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Male Reproductive System: Hormones, Anatomy & Spermatogenesis

Study Guide — Reproductive System

High school / pre-med / IB practice on the HPG axis, endocrine feedback, testicular anatomy, and spermatogenesis/meiosis (n, chromatids/DNA molecules, stages, and locations).

100 items — Study Guide with Answers

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1 Which pairing correctly matches the testis' exocrine and endocrine functions?



- A Exocrine: testosterone secretion; Endocrine: sperm delivery into ducts
- B Exocrine: sperm production; Endocrine: testosterone and inhibin secretion ✓**
- C Exocrine: LH secretion; Endocrine: GnRH secretion
- D Exocrine: semen production; Endocrine: semen storage
- E Exocrine: sperm motility; Endocrine: sperm capacitation

► **Explanation:** Exocrine means producing something delivered through ducts: the testes produce sperm that enter the reproductive ducts. Endocrine means hormones released to blood: testes secrete testosterone (Leydig cells) and inhibin (Sertoli cells).

2 Where does spermatogenesis primarily occur?



- A Epididymis
- B Seminiferous tubules ✓**
- C Prostate gland
- D Seminal vesicles
- E Vas deferens

► **Explanation:** Spermatogenesis (production of sperm cells) occurs in the seminiferous tubules of the testes. The epididymis mainly matures and stores sperm.

3 Leydig cells are located in the testes and are best described as cells that:



- A Line the seminiferous tubules and form the blood-testis barrier
- B Produce testosterone mainly in response to LH ✓**





- C Store sperm until ejaculation
- D Secrete fructose-rich fluid into semen
- E Carry action potentials to muscle fibers

► **Explanation:** Leydig cells sit in the interstitial space and secrete testosterone when stimulated by LH. Sertoli cells line tubules and support spermatogenesis.

4 Which pituitary hormone most directly stimulates Sertoli cells to support spermatogenesis?



- A LH
- B FSH ✓
- C TSH
- D ADH
- E Oxytocin

► **Explanation:** FSH targets Sertoli cells, increasing support for spermatogenesis (e.g., ABP and inhibin production). LH targets Leydig cells.

5 Which mapping of hormone -> target cell -> main product/action is most accurate?



- A FSH -> Leydig cell -> testosterone
- B LH -> Sertoli cell -> inhibin
- C LH -> Leydig cell -> testosterone; FSH -> Sertoli cell -> support of spermatogenesis (ABP/inhibin) ✓
- D GnRH -> Leydig cell -> sperm
- E Testosterone -> pituitary -> GnRH





► **Explanation:** LH stimulates Leydig cells to produce testosterone. FSH stimulates Sertoli cells to support spermatogenesis and secrete factors like ABP and inhibin.

6 Inhibin released from the testes primarily acts on the anterior pituitary to:



- A Increase FSH secretion
- B **Decrease FSH secretion ✓**
- C Increase LH secretion
- D Increase GnRH secretion from the hypothalamus
- E Convert testosterone into DHT

► **Explanation:** Inhibin provides negative feedback mainly on FSH secretion from the anterior pituitary.

7 A rise in circulating testosterone would most directly tend to:



- A Increase GnRH and LH release (positive feedback)
- B **Decrease GnRH and LH release (negative feedback) ✓**
- C Increase FSH by stimulating inhibin
- D Stop meiosis I from occurring by removing DNA
- E Increase sperm count instantly within minutes

► **Explanation:** Testosterone exerts negative feedback on the hypothalamus and pituitary, lowering GnRH and especially LH.





8 GnRH is secreted from the hypothalamus and reaches the anterior pituitary mainly through:

- A The lymphatic system
- B The hypothalamic-hypophyseal portal blood system ✓**
- C The spermatic cord
- D The urethra
- E Cerebrospinal fluid only

► **Explanation:** GnRH is released into portal vessels that deliver it directly to the anterior pituitary.



9 Why must GnRH be released in pulses (rather than continuously) to maintain normal LH/FSH secretion?

- A Continuous GnRH increases receptor sensitivity and boosts LH/FSH
- B Continuous GnRH causes pituitary GnRH receptors to downregulate, lowering LH/FSH release ✓**
- C Pulses are needed to allow sperm to swim
- D Pulses prevent testosterone from being made
- E GnRH is stored only in the testes and released from there

► **Explanation:** Pulsatile GnRH keeps pituitary receptors responsive. Continuous stimulation causes receptor downregulation and decreased LH/FSH.



10 What is the main purpose of androgen-binding protein (ABP) produced by Sertoli cells?

- A To break down testosterone into inactive products





B To bind testosterone in the seminiferous tubules and maintain a high local concentration for spermatogenesis ✓

- C** To transport sperm from the epididymis to the urethra
- D** To convert GnRH into LH
- E** To provide ATP directly to myosin in muscle

► **Explanation:** ABP binds and concentrates testosterone in the seminiferous tubules, supporting spermatogenesis.

11 The blood-testis barrier is formed primarily by:



- A Tight junctions between Sertoli cells ✓**
- B** Desmosomes between Leydig cells
- C** Gap junctions between sperm cells
- D** The basement membrane alone
- E** The sperm tail (flagellum)

► **Explanation:** Sertoli-Sertoli tight junctions create the blood-testis barrier, separating basal and adluminal compartments.

