season
- Disease
- Trauma or heat
- Hormone levels
- Normal part of spermatogenesis

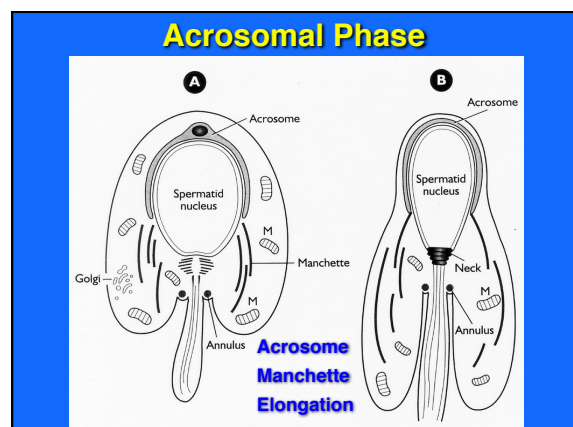
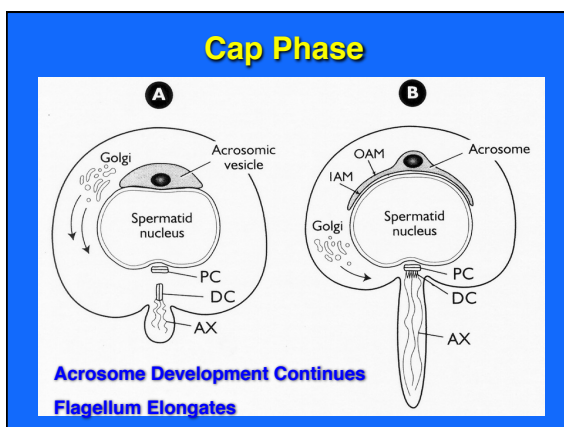
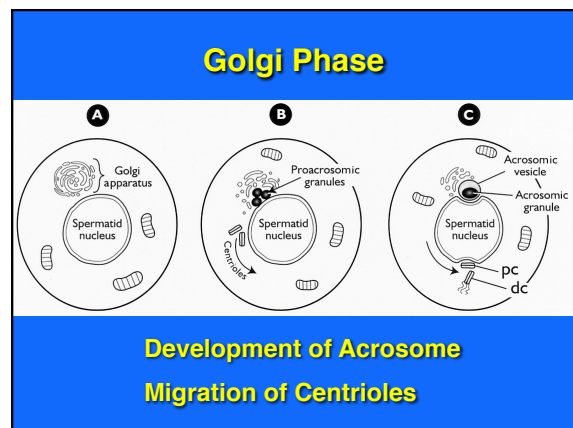
Stem Cell Renewal

- To keep spermatogenesis going indefinitely
- Replenish testis incase of injury, trauma, or high heat

