Anatomy and Physiology: The Reproductive System

AI-Generated Study Guide

(Based on lectures delivered by Dr. Ty C.M. Hoffman)

I. Short-Answer Quiz

Instructions: Answer each question in 2-3 sentences.

1. **Distinguish between primary and secondary sex organs in humans.**
2. **Explain the significance of the scrotum in male anatomy, including a potential issue if descent does not occur.**
3. **Describe the pathway of sperm from production to ejaculation, highlighting the role of the epididymis.**
4. **Name the three major parts of the male urethra and state how the male urethra differs in function from the female urethra.**
5. **What is the function of the corpora cavernosa and corpus spongiosum in the penis?**
6. **Define meiosis and explain its importance in sexual reproduction, contrasting it with mitosis in terms of ploidy.**
7. **Identify the three components of the hypothalamo-pituitary-gonadal axis in males and explain their general interaction.**
8. **Describe the primary roles of FSH and LH in the male reproductive system.**
9. **What is the corpus luteum, how is it formed, and what is its fate in the absence of pregnancy?**
10. **Explain the purpose of the endometrial glands in the secretory phase of the uterine cycle.**

Answer Key

1. **Distinguish between primary and secondary sex organs in humans.** Primary sex organs are defined by their production of gametes; these are the gonads (testes in males, ovaries in females). Secondary sex organs are structures involved in the delivery or reception of gametes but do not produce them, such as the penis and vagina.

2. **Explain the significance of the scrotum in male anatomy, including a potential issue if descent does not occur.** The scrotum is a sac-like structure that houses the testes outside the abdominal-pelvic cavity. This external positioning is crucial for proper sperm development, as it provides a cooler environment than the internal body temperature. If the testes remain undescended in the abdominal-pelvic cavity, it can lead to problems with fertility.
3. **Describe the pathway of sperm from production to ejaculation, highlighting the role of the epididymis.** Sperm are produced in the seminiferous tubules of the testes. From there, immature sperm move to the epididymis, where they mature over several weeks. During ejaculation, mature sperm are released from the epididymis and travel through the ductus deferens, ampulla, prostatic urethra, membranous urethra, and finally the spongy urethra to exit the body.
4. **Name the three major parts of the male urethra and state how the male urethra differs in function from the female urethra.** The three major parts of the male urethra are the prostatic urethra, membranous urethra, and spongy urethra. Unlike the female urethra, which only transports urine, the male urethra serves as a delivery device for both urine and semen.
5. **What is the function of the corpora cavernosa and corpus spongiosum in the penis?** The corpora cavernosa (two) and corpus spongiosum (one, surrounding the spongy urethra) are three columns of erectile tissue within the penis. During erection, these tissues become engorged with blood, leading to increased hydrostatic pressure that stiffens the penis.
6. **Define meiosis and explain its importance in sexual reproduction, contrasting it with mitosis in terms of ploidy.** Meiosis is a type of cell division that produces haploid cells (gametes) from a diploid cell, effectively cutting the ploidy in half. This halving of chromosomes is essential for sexual reproduction, as it ensures that when two haploid gametes fuse during fertilization, the resulting zygote will restore the diploid number, preventing a doubling of chromosomes in each generation, unlike mitosis which produces genetically identical diploid cells.
7. **Identify the three components of the hypothalamo-pituitary-gonadal axis in males and explain their general interaction.** In males, the hypothalamo-pituitary-gonadal axis involves the hypothalamus, the anterior pituitary, and the testes (gonads). The hypothalamus releases GnRH, which stimulates the anterior pituitary to release FSH and LH. These gonadotropins then act on the testes to stimulate sperm production and testosterone release, which in turn provides negative feedback to the hypothalamus and anterior pituitary.
8. **Describe the primary roles of FSH and LH in the male reproductive system.** In males, Follicle-Stimulating Hormone (FSH) acts on supporting cells within the testes, which are essential for supporting spermatagonia and proper sperm production. Luteinizing Hormone (LH) stimulates interstitial cells in the testes to produce testosterone, a male hormone that controls many functions, including sperm production.
9. **What is the corpus luteum, how is it formed, and what is its fate in the absence of pregnancy?** The corpus luteum, meaning "yellow body," is the structure formed from a ruptured follicle in the ovary after ovulation. It is formed under the influence of Luteinizing

Hormone (LH). In the absence of pregnancy, the corpus luteum degenerates and stops producing hormones, leading to a decrease in progesterone.