12 A key reason the blood-testis barrier is biologically important is that it:



- A** Prevents oxygen from reaching the testes
- B Separates developing haploid germ cells from the immune system and helps control the tubule environment ✓**
- C** Stops testosterone from entering the seminiferous tubules
- D** Creates the sperm tail from microtubules
- E** Produces fructose for sperm energy





► **Explanation:** After meiosis, germ cells express new antigens; the barrier reduces immune exposure and maintains a controlled microenvironment.

13 Which sequence correctly describes the main stages of sperm development?



A Spermid -> spermatogonium -> spermatozoon -> primary spermatocyte

B **Spermatogonium -> primary spermatocyte -> secondary spermatocyte -> spermatid -> spermatozoon ✓**

C Primary spermatocyte -> spermatogonium -> spermatid -> secondary spermatocyte -> spermatozoon

D Spermatozoon -> spermatid -> secondary spermatocyte -> primary spermatocyte -> spermatogonium

E Leydig cell -> Sertoli cell -> spermatozoon -> spermatid -> spermatogonium

► **Explanation:** Development proceeds from spermatogonia to primary spermatocytes, secondary spermatocytes, spermatids, then spermatozoa.

14 A human spermatogonium in G1 phase has which combination of chromosome number and DNA molecules?



A 23 chromosomes and 23 DNA molecules

B **46 chromosomes and 46 DNA molecules ✓**

C 46 chromosomes and 92 DNA molecules

D 23 chromosomes and 46 DNA molecules

E 92 chromosomes and 92 DNA molecules

► **Explanation:** In G1, diploid cells have 46 chromosomes, each made of one DNA molecule, so 46 DNA molecules.





15 A human primary spermatocyte AFTER S phase (just before meiosis I) has which combination?



- A 46 chromosomes and 46 DNA molecules
- B 46 chromosomes and 92 DNA molecules ✓**
- C 23 chromosomes and 46 DNA molecules
- D 23 chromosomes and 23 DNA molecules
- E 92 chromosomes and 92 DNA molecules

► **Explanation:** DNA replication doubles DNA molecules but does not change chromosome count. So 46 chromosomes with 92 DNA molecules.

16 A human secondary spermatocyte (after meiosis I, before meiosis II) has which combination?



- A 46 chromosomes and 92 DNA molecules
- B 46 chromosomes and 46 DNA molecules
- C 23 chromosomes and 46 DNA molecules ✓**
- D 23 chromosomes and 23 DNA molecules
- E 92 chromosomes and 46 DNA molecules

► **Explanation:** Meiosis I separates homologous chromosomes, reducing to 23. Each still has two sister chromatids, so 46 DNA molecules.

17 A human spermatid (after meiosis II) has which combination?



- A 46 chromosomes and 46 DNA molecules
- B 46 chromosomes and 92 DNA molecules





- C 23 chromosomes and 46 DNA molecules
- D 23 chromosomes and 23 DNA molecules ✓
- E 92 chromosomes and 92 DNA molecules

► **Explanation:** Meiosis II separates sister chromatids, so each haploid cell ends with 23 chromosomes and 23 DNA molecules.

18 At metaphase I of meiosis in a primary spermatocyte, what is aligned at the metaphase plate?



- A Single chromosomes lined up individually (as in mitosis)
- B Homologous chromosome pairs (bivalents/tetrads) ✓
- C Only sister chromatids with no homologs present
- D Only haploid chromosomes
- E Only sperm tails

► **Explanation:** In metaphase I, homologous pairs align together. Sister chromatids remain joined.

19 Crossing over (exchange of genetic material between homologous chromosomes) occurs primarily during:



- A Prophase I ✓
- B Metaphase II
- C Anaphase II
- D Telophase II
- E G2 phase after meiosis





► **Explanation:** Crossing over happens in prophase I when homologous chromosomes pair and exchange segments.

20 Independent assortment is best explained by which event?



- A Random alignment of homologous chromosome pairs at metaphase I ✓
- B Random separation of sister chromatids at anaphase II only
- C Random mutation of DNA during fertilization
- D Random ATP binding to myosin
- E Random diffusion of sperm in semen

► **Explanation:** Independent assortment comes from each homologous pair orienting randomly at metaphase I.

21 Mendel's law of segregation is most directly reflected in meiosis when:



- A Homologous chromosomes separate from each other in anaphase I ✓
- B DNA replicates in S phase
- C Sister chromatids align in metaphase II
- D The sperm tail forms in spermiogenesis
- E LH binds to receptors on Sertoli cells

► **Explanation:** Alleles on homologous chromosomes segregate when homologs separate in meiosis I.





22 Which process can create NEW combinations of alleles within the SAME chromosome?



- A Independent assortment
- B Crossing over ✓
- C Mitosis of spermatogonia
- D Testosterone negative feedback
- E Sperm motility in the epididymis

► **Explanation:** Crossing over swaps DNA between homologs, creating recombinant chromosomes.

23 One primary spermatocyte ultimately produces how many haploid spermatids?



- A 1
- B 2
- C 3
- D 4 ✓
- E 8

► **Explanation:** One primary spermatocyte completes meiosis I to form 2 secondary spermatocytes, then meiosis II to form 4 spermatids.

