Digestive System

1. Describe the structures of the digestive system and their functions; list the 6 functions of the digestive system in general.

   **Structures -**
   1. Alimentary Canal organs: food tube – wherever food passes through:
      - Mouth, Pharynx, Esophagus, Stomach, Small and Large Intestines
   2. Accessory Organs: Produce enzymes: salivary glands, liver, gall bladder, pancreas

   **Functions -**
   1. Ingestion – tasting or taking in food
   2. Mastication – chewing/salivating food in mouth
   3. Deglutition - swallowing
   4. Digestion – breaking food into smaller pieces (mechanical) or chemically changing into smaller molecules (chemical)
   5. Absorption – movement of digested food from the alimentary canal to the blood
   6. Defecation – elimination of feces (waste products) from alimentary canal

2. Describe the four layers of alimentary canal tissue
   A. Mucosa – simple columnar epithelial
      Inner layer – protects the other layers from acids/bases, bacteria, viruses, etc
   B. Submucosa – loose connective
      Next layer – connects epithelium to muscle
   C. Muscular – smooth muscle
      Next layer towards peritoneal cavity – helps move food through alimentary canal
   D. Serosa – areolar loose connective
      Visceral Peritoneum – covers the organs of the GI tract
      Parietal Peritoneum - Lines the peritoneal cavity

3. Describe two types of mechanical digestion.
   A. **Mixing motions** – rhythmic contractions of smooth muscle – mixes food with digestive enzymes
   B. **Propelling motions** – Peristalsis – alternate smooth muscle contraction and relaxation – slowly squeeze food and waste through alimentary canal

4. Be able to list several digestive enzymes for each macromolecule (carbohydrates, lipids, proteins, nucleic acids) and the products of each.
   A. **Carbohydrate Digestion**
      1. Starch – amylase (salivary and pancreatic – in mouth and small intestines)
      2. Disaccharides – disaccharidases (sucrase, maltase, lactase - from small intestines in small intestines)
   B. **Protein Digestion**
      1. Proteins – Pepsin (stomach)
         Breaks down large globular proteins into large polypeptide chains
      2. Large Polypeptides – Trypsin, chymotrypsin, and carboxypeptidase (in small intestines)
         Breaks down large polypeptides into small polypeptides and peptides
3. Small Polypeptides – Aminopeptidase, carboxypeptidase, and dipeptidases (in small intestines) Break down small polypeptides and peptides into amino acids

C. Lipid Digestion
1. Fat globules – Bile – breaks larger pieces of fat into smaller fat globules (emulsification – not chemical)
2. Fat droplets – Lipase – breaks triglycerides into fatty acids and glycerol (small intestines)

D. Nucleic acid Digestion
1. DNA and RNA - Convert into nucleotides (small intestines)
2. Nucleotides - monomers of Nucleic acids

5. Describe the autonomic nervous system influence on digestion.
   A. Sympathetic - slows visceral motility
   B. Parasympathetic – increases visceral motility

6. Describe several common disorders of the digestive system.
   A. Peptic ulcers – Ulcers in stomach (largely caused by Helobacter pylori)
   B. Appendicitis – Inflammation of appendix
   C. Diverticulitis – Inflammation of diverticuli
   D. Diverticulosis – Production of diverticuli (outpouching of colon – can become polyps – develop into tumors)
   E. Anorexia nervosa – disorder in which person eats very little and exercises excessively
   F. Bulimia – disorder in which person binges on food and then forces vomiting immediately afterward

Reproductive System
1. Describe the functions of the male reproductive system (general).
   reproductive - produce/transport sperm/semen for fertilization of ovum
   endocrine - produce/secrete Androgens for male sexual organs and traits

2. Describe the structures and functions of the primary and secondary internal and external reproductive organs.

   Primary – Testes – located inside the scrotum
   structure - 5x3 cm ovoids weighing about 10 g
   tunica albuginea - dense fibrous connective tissue outer covering
   arrangement - divided into about 250 lobules divided by septa
   a. Each lobule contains 1-4 highly convoluted “semiferous tubules”
   b. germinal epithelium - outer region of specialized stratified epithelium - two types of cells :
      1) Spermatogenic cells - give rise to sperm cells (spermatozoa)
      2) Sertoli’s (Nurse) cells - support/nourish spermatogenic cells
   c. “rete testes” - formed by several semiferous tubules
   d. “efferent ductules” formed by several rete testes
   e. “epididymus” - formed by several efferent ductules
   f. sperm travels through “vas deferens” to the “ejaculatory duct”, prostatic urethra, membranous urethra, penile urethra and out the body.