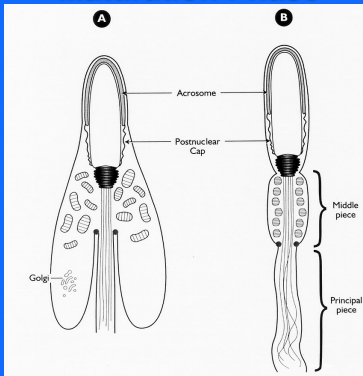




Spermiogenesis



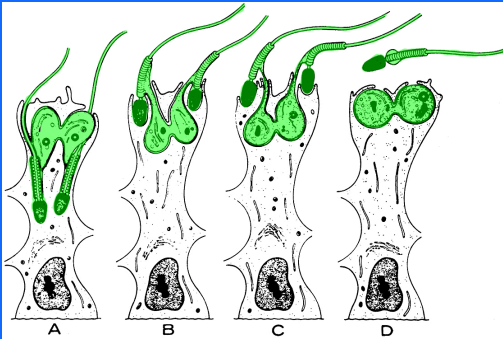
Maturation Phase



Manchette
disappears
Mitochondria
migrate
Dense fibers
form

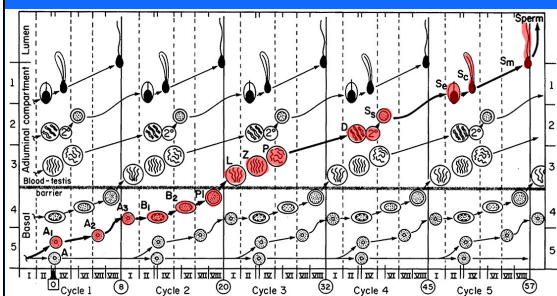
Spermiation

Spermiation



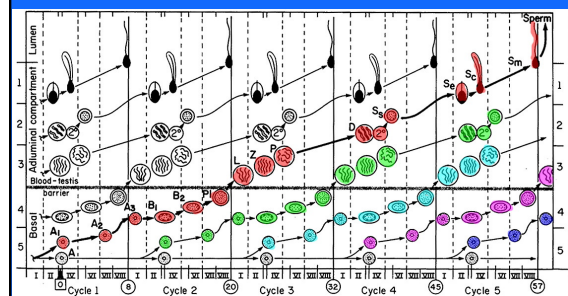
Temporal Relationships of Spermatogenesis

Spermatogenesis

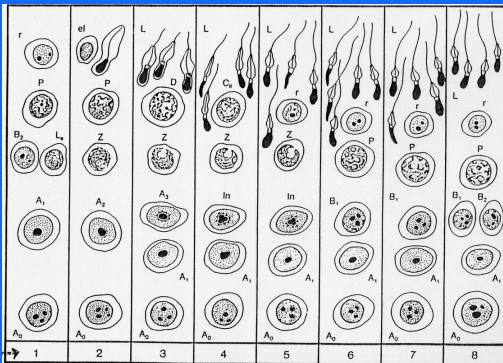


57 days
Stallion

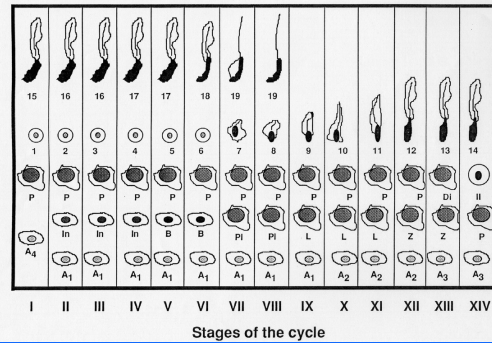
Multiple Generations of Germ Cells



Bull Spermatogenesis



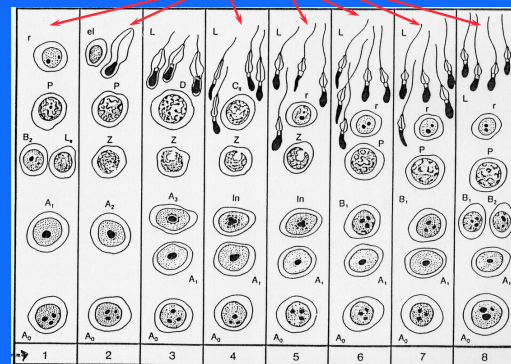
SPERMATOGENESIS IN THE RAT



Stages

- Specific cellular associations within a small segment of a seminiferous tubule
- stages are not the same length in time

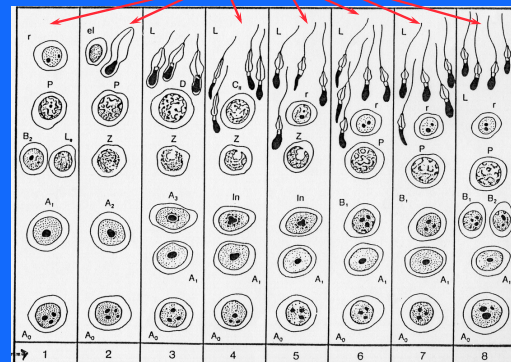
Bull Spermatogenesis - Stages



Stages

- Specific cellular associations within a small segment of a seminiferous tubule
- stages are not the same length in time

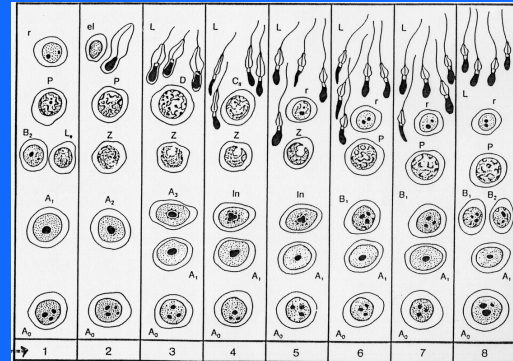
Bull Spermatogenesis - Stages



Cycle

- progression through sequence of all stages

Bull Spermatogenesis - Cycles



Cycle

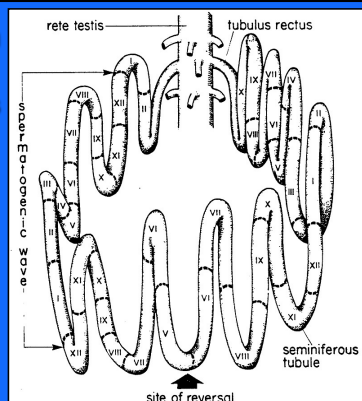
- progression through sequence of all stages
- 4.5 cycles to form spermatozoa
– some species variation