24 Spermiogenesis refers to:



- A Mitosis of spermatogonia to make more diploid cells
- B The two meiotic divisions that reduce chromosome number





- C The maturation of spermatids into spermatozoa without further cell division ✓**
- D The movement of sperm through the vas deferens
- E Fusion of sperm and egg nuclei

► **Explanation:** Spermiogenesis is differentiation (head/acrosome/flagellum formation) without division.

25 Spermiation is best defined as:



- A Release of mature spermatozoa from Sertoli cells into the seminiferous tubule lumen ✓**
- B Release of LH from the pituitary
- C Release of semen from the urethra
- D Release of CO₂ from red blood cells
- E Release of testosterone from the prostate gland

► **Explanation:** Spermiation is the final step: spermatozoa detach from Sertoli cells and enter the lumen.

26 The epididymis is most important for:



- A Producing testosterone
- B Maturation and storage of sperm (including gaining motility) ✓**
- C Producing most of the semen volume
- D Performing meiosis I
- E Producing GnRH

► **Explanation:** Sperm mature and are stored in the epididymis. Meiosis occurs in seminiferous tubules.





27 The vas deferens is best described as the structure that:



- A Produces sperm
- B Stores sperm for long-term development into spermatocytes
- C Transports sperm from epididymis toward the ejaculatory duct during ejaculation
- D Is the main site of testosterone synthesis
- E Is the gland that makes fructose-rich fluid

► **Explanation:** The vas deferens is a muscular tube that carries sperm from the epididymis toward the urethra.

28 Which secretion is most strongly associated with the seminal vesicles?



- A Fructose-rich fluid contributing much of semen volume
- B Bile salts for fat digestion
- C Insulin to lower blood glucose
- D Rhodopsin for vision
- E Myelin for nerve conduction

► **Explanation:** Seminal vesicles contribute a large fraction of semen volume and provide fructose.

29 Which statement about the prostate gland is most accurate?



- A It is the site where meiosis occurs to form spermatids





B It contributes fluid with enzymes that can help semen become more liquid after ejaculation ✓

- C** It is the main storage site for sperm
- D** It produces GnRH
- E** It forms the blood-testis barrier

► **Explanation:** The prostate contributes fluid (including enzymes) to semen that helps liquefaction.

30 Bulbourethral (Cowper's) glands mainly secrete:



- A Mucus-like fluid that lubricates and helps neutralize the urethra ✓**
- B** The majority of semen volume and fructose
- C** Testosterone into blood
- D** Inhibin to block LH release
- E** Myosin to power sperm motility

► **Explanation:** Bulbourethral glands produce a lubricating mucus-like secretion (pre-ejaculate).

31 Which accessory gland typically contributes the largest fraction of semen volume?



- A Seminal vesicles ✓**
- B** Prostate
- C** Bulbourethral glands
- D** Epididymis
- E** Pituitary gland





► **Explanation:** Seminal vesicles contribute the largest portion of semen volume.

32 A common energy source provided in semen to support sperm motility is:



- A** Fructose ✓
- B** Hemoglobin
- C** Glycogen granules inside red blood cells
- D** DNA
- E** Cellulose

► **Explanation:** Seminal vesicles provide fructose, which sperm can metabolize for energy.

33 Semen is typically slightly alkaline. The most direct advantage of this is that it:



- A** Neutralizes acidic conditions in the female reproductive tract to improve sperm survival ✓
- B** Prevents meiosis from occurring in the testes
- C** Converts sperm into testosterone
- D** Stops oxygen from binding hemoglobin
- E** Directly increases chromosome number in sperm

► **Explanation:** A slightly alkaline semen helps protect sperm in the acidic environment of the vagina.





34 Which statement best matches erection vs ejaculation control?

- A Erection: sympathetic; Ejaculation: parasympathetic
- B Erection: parasympathetic; Ejaculation (emission) mainly sympathetic ✓**
- C Both are controlled only by the somatic nervous system
- D Neither involves the nervous system; both are purely hormonal
- E Erection depends on LH, ejaculation depends on FSH

► **Explanation:** Erection is largely parasympathetic (vasodilation). Ejaculation involves mainly sympathetic pathways.



35 Which statement about testosterone vs dihydrotestosterone (DHT) is most accurate?

- A DHT is a weaker androgen than testosterone in most tissues
- B DHT is formed from testosterone by 5-alpha reductase and is often a more potent androgen ✓**
- C Testosterone is formed from DHT by aromatase
- D DHT is produced by the pituitary gland
- E DHT is a peptide hormone that cannot enter cells

► **Explanation:** DHT is produced from testosterone by 5-alpha reductase and binds androgen receptors strongly.



36 5-alpha reductase catalyzes which reaction?

- A Testosterone -> DHT ✓**
- B Testosterone -> estradiol





- C GnRH -> LH
- D FSH -> inhibin
- E Glucose -> glycogen

► **Explanation:** 5-alpha reductase converts testosterone to DHT.

37 Aromatase catalyzes which reaction?



- A Testosterone -> estradiol ✓
- B Testosterone -> DHT
- C Estradiol -> testosterone
- D GnRH -> FSH
- E ATP -> ADP

► **Explanation:** Aromatase converts androgens such as testosterone into estrogens such as estradiol.

