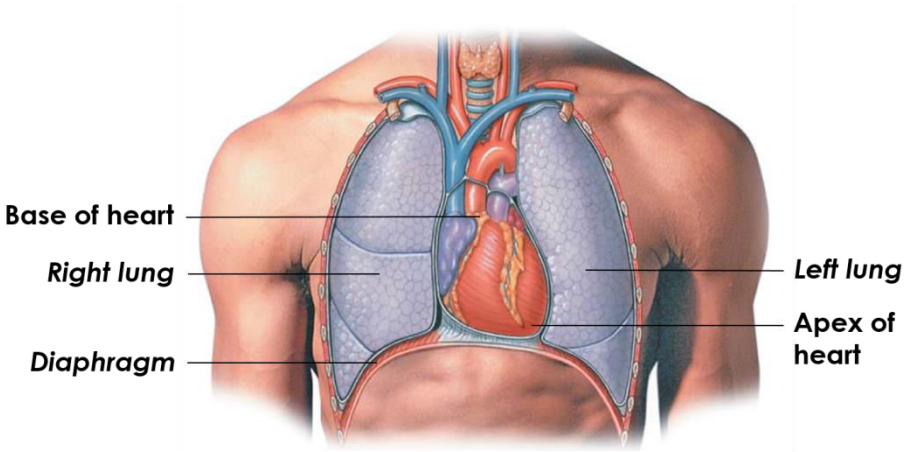
Lecture Notes

Week One- The Heart

- The heart is a double pump
    - Has 2 sides:
        - Right side receives blood from the body, pumps to lungs (pulmonary circuit)
        - Left side receives blood from lungs, pumps to the rest of the body (systemic circuit)
    - Has 4 chambers:
        - 2 Atria at the top (receives blood)
        - 2 Ventricles at the bottom (discharges blood)
- The heart acts **purely as a pump**
- Blood is **ALWAYS RED** (regardless of if its oxygenated or deoxygenated)
- The structure of the heart facilitates its function, i.e. one-way blood flow
- The heart works by a series of continually repeated mechanical events (cardiac cycle), each of which is regulated by specific electrical events
- The purpose of the cardiovascular system is:
    - **To provide adequate blood flow to all tissues/organs according to their immediate needs**
- The heart is a muscular organ about the size of a fist
- Is located between the left and right lungs, in a region of the thorax (chest cavity) called the mediastinum
- Sits just behind (posterior to) and slightly left of the sternum but in front of (anterior to) the vertebral column

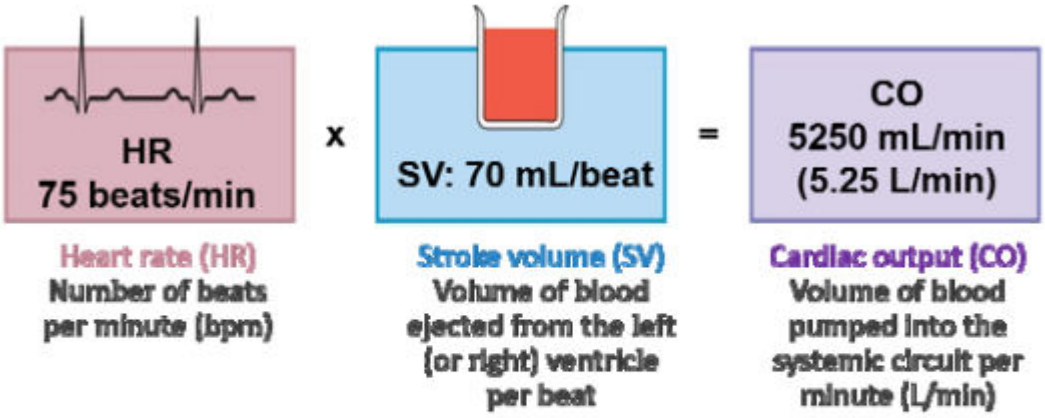


- The top of the heart (sometimes referred to as the base) is attached to a series of large blood vessels (arteries and veins)
- This superior surface sits just below the 2nd and 3rd costal cartilages of the rib cage
- Bottom of the heart projects further to the left of the sternum, with the apex (most inferior point) being situated behind the 5th intercostal space and approximately in line with the nipple (7.5cm left of the midline)