   Secondary Internal:
   epididymus - 6 m tightly coiled threadlike tube ; located - superior/lateral/posterior surface of testis
   structure - ciliated columnar epithelium lining and smooth muscle walls
function - maturation of non-mobile/viable immature spermatozoa

vas deferens - 45 cm muscular tube; located within spermatic cord which passes through inguinal canal; located - superior and posterior to urinary bladder; connected to ejaculatory duct

structure - ciliated columnar epithelium lining and thick smooth muscle walls with distal Ampulla
function - propel mature sperm by peristalsis/ciliary action to ejaculatory duct

semenal vesicle- 5-7 cm finger shaped glands - joins vas deferens at the posterior wall of urinary bladder
structure - specialized glandular epithelial lining
function - secretes alkaline fluid rich in fructose and prostaglandins
  regulate pH of semen, b) provides 60% of semen volume c) fructose -nourish sperm, d) prostaglandin helps sperm travel

ejaculatory duct - formed by junction of seminal vesicle and vas deferens; passes through prostate gland
structure - short tube; function - empty semen into urethra

prostate gland - 4x3 cm chestnut shaped gland; immediately inferior to urinary bladder
structure - specialized glandular epithelium surrounded by smooth muscle
function - a) secretes thin alkaline fluid into semen/urethra at ejaculation; b) provides 35% of semen volume; c) helps establish pH of semen

bulbourethral (Cowper’s) gland- pea-sized gland located inferior to prostate gland and lateral to urethra
structure - specialized glandular epithelium with 2.5 cm duct at urethra
function - secretes mucous-like fluid that helps neutralize acidic urethra

components of semen 4-5% sperm and 95% alkaline fluid

Secondary External Structures
Scrotum - pouch of skin; located below groin behind penis
structure - integument with subcutaneous layer containing with layer of smooth muscle called Dartos Muscle
function - house testis outside body for proper spermatogenic temperature

Penis - urinary and copulatory organ; hangs suspended from perineum anterior to scrotum/testes
structure- 8-10 cm long cylindrical organ
  a. body - 3 columns of “erectile tissue covered by Tunica Albuginea
  2 dorsally located larger corpora cavernosa
  1 ventral located smaller corpus spongiosum contains penile urethra
  b. glans penis - distal/terminal enlarge end containing many “pleasure” nerve endings
  c. Prepuce- foreskin for protection (?) - often removed at birth
function - conveys urine at micturition and semen at sexual intercourse

3. Describe spermatogenesis and androgenesis.

spermatogenesis - production of sperm within seminiferous tubules stimulated by production of FSH by adenohypophysis during puberty
process - spermatogonium, primary spermatocyte, secondary spermatocyte, spermatids, spermatozoa
meiosis I produces secondary spermatocyte(N), meiosis II produces spermatids (N)
immature spermatids are connected by cytoplasm and will develop into
mature spermatozoa with the help of nurse cells which phagocytize the
cytoplasm between the immature spermatids. (see figure.28.12 and 28.13)
androgenesis - production of testosterone in the interstitial cells of testes
a. stimulates growth and development of primary and secondary
reproductive organs
b. stimulated by LH (which is secreted by adenohypophysis)

4. Describe the path of sperm from the testes through the male reproductive system.
SREEVE (is the acronym before the sperm gets to the urethra) Seminiferous tubules
→ Rete Testes → Efferent Ductules → Epidiymus → Vas Deferens → Ejaculatory
Duct → Prostatic Urethra → Membranous Urethra → Penile Urethra

5. Describe the structure of sperm.
a. head - contains nucleus (23 chromosomes) - covered by acrosome containing
hyaluronidase (dissolved hyaluronic acid surrounding/protecting ovum.)
b. body - contains large numbers of mitochondria - for energy
c. tail - flagellum for propelling sperm through female system

6. Describe the general functions of the female reproductive system.
1. Reproductive - produce/secrete ova for fertilization by sperm
2. Endocrine - produce/secrete estrogens and progesterone for female sexual organs
and traits and perpetuation of pregnancy

7. Describe the structures and functions of the primary and secondary internal and external
reproductive organs.
Primary Reproductive Organs – Ovaries
structure - 3.5 x 2 x 1 cm almond-shaped organs/glands weighing about 3 g.
a. outer covering- Germinal epithelium and Tunic Albuginea
b. cortex- outer highly vascularized tissue containing ovarian follicles
c. medulla - inner region of connective tissue, blood/lymph vessels, and
nerves
function - Oogenesis, estrogenesis, and progesteronesis