38 In the testes, a key effect of FSH on Sertoli cells is to increase production of:



- A GnRH
- B Androgen-binding protein (ABP) and inhibin ✓
- C Insulin
- D Oxytocin
- E Hemoglobin

► **Explanation:** FSH stimulates Sertoli cells to produce ABP and inhibin.





39 A blood test shows very high testosterone with very low LH and low FSH. Which explanation is MOST consistent?

- A Primary testicular failure
- B Exogenous anabolic steroid (testosterone) use causing negative feedback ✓**
- C GnRH deficiency
- D Sertoli cells producing too much inhibin only
- E Complete lack of androgen receptors

► **Explanation:** Exogenous testosterone raises blood testosterone while suppressing GnRH/LH/FSH via negative feedback.



40 Which hormone pattern best fits PRIMARY testicular failure?

- A Low testosterone, high LH, high FSH ✓**
- B High testosterone, low LH, low FSH
- C Low testosterone, low LH, low FSH
- D Normal testosterone, high LH, low FSH
- E High testosterone, high LH, high FSH

► **Explanation:** When the testes fail, testosterone decreases, so negative feedback is reduced and the pituitary increases LH and FSH.



41 Which hormone pattern best fits SECONDARY hypogonadism (problem in hypothalamus/pituitary)?

- A Low testosterone, low or inappropriately normal LH and FSH ✓**





- B Low testosterone, high LH, high FSH
- C High testosterone, high LH, high FSH
- D High testosterone, low LH, low FSH
- E Normal testosterone, absent inhibin only

► **Explanation:** If the hypothalamus/pituitary cannot drive the testes, LH/FSH are low, leading to low testosterone.

42 If Sertoli cells produced much less inhibin, what change would be most expected?



- A FSH would decrease because inhibin normally stimulates it
- B **FSH would increase because inhibin normally inhibits it** ✓
- C LH would increase because inhibin normally inhibits LH
- D Testosterone would become very high
- E GnRH would stop being pulsatile immediately

► **Explanation:** Inhibin provides negative feedback mainly on FSH. With less inhibin, the pituitary secretes more FSH.

43 If Leydig cells fail to respond to LH, which change is most directly expected?



- A High testosterone and low LH
- B **Low testosterone and high LH (loss of negative feedback)** ✓
- C Low FSH and high inhibin
- D Normal testosterone because Sertoli cells make it
- E Sperm gain motility faster in the epididymis





► **Explanation:** Leydig cells make testosterone in response to LH. If they cannot respond, testosterone falls and LH rises.

44 Why can exogenous testosterone reduce sperm count even though blood testosterone is high?



- A** It directly destroys sperm DNA in the epididymis
- B** It suppresses GnRH/LH/FSH, lowering intratesticular testosterone needed for spermatogenesis ✓
- C** It increases FSH too much, causing spermatogonia to stop dividing
- D** It prevents the prostate from making semen volume
- E** It prevents crossing over by removing the synaptonemal complex

► **Explanation:** External testosterone suppresses LH/FSH via negative feedback. Intratesticular testosterone falls, so spermatogenesis decreases.

45 A vasectomy most directly prevents pregnancy by blocking:



- A** FSH release from the pituitary
- B** Sperm transport through the vas deferens ✓
- C** Testosterone production by Leydig cells
- D** Semen production by seminal vesicles
- E** Meiosis in spermatocytes

► **Explanation:** Vasectomy cuts/blocks the vas deferens, preventing sperm from entering the ejaculate.





46 Which change is **MOST** expected after a successful vasectomy?



- A Large decrease in semen volume
- B Semen still present but with very few or no sperm cells ✓**
- C Complete loss of testosterone production
- D Increased LH because sperm are no longer made
- E Immediate shutdown of spermatogenesis within minutes

► **Explanation:** Most semen volume comes from accessory glands, so volume changes little. The key change is sperm are absent.

47 Cryptorchidism (undescended testes) most directly risks infertility mainly because:



- A The testes lack blood supply in the abdomen
- B Higher temperature impairs spermatogenesis more than testosterone production ✓**
- C LH cannot reach the testes unless they are in the scrotum
- D Semen cannot be produced without scrotal skin
- E The epididymis cannot exist unless the testes descend

► **Explanation:** Spermatogenesis is temperature-sensitive and works best a few degrees below core body temperature.

48 Why are the testes located in the scrotum outside the body cavity?



- A To keep the testes warmer than the body core





- ✓ **B To keep the testes cooler than core body temperature for optimal spermatogenesis**
- C** To allow LH to be converted into testosterone by skin enzymes
- D** To protect sperm from oxygen
- E** To keep testosterone from entering the bloodstream

► **Explanation:** Sperm production is optimized at slightly lower than core body temperature.

49 The pampiniform plexus in the spermatic cord is most directly involved in:



- A Countercurrent heat exchange to cool arterial blood entering the testes** ✓
- B** Producing seminal fluid rich in fructose
- C** Making inhibin to suppress LH
- D** Performing meiosis II
- E** Conducting action potentials to the penis

► **Explanation:** The pampiniform plexus is a venous network that cools incoming arterial blood.