Duration of Spermatogenesis

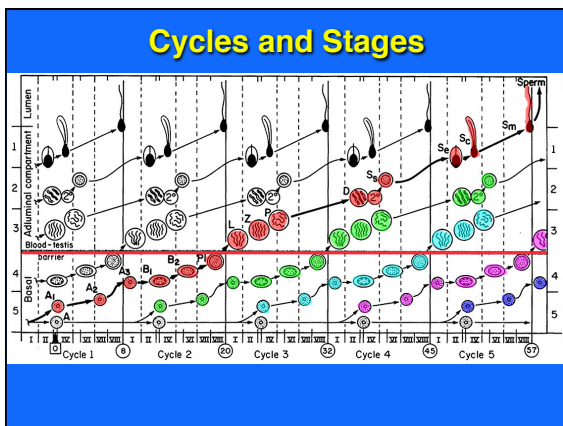
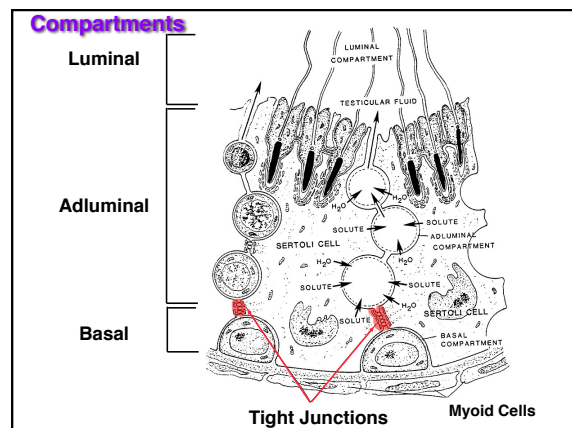
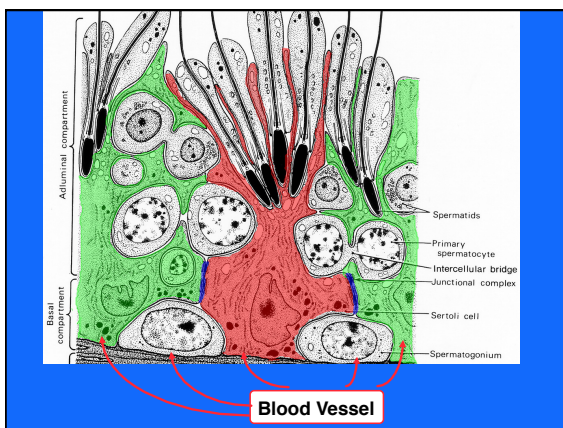
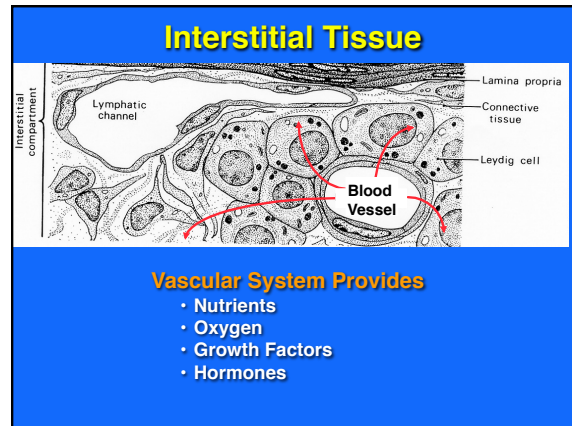
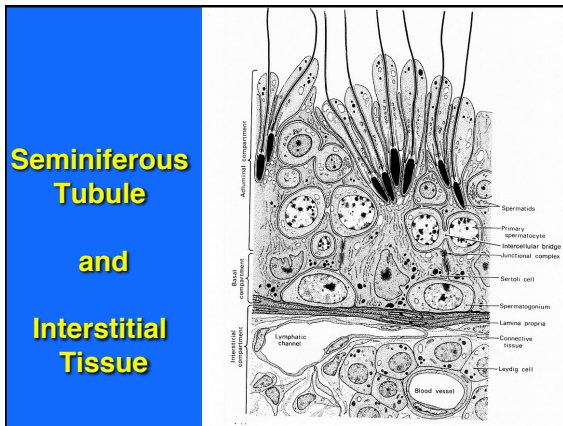
	Bull	Ram	Boar	Stallion	Man
cycle (days)	13.5	10.4	8.3	12.2	16
Spermatogenesis	61	47	39	57	75