10. **Explain the purpose of the endometrial glands in the secretory phase of the uterine cycle.** During the secretory phase of the uterine cycle, the endometrial glands, which have proliferated along with the endometrium, become active. They secrete substances that make the uterine lining moist and provide the ideal chemical environment for the implantation and initial development of an embryo, should fertilization occur.

II. Essay Format Questions

1. Compare and contrast spermatogenesis and oogenesis in humans, focusing on differences in timing, number of viable gametes produced, and the size disparity of the resulting gametes.
2. Discuss the intricate hormonal regulation of the male reproductive system, detailing the roles of GnRH, FSH, LH, and testosterone within the hypothalamo-pituitary-gonadal axis and highlighting the importance of negative feedback.
3. Describe the journey of sperm from its production in the testes to its potential encounter with an egg in the female reproductive tract. Include the specific structures involved and their contributions to the maturation and transport of sperm.
4. Trace the events of the female ovarian and uterine cycles, explaining how the hormonal fluctuations of estrogens and progesterone regulate the development of the egg and the preparation of the uterus for potential pregnancy.
5. Explain the concept of ploidy (haploid and diploid) in the context of human sexual reproduction. Discuss how fertilization and meiosis work in alternation to maintain the correct chromosome number across generations.

III. Glossary of Key Terms

- **Ampulla (of ductus deferens):** The widened end of the ductus deferens, where sperm mixes with secretions from the seminal vesicle before entering the prostate.
- **Anterior Pituitary:** A gland located at the base of the brain that releases gonadotropins (FSH and LH) in response to GnRH from the hypothalamus.
- **Areola:** The darkened circular area of skin surrounding the nipple.
- **Asexual Reproduction:** Reproduction involving a single parent, producing genetically identical offspring.
- **Atapost Tissue:** Fatty tissue that makes up a significant portion of the breast, especially in non-pregnant, non-nursing females.
- **Bulbourethral Gland:** A male accessory gland that produces mucus, which is added to semen just before ejaculation, cleansing and lubricating the urethra.
- **Cervix:** The narrow, neck-like lower portion of the uterus that opens into the vagina.
- **Circumcision:** A surgical procedure that removes the prepuce (foreskin) of the penis, exposing the glans penis.

- **Clitoris:** A female external genital organ, homologous to the male penis, which is highly sensitive and plays a role in sexual arousal and orgasm.
- **Conception:** Another term for fertilization, the beginning of pregnancy.
- **Corpora Cavernosa:** Two columns of erectile tissue in the male penis that become engorged with blood during erection.
- **Corpus Luteum:** A temporary endocrine structure formed in the ovary after ovulation from the remnants of the follicle; it produces hormones (estrogens and progesterone) crucial for maintaining a potential pregnancy.
- **Corpus Spongiosum:** One column of erectile tissue in the male penis that surrounds the spongy urethra and also forms the bulk of the glans penis.
- **Coxxyx:** The tailbone, a bone that forms one of the bony landmarks of the perineum.
- **Crura:** (Singular: crus) The "legs" or roots of the penis, which are not externally visible and are composed of erectile tissue.
- **Diploid (2n):** A cell or organism containing two complete sets of chromosomes, one from each parent; characteristic of somatic cells and zygotes in humans.
- **Ductus Deferens (Vas Deferens):** A muscular tube that transports sperm from the epididymis to the ejaculatory duct.
- **Ejaculation:** The expulsion of semen from the male reproductive tract.
- **Embryo:** The early stage of human development, from the first cell divisions after fertilization until about 8 weeks of gestation, when organ systems begin to form.
- **Endometrial Glands:** Glands within the endometrium (uterine lining) that secrete substances to create a favorable environment for an embryo.
- **Endometrium:** The inner lining of the uterus, which thickens and undergoes changes in preparation for embryo implantation.
- **Epididymis:** A convoluted tube located on the posterior side of each testis, where sperm mature and are stored.
- **Erection:** The engorgement of the penis with blood, causing it to become firm and enlarged.
- **Estrogens:** A group of female sex hormones primarily produced by ovarian follicles, responsible for the development of female secondary sexual characteristics and regulation of the menstrual cycle.
- **Fertilization:** The fusion of two haploid gametes (sperm and egg) to form a diploid zygote, initiating sexual reproduction.
- **Fetus:** The stage of human development from about 9 weeks after fertilization until birth, characterized by further growth and maturation of organs.
- **Fimbriae:** Finger-like projections at the end of the infundibulum of the uterine tube that sweep over the ovary to capture ovulated eggs.
- **Flagellated Cell:** A cell possessing one or more flagella, whip-like appendages used for motility, such as a sperm cell.
- **Follicle (Ovarian):** A structure within the ovary containing an immature egg (oocyte) and surrounding cells that nourish it as it develops.
- **Follicle-Stimulating Hormone (FSH):** A gonadotropin produced by the anterior pituitary that stimulates the development of ovarian follicles in females and supports sperm production in males.