50 Cremaster and dartos muscles help fertility mainly by:



- A** Pulling sperm through the epididymis
- B Adjusting testis position and scrotal skin to regulate testicular temperature** ✓
- C** Producing testosterone in response to FSH
- D** Creating the acrosome reaction
- E** Forming the blood-testis barrier





► **Explanation:** Cremaster moves testes closer/farther from the body, and dartos wrinkles scrotal skin, helping regulate heat.

51 Which germ cell stage is typically found closest to the lumen of the seminiferous tubule?



- A Spermatozoa
- B Primary spermatocytes (early)
- C Spermatis / spermatozoa ✓**
- D Leydig cells
- E Blood cells

► **Explanation:** Development progresses from basal lamina toward the lumen. The most mature forms are nearest the lumen.

52 The primary storage site for mature sperm prior to ejaculation is the:



- A Seminal vesicle
- B Epididymis (especially the tail) ✓**
- C Prostate
- D Urethra
- E Anterior pituitary

► **Explanation:** Sperm mature and are stored in the epididymis.





53 Sperm gain much of their motility and fertilizing capacity mainly while passing through the:



- A Seminiferous tubules
- B Epididymis ✓**
- C Ureter
- D Bladder
- E Hypothalamus

► **Explanation:** Sperm formed in the testes are initially non-motile; maturation in the epididymis is key for motility.

54 Capacitation is a process that occurs:



- A In the seminiferous tubules before sperm are released
- B In the epididymis immediately after meiosis II
- C In the female reproductive tract after ejaculation ✓**
- D Inside Leydig cells to make testosterone
- E In the pituitary to activate FSH

► **Explanation:** Capacitation is a functional preparation of sperm that occurs in the female tract.

55 The acrosome reaction is important mainly because it:



- A Allows sperm to release enzymes that help penetrate the egg's outer layers ✓**
- B Allows the sperm to replicate its DNA before fertilization
- C Produces testosterone for puberty





- D Creates ATP in the sperm nucleus
- E Prevents meiosis II from finishing

► **Explanation:** The acrosome contains enzymes needed for the sperm to penetrate the egg's protective layers.

56 The midpiece of a sperm cell is specialized mainly for:



- A Storing digestive enzymes for the acrosome reaction
- B Containing mitochondria to generate ATP for tail movement ✓**
- C Holding the paternal chromosomes in a nucleus
- D Producing inhibin
- E Forming tight junctions with Sertoli cells

► **Explanation:** The midpiece contains many mitochondria that provide ATP needed for flagellar beating.

57 The flagellum of a typical human sperm cell contains microtubules arranged in a classic:



- A 1+9 arrangement
- B 9+2 arrangement ✓**
- C 2+2 arrangement
- D Random arrangement with no pattern
- E 4+4 arrangement

► **Explanation:** Motile cilia/flagella usually have the 9+2 microtubule structure.





58 Which cell type provides direct nourishment and support to developing germ cells inside seminiferous tubules?



- A Leydig cells
- B Sertoli cells ✓
- C Smooth muscle cells of the vas deferens
- D Red blood cells
- E Prostate epithelial cells

► **Explanation:** Sertoli cells are nurse cells that support, nourish, and coordinate germ cell development.

59 During spermiogenesis, Sertoli cells help by:



- A Phagocytosing excess cytoplasm shed from developing spermatids ✓
- B Performing the acrosome reaction
- C Producing LH
- D Becoming spermatozoa themselves
- E Synthesizing fructose for seminal vesicles

► **Explanation:** Sertoli cells remove residual bodies (excess cytoplasm) during spermatid maturation.

60 Anti-Mullerian hormone (AMH) is best linked to which statement?



- A Produced by fetal Sertoli cells and helps regression of Mullerian ducts during male development ✓





- B Produced by adult Leydig cells to trigger spermiogenesis
- C Produced by seminal vesicles to provide fructose
- D Produced by the prostate to liquefy semen
- E Produced by the hypothalamus as the main puberty hormone

► **Explanation:** AMH is secreted by Sertoli cells in fetal life and prevents development of female internal ducts.

61 Testosterone is classified as a steroid hormone, which implies it is synthesized from:



- A Amino acids in ribosomes
- B **Cholesterol ✓**
- C Glucose in glycolysis
- D DNA nucleotides
- E Fructose from seminal vesicles

► **Explanation:** Steroid hormones (including testosterone) are derived from cholesterol.

62 A key property of steroid hormones like testosterone is that they typically:



- A Bind to receptors on the cell surface and act only through ion channels
- B **Enter cells easily and bind intracellular receptors that influence gene expression ✓**
- C Cannot cross membranes and must use transporters like GLUT4
- D Are stored in vesicles and released by exocytosis
- E Act only in the blood and never enter tissues





► **Explanation:** Steroids are lipid-soluble, can cross membranes, and bind intracellular receptors.

63 LH and FSH are peptide/protein hormones. This most strongly suggests their receptors are:



- A Inside the nucleus
- B In the cytosol only
- C On the cell membrane, triggering intracellular signaling cascades ✓**
- D Covalently attached to DNA
- E Only on sperm tails

► **Explanation:** Peptide hormones bind receptors on the cell surface and trigger signaling pathways.

64 LH/FSH receptors commonly activate which second messenger pathway?



- A cAMP signaling (via G-proteins) ✓**
- B Direct DNA binding in the nucleus without signaling
- C Only voltage-gated Na⁺ channels
- D Only ribosomal translation
- E Hemoglobin oxygen binding

► **Explanation:** LH and FSH classically act via membrane receptors coupled to G-proteins that increase cAMP.





