

"Spermatogenesis"

1. Definition

- Spermatogenesis = process by which spermatogonia
→ spermatozoa
 - Occurs in seminiferous tubules of testis
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2. Key Differences from Oogenesis

Feature	Spermatogenesis	Oogenesis
Onset	Puberty	Before birth
Continuity	Continuous	Cyclical

Gametes produced	Millions daily	~1 per cycle
Meiotic arrest	Minimal	Prolonged arrests
Stem cells	Present (lifelong)	Absent after birth

3. Hormonal Regulation

A. LH Pathway

LH (Anterior pituitary) → Acts on Leydig cells →

Testosterone production → Testosterone acts on Sertoli cells → Promotes spermatogenesis

B. FSH Pathway

FSH (Anterior pituitary) → Acts on Sertoli cells →

Increases:

- Intracellular androgen receptor proteins (IARP)
 - Support for sperm maturation
 - Seminal fluid production
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High-Yield Concept

- Testosterone + FSH together are essential for spermatogenesis
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4. Spermatogonia (Starting Cells)

- Present in sex cords at birth
- Large, pale-staining cells
- Remain dormant until puberty

5. Steps of Spermatogenesis (Cellular Progression)

Complete Flowchart

- Primordial Germ Cells (PGCs) → Mitosis → Stem cells
- Type A dark spermatogonia (stem cell reserve) → Mitosis → Type A pale spermatogonia (active) → Mitosis → Type B spermatogonia → Mitosis → Primary spermatocyte (diploid) → Meiosis I → (Prophase I lasts ~22 days) → Secondary spermatocytes (haploid) → Meiosis II → Spermatids → Differentiation → Spermatozoa

6. Summary of Cell Types

Stage	Ploidy	Key Feature
Spermatogonia	2N	Mitotic division
Primary spermatocyte	2N	Undergoes Meiosis I
Secondary spermatocyte	1N	Undergoes Meiosis II
Spermatid	1N	Immature sperm
Spermatozoa	1N	Mature sperm

7. Key Meiosis Feature

- Longest phase: Prophase I (~22 days)
- No long-term arrest (unlike oogenesis)

8. Spermiogenesis (Final Maturation Phase)

Definition

- Transformation of spermatids → spermatozoa
 - No cell division involved
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Steps of Spermiogenesis

Spermatid → Acrosome formation → Nuclear condensation → Development of neck, middle piece, tail → Residual cytoplasm removed → Mature spermatozoa

9. Structural Changes in Spermiogenesis

A. Acrosome Formation

- Derived from Golgi apparatus

- Contains lysosomal enzymes
 - Important for fertilization (zona pellucida penetration)
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B. Nuclear Condensation

- Nucleus becomes:
 - Dense
 - Streamlined

Important for motility and DNA protection

C. Tail Formation

Part	Function
Head	Genetic material + acrosome

Neck	Connects head to midpiece
Midpiece	Mitochondria → energy
Tail	Motility

D. Residual Body Formation

- Excess cytoplasm is shed
 - Phagocytosed by Sertoli cells
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10. Integrated Overview

Spermatogonia → Mitosis → Type A (dark → pale) →
Type B → Primary spermatocyte → Meiosis I →
Secondary spermatocyte → Meiosis II → Spermatids →

Spermiogenesis: Acrosome formation + Nuclear condensation + Tail formation + Residual body removal → Spermatozoa

II. Clinical Concept

a. Sertoli Cell Dysfunction

- Leads to impaired spermatogenesis
 - Affects:
 - Nutritional support
 - Hormonal response
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b. Leydig Cell Dysfunction

- ↓ Testosterone → ↓ sperm production
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c. Hormonal Imbalance

- ↓ FSH or LH → infertility
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12. Exam Points

- Spermatogenesis starts at puberty
 - Occurs in seminiferous tubules
 - Type A dark = stem cell reserve
 - Primary spermatocyte = largest cell
 - Prophase I lasts ~22 days
 - Spermiogenesis = no division, only differentiation
 - Acrosome from Golgi
 - Sertoli cells = support + phagocytosis
 - Leydig cells = testosterone
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-> The End <-