Lecture Notes

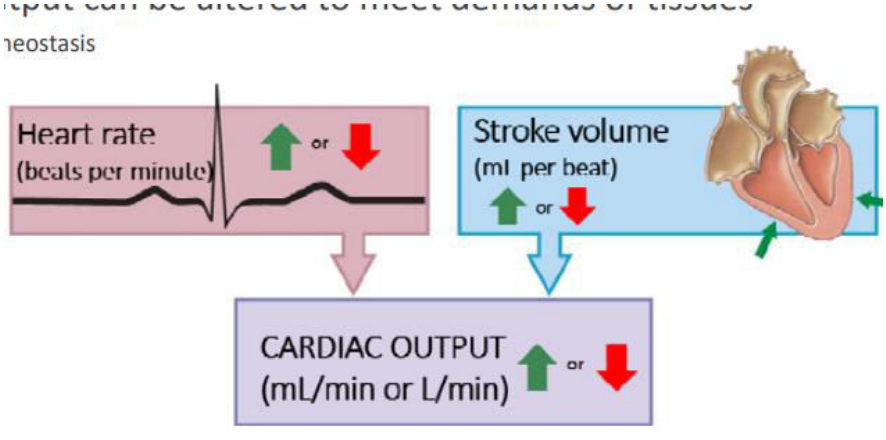
Week Two- The Blood

- **Cardiac output**
  - The volume of blood leaving the heart each minute
  - Measured as a rate (ml or L per min)
  - The action of the heart can change how hard and how fast it pumps
  - The amount of blood pumped out of a single ventricle in one minute is known as the **cardiac output** (ml or L per min)
  - Can be calculated using a simple formula
    - **Cardiac output = heart rate x stroke volume**
    - **CO = HR x SV**



Cardiac output = heart rate x stroke volume
CO = HR x SV

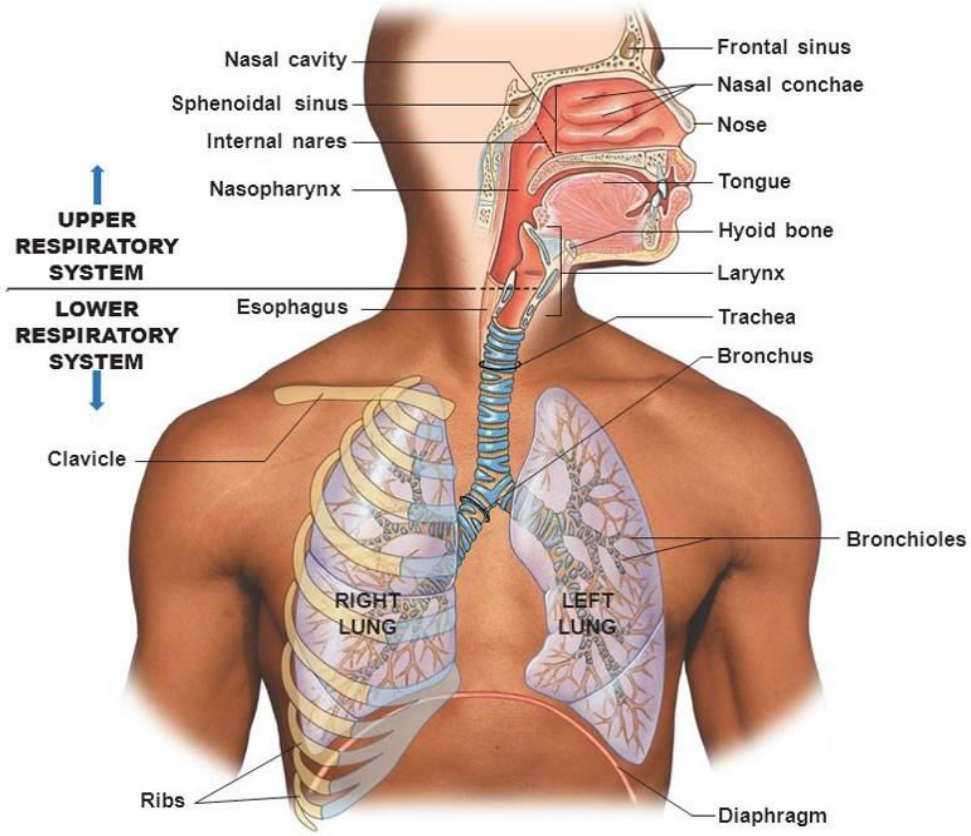
  - Cardiac output can be altered to meet demands of tissues
    - Maintain homeostasis
  - Changes in stroke volume or heart rate lead to changes in cardiac output



Lecture Notes

Week Three- The Respiratory System

- **Functions of the respiratory system**
  - The respiratory system helps us to:
    - Breathe
    - Speak and make other vocalisations
    - Control the pH of our body (by regulating carbon dioxide levels)
    - Create pressure gradients that promote the flow of venous blood and lymph (during inspiration and expiration)
    - Expel contents of the abdomen and pelvis during urination, defaecation and childbirth (all via breath-holding)
  - The respiratory system is a series of specialised tubes that take gas (air) from the atmosphere, down to the tiny gas-exchanging regions known as **alveoli**
  - Along this passage gas is warmed and humidified to limit damage to the delicate structures of the alveoli and is also cleared of large foreign particles to prevent blockage (obstruction) of the airways and infection (as much as possible
  - The respiratory system can be structurally separated into upper and lower zones:



    - Upper respiratory tract:
      - Starts at the nose- with the nostrils allowing air to enter the system
        - Mucous and hair within the nasal cavity work to trap and eliminate any coarse particles