65 Which statement best captures the specificity of inhibin feedback?



- A Inhibin mainly decreases FSH more than LH ✓
- B Inhibin mainly decreases LH more than FSH
- C Inhibin increases GnRH secretion
- D Inhibin converts testosterone into estrogen
- E Inhibin is produced by Leydig cells

► **Explanation:** Inhibin is produced mainly by Sertoli cells and selectively suppresses FSH secretion.

66 FSH supports spermatogenesis partly by stimulating Sertoli cells to increase ABP. Why is this helpful?



- A ABP lowers testosterone in the testes to prevent too much sperm production
- B ABP raises local testosterone levels in seminiferous tubules where spermatogenesis occurs ✓
- C ABP converts LH into FSH
- D ABP blocks the blood-testis barrier
- E ABP is a motor protein that moves sperm

► **Explanation:** Spermatogenesis requires high intratesticular testosterone. ABP helps maintain this.

67 Compared with circulating (blood) testosterone, intratesticular testosterone concentration is normally:



- A Much lower, because the testes keep testosterone out of the tubules
- B Much higher, because high local testosterone is required for spermatogenesis ✓





- C Exactly zero, because testosterone is only a blood hormone
- D Unrelated to spermatogenesis and therefore random
- E Identical to blood at all times

► **Explanation:** Spermatogenesis needs high testosterone in seminiferous tubules; ABP helps keep intratesticular testosterone much higher than blood levels.

68 In blood, most testosterone is transported:



- A Dissolved freely in plasma without any binding
- B Bound to plasma proteins (e.g., SHBG and albumin), with only a small free fraction** ✓
- C Inside red blood cell nuclei
- D Covalently bound to glucose
- E As bicarbonate (HCO_3^-)

► **Explanation:** Steroid hormones circulate largely bound to carrier proteins; only a small fraction is free.

69 Which statement about estradiol in males is most accurate?



- A Estradiol is absent in males and has no physiological role
- B Some testosterone is converted to estradiol, which can contribute to functions like bone maturation** ✓
- C Estradiol is produced only by seminal vesicles
- D Estradiol is the main hormone that triggers sperm meiosis
- E Estradiol is made by GnRH neurons as a neurotransmitter





► **Explanation:** Males produce small amounts of estradiol via aromatization of testosterone.

70 Which sequence best represents the typical endocrine chain that initiates male puberty?



- A Testes increase testosterone first -> pituitary releases GnRH -> hypothalamus releases LH
- B Hypothalamus increases pulsatile GnRH -> pituitary increases LH/FSH -> testes increase testosterone and sperm production ✓**
- C Seminal vesicles release FSH -> testes release GnRH -> hypothalamus releases testosterone
- D Prostate releases LH -> pituitary releases testosterone -> hypothalamus releases inhibin
- E Epididymis releases GnRH -> pituitary releases sperm

► **Explanation:** Puberty begins with increased GnRH pulsatility, stimulating pituitary LH/FSH, which stimulates the testes.

71 Which statement best summarizes what is required for normal spermatogenesis?



- A FSH alone is sufficient even if testosterone is absent
- B Testosterone alone is sufficient even if Sertoli cells are inactive
- C Both Sertoli cell support (FSH) and high intratesticular testosterone (LH -> Leydig) are important ✓**
- D Only prolactin is required
- E Only seminal vesicle secretions are required

► **Explanation:** Spermatogenesis depends on both Sertoli cell function (stimulated by FSH) and testosterone from Leydig cells (stimulated by LH).





72 If FSH is very low but LH/testosterone are normal, the person will have normal sperm production. Which is the best evaluation?

- A** Correct: FSH is not involved in spermatogenesis
- B** **Incorrect: low FSH reduces Sertoli cell support and can lower sperm count even if testosterone is normal** ✓
- C** Correct: testosterone replaces Sertoli cells completely
- D** Incorrect: low FSH increases inhibin and therefore increases sperm production
- E** Correct: sperm are produced only in the epididymis

► **Explanation:** FSH stimulates Sertoli cells. Even with normal testosterone, very low FSH can reduce sperm production.



73 If LH is very low but FSH is normal, which outcome is most likely?

- A** Normal testosterone production, normal spermatogenesis
- B** **Low testosterone from reduced Leydig stimulation, which can impair spermatogenesis even if FSH is present** ✓
- C** High testosterone due to lack of negative feedback
- D** No effect because LH does not act on testes
- E** Immediate increase in semen volume because seminal vesicles enlarge

► **Explanation:** LH stimulates Leydig cells to make testosterone. Without LH, testosterone drops, impairing spermatogenesis.



74 Which structure directly carries sperm from the epididymis toward the ejaculatory ducts?

- A** Ureter





- B Vas deferens** ✓
- C Seminiferous tubule
- D Prostatic urethra only
- E Renal pelvis

► **Explanation:** The vas deferens transports sperm from epididymis toward ejaculatory ducts.