- **Fundus (of uterus):** The superior, rounded, blind end of the uterus.
- **Gametes:** Unisex term for sex cells (sperm in males, eggs/ova in females), which are haploid and participate in fertilization.
- **Germline Cells:** Cells in the gonads (testes or ovaries) that undergo meiosis to produce gametes.
- **Glans Penis:** The sensitive head of the male penis.
- **Gonadotropen Releasing Hormone (GnRH):** A hormone released by the hypothalamus that stimulates the anterior pituitary to release gonadotropins (FSH and LH).
- **Gonads:** Unisex term for the primary sex organs (testes in males, ovaries in females) that produce gametes.
- **Haploid (n):** A cell or organism containing a single set of unpaired chromosomes; characteristic of human gametes (sperm and egg), where n=23.
- **Hypothalamus:** A region of the brain that plays a crucial role in regulating many bodily functions, including the release of GnRH, which controls the reproductive system.
- **Infundibulum (of uterine tube):** The funnel-shaped, fringed opening of the uterine tube located near the ovary.
- **Interstitial Cells (Leydig cells):** Cells located in the spaces between seminiferous tubules in the testes; they produce testosterone in response to LH.
- **Labia Majora:** The larger, outer folds of skin that protect the external female genitalia; they are typically dry and hairy.
- **Labia Minora:** The smaller, inner folds of moist epithelium located medial to the labia majora; they become engorged with blood during sexual arousal.
- **Lactation:** The production and secretion of milk by the mammary glands.
- **Lactiferous Ducts:** Ducts within the mammary glands that transport milk from the alveoli to the lactiferous sinuses.
- **Lactiferous Sinuses:** Widened areas within the lactiferous ducts where milk collects before being ejected through the nipple.
- **Luteinizing Hormone (LH):** A gonadotropin produced by the anterior pituitary that triggers ovulation and corpus luteum formation in females, and stimulates testosterone production in males.
- **Mammary Glands:** Glands within the breasts that are responsible for producing milk in lactating females.
- **Menses (Menstrual Flow):** The shedding of the endometrial lining of the uterus, accompanied by blood and other material, marking the beginning of the menstrual cycle.
- **Menopause:** The cessation of menstruation and ovulation in women, marking the end of their reproductive years.
- **Membranous Urethra:** The shortest and second part of the male urethra, passing through the floor of the abdominal-pelvic cavity.
- **Mitochondria:** Organelles within cells responsible for cellular respiration and the production of ATP (energy currency), abundant in the midpiece of sperm to power flagellar movement.
- **Mitosis:** A type of cell division that produces two genetically identical diploid daughter cells from one diploid parent cell.

- **Myometrium:** The thick, muscular middle layer of the uterine wall, composed of smooth muscle, responsible for contractions during childbirth.
- **Nipple:** The pigmented projection on the breast through which milk is ejected during nursing.
- **Oogenesis:** The process of egg (ovum) production in females, occurring in the ovaries.
- **Orgasm:** The climax of sexual excitement, characterized by rhythmic muscular contractions; in males, it is often coincident with ejaculation.
- **Ovaries:** The primary female sex organs (gonads) that produce eggs (ova) and female hormones.
- **Ovarian Cycle:** The approximately 28-day cycle of events occurring in the ovaries that culminates in ovulation; it consists of the follicular phase and the luteal phase.
- **Ovulation:** The release of a mature egg (oocyte) from an ovarian follicle.
- **Ovum (Ova):** The female gamete; an egg cell.
- **Oxytocin:** A hormone released by the posterior pituitary that stimulates uterine contractions during childbirth and milk ejection during nursing.
- **Parametrium:** The outer layer of the uterine wall.
- **Parturition (Childbirth):** The process of giving birth, involving uterine contractions to expel the fetus through the vagina.
- **Penis:** The male external copulatory organ, responsible for delivering sperm into the female reproductive tract.
- **Perineum:** The diamond-shaped region of the body between the thighs, bounded by the pubic symphysis, ischial tuberosities, and coccyx; it contains the external genitalia and anus.
- **Ploidy:** The number of sets of chromosomes in a cell.
- **Polar Bodies:** Tiny cells produced during oogenesis that contain chromosomes but little cytoplasm; they are non-viable and degenerate, ensuring the main egg retains maximum cytoplasm.
- **Posterior Pituitary:** A part of the pituitary gland that stores and releases hormones like oxytocin and antidiuretic hormone produced by the hypothalamus.
- **Prepuce (Foreskin):** A fold of skin that covers the glans penis in uncircumcised males and the clitoris in females.
- **Primary Sex Organs:** Organs that produce gametes (gonads).
- **Progesterone:** A female sex hormone primarily produced by the corpus luteum, crucial for preparing and maintaining the uterine lining for pregnancy.
- **Proliferative Phase (Uterine Cycle):** The phase of the uterine cycle during which the endometrium rapidly rebuilds and thickens due to cell division, following menstruation.
- **Prostate:** A male accessory gland located inferior to the bladder, which surrounds the prostatic urethra and contributes secretions to semen.
- **Prostatic Urethra:** The first part of the male urethra, which passes through the prostate gland.
- **Pubic Symphysis:** The cartilaginous joint that connects the two pubic bones in the pelvis.
- **Rete Testis:** A network of tubules within the testis that receive immature sperm from the seminiferous tubules.