Coordination of Stages Form Waves

- some portion of seminiferous tubule is always releasing sperm



Compartmentalization of Spermatogenesis and the Blood Testis Barrier



- ## Compartmentalization
- Basal
 - mitosis
 - spermatogonia (A, I, B)
 - primary spermatocytes
 - Adluminal
 - meiosis
 - primary spermatocytes
 - secondary spermatocytes
 - spermatids
 - spermiogenesis
 - Lumen
 - spermiation

Blood Testis Barrier

- Sertoli cells and associated tight junctions
- first appears at puberty
- induced by FSH
- after puberty can be maintained by FSH and/or testosterone
- essential for meiosis !!!!!

Tight Junction Role in Meiosis

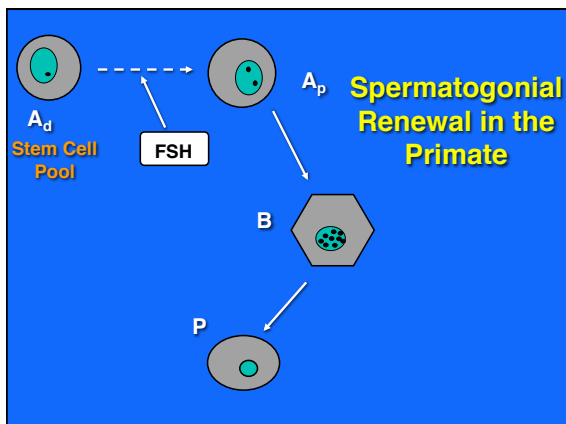
- Sertoli cells can manipulate environment around 1° spermatocyte
 - Enters meiosis
 - Completes meiosis
- Destruction of TJ causes impairment of meiosis
 - Heat, heavy metals, pesticides, lack of FSH or Testosterone

Capacity for Sperm Production

Species	Testis Weight (gm)	Sperm/gm (X 10 ⁶)	DSP (X 10 ⁹)
Dairy Bull	650	18	10
Beef Bull	500	18	8
Ram	550	26	14
Boar	750	30	25
Stallion	165	18	3
Man	40	4	.045 - .2

Duration of Spermatogenesis

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Capacity for Sperm Production

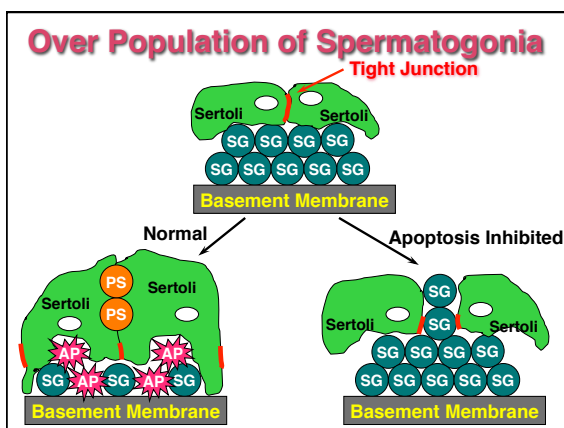
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Variation in Sperm Production

- Testis Size
- Efficiency of spermatogenesis
 - mitotic division
 - degeneration of germ cells
- Length of spermatogenesis

Apoptosis of Germ Cells

- Season
- Disease
- Trauma or heat
- Hormone levels
- Normal part of spermatogenesis



Animation of Spermatogenesis

**View the Animation of Spermatogenesis
Using the Link at the Bottom of the Screen**

The objective is to see how the process of spermatogenesis takes place over time and involves both stages and cycles.

- In the animation, the timing of events is correct but we have taken liberties in moving groups of cells from side to side to make room for development of other cells.
- The animation begins with primordial germ cell migration into the primary sex chord and replication of gonocytes to form stem cell A-Type spermatogonia.