75 Which sequence correctly traces sperm movement from production to exit?



- A Epididymis -> seminiferous tubules -> urethra -> vas deferens
- B Seminiferous tubules -> epididymis -> vas deferens -> ejaculatory duct -> urethra** ✓
- C Seminal vesicle -> prostate -> epididymis -> urethra
- D Vas deferens -> seminiferous tubules -> epididymis -> urethra
- E Testis -> bladder -> ureter -> urethra

► **Explanation:** Sperm are made in seminiferous tubules, mature in epididymis, travel via vas deferens, then enter ejaculatory duct and urethra.

76 Which statement correctly distinguishes sperm from semen?



- A Sperm and semen are the same term
- B Sperm are the male gamete cells; semen is the fluid mixture containing sperm plus gland secretions** ✓
- C Semen is produced in seminiferous tubules; sperm are produced by seminal vesicles
- D Sperm are hormones; semen is a nerve impulse
- E Sperm are diploid cells; semen is haploid





► **Explanation:** Sperm are cells (male gametes). Semen is the ejaculate fluid that contains sperm plus secretions.

77 Prostaglandins in semen are often taught to help reproduction by:



- A Stimulating contractions in the female reproductive tract that can aid sperm movement ✓
- B Triggering meiosis II in the male testes
- C Directly increasing LH release from the pituitary
- D Forming the sperm head nucleus
- E Providing iron for hemoglobin in sperm

► **Explanation:** Seminal vesicles produce prostaglandins that may influence the female reproductive tract.

78 Which gland is most associated with producing an alkaline, fructose-containing secretion?



- A Seminal vesicles ✓
- B Prostate gland
- C Adrenal cortex
- D Thyroid gland
- E Pancreas

► **Explanation:** Seminal vesicles contribute an alkaline secretion and fructose.





79 Why is semen liquefaction after ejaculation functionally useful?



- A It prevents sperm from being released into the female tract
- B It helps sperm move more freely after initial coagulation ✓**
- C It increases chromosome number in sperm
- D It stops the acrosome reaction permanently
- E It turns testosterone into inhibin

► **Explanation:** Semen can initially coagulate, then enzymes help liquefy it, improving sperm motility.

80 Meiosis that produces haploid male gametes occurs in which location?



- A Seminal vesicles
- B Seminiferous tubules of the testes ✓**
- C Prostate gland
- D Epididymis only
- E Vas deferens

► **Explanation:** Primary spermatocytes undergo meiosis in seminiferous tubules, producing haploid spermatids.

81 A human secondary spermatocyte at metaphase II contains:



- A 46 chromosomes and 92 DNA molecules
- B 46 chromosomes and 46 DNA molecules
- C 23 chromosomes and 46 DNA molecules ✓**





- D 23 chromosomes and 23 DNA molecules
- E 92 chromosomes and 46 DNA molecules

► **Explanation:** After meiosis I, the cell is haploid (23 chromosomes) but each chromosome still has two chromatids, so DNA molecules = 46.

82 The key event in anaphase II of meiosis is:



- A Separation of homologous chromosomes
- B **Separation of sister chromatids** ✓
- C DNA replication
- D Crossing over
- E Fusion of gametes

► **Explanation:** Meiosis II resembles mitosis: sister chromatids separate in anaphase II.

83 The key event in anaphase I of meiosis is:



- A Separation of sister chromatids
- B **Separation of homologous chromosomes** ✓
- C Formation of the acrosome
- D Fusion of sperm and egg
- E Formation of ABP

► **Explanation:** Anaphase I separates homologous chromosomes (reductional division).





84 Which statement correctly defines a haploid cell in humans?



- A A cell with 46 chromosomes
- B A cell with 23 chromosomes (one set) ✓**
- C A cell with 92 chromosomes
- D A cell that has no DNA
- E A cell that contains only mitochondria

► **Explanation:** Haploid means one set of chromosomes: 23 in humans.

85 If nondisjunction occurs in meiosis I in a primary spermatocyte, what is the expected outcome?



- A All gametes are normal
- B All gametes are abnormal (some $n+1$ and some $n-1$) ✓**
- C Half the gametes are normal and half are abnormal
- D Only one gamete is produced
- E Nondisjunction cannot occur in meiosis I

► **Explanation:** If homologous chromosomes fail to separate in meiosis I, all four gametes carry abnormal numbers.

86 If nondisjunction occurs in meiosis II in ONE secondary spermatocyte, what is the expected outcome?



- A All four are abnormal
- B Two are normal and two are abnormal (one $n+1$ and one $n-1$, plus two normal) ✓**





- C All four are normal because meiosis I was correct
- D One is normal and three are abnormal
- E None are produced

► **Explanation:** With nondisjunction in meiosis II, sister chromatids fail to separate in one secondary spermatocyte, producing two abnormal gametes. The other secondary spermatocyte divides normally.

87 In seminiferous tubules, spermatogonia are typically located:



- A Near the lumen, ready to be ejaculated
- B Near the basement membrane in the basal compartment ✓
- C Only in the epididymis
- D Only in the seminal vesicles
- E Outside the testes in the scrotal skin

► **Explanation:** Spermatogonia sit near the basement membrane. As they differentiate, cells move toward the lumen.

88 Which statement about the blood-testis barrier is most accurate?



- A It is made by Leydig cells and blocks testosterone entry into seminiferous tubules
- B It is made by Sertoli tight junctions and helps create an adluminal compartment for meiosis and spermiogenesis ✓
- C It is a layer of bone surrounding the testes
- D It exists mainly to pump sperm through the epididymis
- E It is formed by the prostate to control semen pH





► **Explanation:** The barrier is formed by Sertoli-Sertoli junctions, creating distinct environments.