Secondary Reproductive Organs
a. Internal - fallopian/uterine tubes (oviducts), uterus, vagina
1. Fallopian/uterine tubes/oviducts - 10-0.7 cm ciliated, muscular tubes located from
ovaries through pelvic cavity to uterus
structure -outer fibrous tissue, middle smooth muscle, inner ciliated epithelia
infundibulum/fimbrae - enlarged distal end with projections
function - receive/transport ovulated ovum by peristalsis and ciliary action
upper 2/3 is site of normal fertilization
2. Uterus - 7.5x5x1 cm pear-shaped hollow organ located medial to oviducts/ovaries and superior to vagina
   structure - 3 regions: uppermost fundus, center body, lower neck-like cervix
   layers - perimetrium (visceral peritoneum) - outer fibrous connective tissue
   myometrium - middle smooth muscle contracts during labor/parturition
   endometrium - inner highly vascularized/glandularized epithelium
   function - endometrium develops into placenta, which nourishes embryo/fetus at pregnancy and expels fetus (labor)
3. Vagina - 7-10 cm distensible/collapsible muscular tube located inferior to cervix between urinary bladder and rectum
   structure - inner stratified squamous epithelium at rugae, middle smooth muscle, Bartholins/G. vestibular gland - secretes lubricant during coitus
   function - receive semen from penis during coitus; discharge menses during menstruation
b. External - mons pubis, labia majora/minora, clitoris, vestibule, Bartholins (greater vestibular gland, and urethral/vaginal orifices, breasts
   1. Mons Pubis - hairy skin covered pad of fat over symphysis pubis
   2. Labia majora - “large lips” covering/protecting labia minora, etc..
   3. Labia minora - “small lips” covering/protecting clitoris, etc.
   4. Clitoris - highly vascularized innervated erectile tissue
   5. Breasts -
      structure - many lobes/lobules containing alveolar glands and adipose tissue
      function - produce/secrete mother’s milk 2-3 after parturition
      a. stimulated to increase by estrogen and progesterone
      b. milk production is stimulated by prolactin secreted by adenohypophysis
      c. milk let down is stimulated by oxytocin secreted by neurohypophysis
      d. colostrum (witch’s milk) = watery fluid, rich in antibodies/protein but low in fat/carbohydrates, secreted first 2-3 days after parturition
8. Describe oogenesis, estrogenesis, and progesterogenesis.

Oogenesis - production of ova within follicles
1) process - Oogonia, primary oocyte, secondary oocyte, ova/Graafian follicle
   Oogonia - primitive female gametes - develops into primary Oocytes
   Primary oocytes go through Meiosis I to produce Secondary oocyte
   Ova - mature follicle containing mature ovum
       granulosa cells - outer stratified epithelium that secretes estrogen
       antrum - fluid filled cavity surrounding oocyte/ovum
2) stimulated by FSH secreted by anterior pituitary
Estrogenesis - production of estrogen by granulosa cells of follicle
   estrogens - primarily 17β Estradiol, stimulate growth and development of all female sex organs and growth and development of secondary sexual traits (breasts, fat deposition, etc.)
Progesteriogenesis – production of progesterone
   stimulate endometrium/placenta and embryo growth and development during pregnancy
9. Describe the stages of the Menses, the length of time in each stage, the hormone levels during each stage, and the effect on the ovary and uterus.

Three phases

a. Menstrual phase = days 1-5 (about 3-5 days in length)
   - ovarian - increase in FSH stimulates primary follicles / oocyte to grow
   - uterine - decrease in estrogen/progesterone causes beginning of sloughing/bleeding (Menses)

b. PreOvulatory(Follicular)/Proliferative phase- days 6-15 (most variable length)
   - ovarian – (Called the Follicular phase) increasing FSH stimulate primary follicles to become secondary follicle/oocyte and Graafian follicle/mature ovum
   - uterine- (Called the Proliferative phase) -Increased estrogen stimulate endometrium to become thicker and more vascularized/glandularized; terminates with Ovulation at 14 days before menses

c. Ovulation - LH surge causes Graafian follicle to rupture and release ovum

d. PostOvulatory(Luteal)/Secretory Phase- days 15-28
   - ovarian – (Called the Luteal Phase)Graafian follicle becomes Corpus Luteum which secretes estrogen for continued thickening of endometrium and progesterone for increased glandularization and vascularization
   - uterine – (Called the Secretory Phase) increased estrogen and progesterone causes more endometrial thickening and glandularization/vascularization, respectively

10. Describe what occurs if fertilization does occur; does not occur.

1. Fertilization DOES NOT OCCUR:
   a. Corpus luteum dies and becomes Corpus Albicans and ceases secretion of estrogen and progesterone
   b. Endometrium degenerates and begins sloughing off and bleeding

2. Fertilization DOES OCCUR:
   a. Zygotes becomes blastocyst which implants in upper 2/3 endometrium
   b. After implantation blastocyst/endometrium becomes Embryo/Placenta
   c. Embryo/Placenta secrete Human Chorionic Gonadotropin (HCG)
   d. HCG stimulate Corpus Luteum to continue secreting progesterone and estrogen for 3 months - which maintains endometrium for pregnancy
   e. Placenta secretes Estrogen/Progesterone to maintain pregnancy last 6 months of Gestation
   f. Neurohypophysis secretes oxytocin to stimulate uterus during labor/Parturition