- **Scrotum:** A sac of skin and superficial fascia that encloses the testes, providing a cooler environment for sperm development.
- **Secondary Sex Organs:** Structures involved in the delivery or reception of gametes, but do not produce them.
- **Secretory Phase (Uterine Cycle):** The phase of the uterine cycle following ovulation, during which the endometrial glands secrete substances to nourish a potential embryo, maintained by progesterone.
- **Semen:** The fluid ejaculated from the male penis, composed of sperm and secretions from accessory glands (seminal vesicles, prostate, bulbourethral glands).
- **Seminal Vesicle:** Paired male accessory glands that produce a significant portion of the fluid component of semen, including fructose and other substances.
- **Seminiferous Tubules:** Coiled tubules within the testes where spermatogenesis (sperm production) occurs.
- **Septum (Testis):** Connective tissue walls that partially divide the testis into lobules, each containing seminiferous tubules.
- **Sexual Life Cycle:** The generation-to-generation alternation between fertilization (fusion of gametes) and meiosis (halving of ploidy) characteristic of sexual species.
- **Somatic Cells:** All body cells except germline cells; they are diploid and typically divide by mitosis.
- **Spermatic Cord:** A cord-like structure in males that contains the ductus deferens, blood vessels (arteries and veins), and nerves supplying the testis.
- **Spermatagonia (Spermatagonium):** Diploid stem cells in the seminiferous tubules that undergo mitosis to maintain their population and meiosis to produce sperm.
- **Spermatids:** Immature, haploid sperm cells produced by meiosis that undergo spermiogenesis to mature into spermatozoa.
- **Spermiogenesis:** The maturation process of spermatids into spermatozoa (mature sperm), occurring in the epididymis.
- **Sperm (Spermatozoon):** The male gamete, a motile, haploid cell with a head (containing DNA), midpiece (with mitochondria), and tail (flagellum).
- **Spongy Urethra (Penile Urethra):** The longest and final part of the male urethra, which extends through the corpus spongiosum of the penis.
- **Supporting Cells (Sertoli Cells):** Cells within the seminiferous tubules that nourish and support the developing spermatagonia and sperm.
- **Testes (Testis):** The primary male sex organs (gonads) that produce sperm and male hormones (e.g., testosterone).
- **Testosterone:** The primary male sex hormone, produced by interstitial cells in the testes, responsible for male secondary sexual characteristics and regulation of sperm production.
- **Tunic Albuginea:** The tough, white outer fibrous capsule covering each testis.
- **Ureter:** A tube that carries urine from the kidney to the urinary bladder (part of the urinary, not reproductive, system).
- **Urethra (Male):** A tube in males that transports both urine and semen out of the body.
- **Uterine Tube (Fallopian Tube/Oviduct):** A tube that extends from the infundibulum near the ovary to the uterus, providing the usual site of fertilization.

- **Uterine Cycle:** The approximately 28-day cycle of changes occurring in the uterus, consisting of the menstrual, proliferative, and secretory phases, in preparation for a potential pregnancy.
- **Uterus:** A hollow, muscular organ in females where a fertilized egg implants and develops into a fetus during pregnancy.
- **Vagina:** The female muscular, elastic tube that connects the uterus to the outside of the body; it receives the penis during intercourse and serves as the birth canal.
- **Vasectomy:** A surgical procedure for male sterilization involving the cutting or sealing of the vas deferens (ductus deferens).
- **Vestibular Glands:** Glands located near the vaginal opening in females that produce lubricating secretions during sexual arousal.
- **Zygote:** The single diploid cell formed by the fusion of a sperm and an egg during fertilization, marking the beginning of a new organism.