89 A key immune-related reason sperm can trigger an immune response if exposed to blood is that haploid germ cells:



- A Contain no proteins at all
- B Express new antigens after puberty that the immune system may not have been tolerized to ✓
- C Are always infected by viruses
- D Are made of cartilage, which is foreign to blood
- E Do not contain DNA, so the immune system attacks them

► **Explanation:** After meiosis, germ cells express different proteins/antigens. The blood-testis barrier reduces immune exposure.

90 A student spends weeks using hot tubs daily. Which change is most likely?



- A Temporary reduction in sperm count due to impaired spermatogenesis ✓
- B Immediate doubling of testosterone because heat activates Leydig cells
- C Permanent increase in chromosome number in sperm
- D No effect because temperature does not influence testes
- E Immediate increase in semen volume because seminal vesicles enlarge within hours

► **Explanation:** Increased temperature can reduce spermatogenesis over time, lowering sperm count.





91 A pattern of **HIGH LH** with **NORMAL FSH** could most reasonably suggest a problem mainly affecting:

- A** Leydig cell testosterone production (reducing negative feedback on LH) ✓
- B** Sertoli cell inhibin production only (would mainly affect FSH)
- C** Seminal vesicle fructose synthesis (would not drive LH up)
- D** The ureter (urine transport)
- E** The acrosome reaction (fertilization stage)

► **Explanation:** LH rises when testosterone negative feedback is reduced (often Leydig dysfunction).



92 Which statement is most accurate about **DHT** compared with testosterone?

- A** DHT is an inactive breakdown product with no receptor binding
- B** **DHT often binds androgen receptors strongly and can have stronger effects in certain tissues** ✓
- C** DHT is produced only by Sertoli cells in response to FSH
- D** DHT is a peptide hormone and cannot cross membranes
- E** DHT is the main pituitary hormone that triggers LH release

► **Explanation:** DHT is a potent androgen derived from testosterone by 5-alpha reductase.



93 At puberty, the hormone most directly responsible for many male secondary sex characteristics is:

- A** FSH
- B** LH





- C Testosterone (and its conversion to DHT in some tissues) ✓**
- D Inhibin**
- E Progesterone**

► **Explanation:** Testosterone drives many systemic male pubertal changes, with DHT mediating some tissue-specific effects.

94 Which cell type produces androgen-binding protein (ABP)?



- A Leydig cell**
- B Sertoli cell ✓**
- C Spermatid**
- D Prostate epithelial cell**
- E Seminal vesicle cell**

► **Explanation:** ABP is made by Sertoli cells to bind testosterone locally in seminiferous tubules.

95 Which cell type produces inhibin in the testes?



- A Leydig cell**
- B Sertoli cell ✓**
- C Secondary spermatocyte**
- D Erythrocyte**
- E Smooth muscle cell of vas deferens**

► **Explanation:** Inhibin is produced primarily by Sertoli cells and suppresses FSH.





96 Leydig cells are found primarily:

- A Inside the lumen of the seminiferous tubules
- B In the interstitial space between seminiferous tubules ✓**
- C Inside the epididymal duct lumen
- D In the prostate gland only
- E Inside the bladder wall

► **Explanation:** Leydig cells sit between tubules (interstitial tissue) and secrete testosterone.



97 Which comparison is correct for a human spermatogonium (G1) versus a spermatid (after meiosis II)?

- A Spermatogonium: haploid; Spermatid: diploid
- B Spermatogonium: 2n with 46 DNA molecules; Spermatid: n with 23 DNA molecules ✓**
- C Spermatogonium: n with 46 DNA molecules; Spermatid: 2n with 23 DNA molecules
- D Both are n with 23 DNA molecules
- E Both are 2n with 92 DNA molecules

► **Explanation:** A spermatogonium is diploid (2n) with 46 DNA molecules. A spermatid is haploid (n) with 23 DNA molecules.



98 When does DNA replication occur relative to meiosis during spermatogenesis?





- A Before meiosis I (S phase), but not between meiosis I and meiosis II ✓**
- B Between meiosis I and meiosis II
- C After meiosis II to make sperm diploid again
- D Only after fertilization
- E Replication does not occur in germ cells

► **Explanation:** Primary spermatocytes replicate DNA once (S phase) before meiosis I. There is no S phase between meiosis I and II.

99 Which statement is most accurate about semen volume after vasectomy?



- A Semen volume becomes nearly zero because sperm are most of the volume
- B Semen volume decreases slightly or changes little because most volume comes from accessory glands ✓**
- C Semen volume doubles because seminal vesicles compensate by making sperm
- D Semen volume is unchanged because accessory glands stop secreting
- E Semen volume becomes acidic because sperm make it alkaline

► **Explanation:** Sperm cells contribute a small fraction of semen volume. Most volume is from accessory glands.

100 Which part of the sperm cell contains the paternal chromosomes?



- A Acrosome
- B Nucleus in the head ✓**
- C Midpiece mitochondria
- D Flagellum





E Seminal plasma

► **Explanation:** The sperm head contains the nucleus, which carries the paternal DNA.