Lecture Notes

Week Five- Blood and Lymphatics

- **Blood**
  - The role of blood can be broken down into three main categories
    - Distribution
      - Delivers nutrients e.g. oxygen
      - Removes waste e.g. carbon dioxide
      - Hormones
    - Regulation
      - Controlling body temperature
      - pH
      - Fluid volume (controlling volume of fluid in blood and cells)
    - Protection
      - Infection (WBCs)
      - Blood loss (control of blood flow)
  - What's in blood?
    - Plasma (approx. 55%)
    - Red blood cells (approx. 45%)
    - Buffy coat <1%
      - White blood cells
      - Platelets
  - Key concepts
    - Blood is involved in distribution, regulation and protection
    - Blood can be separated into red blood cells, plasma and the buffy coat (containing white blood cells and platelets)
- **Plasma**
  - Liquid component of blood
  - Straw-coloured liquid
  - 90% water
  - 10% dissolved components
    - Electrolytes e.g. sodium, chloride, potassium etc.
    - Plasma proteins: albumin, globulins, fibrinogen
    - Metabolic by-products e.g. creatinine, urea (things we're getting rid of)
    - Nutrients
    - Respiratory gases
    - Hormones
  - Key concepts
    - Plasma is the fluid component of blood, allowing blood cells and nutrients to move through the cardiovascular system
    - By controlling substance levels in the blood, we can control substance levels in our cells

Lecture Notes

Week Six- The Endocrine System

- The endocrine system
  - Controls and coordinates body processes using hormones
  - Works with the nervous system to carry out these activities
  - Uses hormones (chemical signals) to influence metabolic activities
  - Responses to the body are generally slow but the effects on the body are long lasting (hours-days)
  - Functions of the endocrine system
    - Hormones- chemical messages that regulate:
      - Metabolism (anabolic and catabolic reactions in the body to produce energy)
      - Reproductive processes
      - Growth and development
      - Blood composition/pressure
      - Hunger/digestion (making us feel hungry and full etc.)
      - Body defences (e.g. lymphocytes)
      - Stress response
      - Sleep (releasing melatonin to regulate sleep)
- Organs of the endocrine system
  - The endocrine system is made up of various organs that contain glands capable of synthesising and releasing hormones
  - When stimulated to do so, endocrine glands release hormones into the blood stream to affect distant target cells/glands
  - Hypothalamus
    - Controls secretion of pituitary hormones
    - Neuroendocrine organ (because its involved in the nervous and endocrine systems)
  - Pituitary glands
    - Secretes multiple hormones around the body to target organs such as the thyroid or adrenal glands
  - Pineal gland
    - Responsible for our sleep/wake cycle (Circadian rhythm)
    - Releases melatonin (which induces sleep)
  - Thyroid gland
    - Releases thyroid hormones which regulates metabolic rate
    - Regulates calcium levels
  - Parathyroid glands
    - Regulates blood calcium
  - Thymus
    - Responsible for immune response (maturation of T-cells)
  - Adrenal glands

Lecture Notes

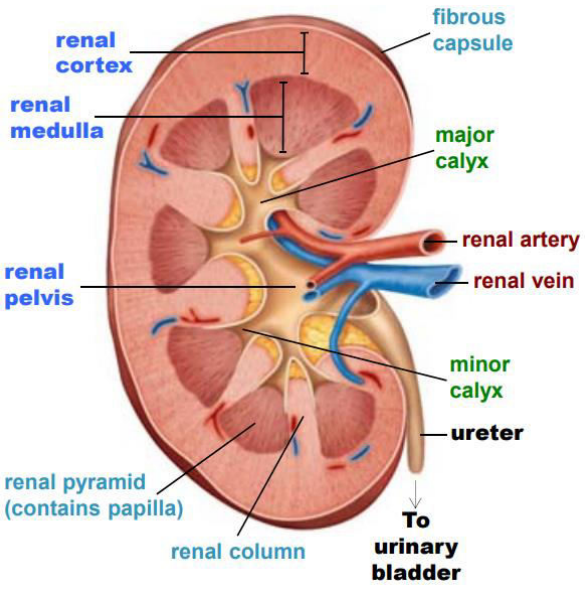
Week Seven- The Digestive System

- Why is digestion so important?
    - Provides the body with:
        - Nutrients
        - Substrates for making new "stuff"
        - Fuel source
        - Energy for cellular metabolism
- Organs of the digestive system
    - The alimentary canal (gastrointestinal tract) (mechanical breakdown of food)
        - Mouth
        - Pharynx
        - Esophagus
        - Stomach
        - Small intestine
        - Large intestine
        - Anus
    - Accessory organs (for chemical breakdown of food)
        - Tongue
        - Salivary glands
        - Liver
        - Gall bladder
        - Pancreas
- Key concepts
    - The alimentary canal (digestive tract) is where the food passes through
    - The accessory organs contribute to digestion but the food does not pass through them
- **Digestive processes**
    - **Six essential steps** in the digestive system
        - **1. Ingestion**
            - Ingest food
        - **2. Propulsion**
            - Propelling the food into the digestive system
            - Swallowing (voluntary)
            - Peristalsis (involuntary)
                - Propulsion of food through the gastrointestinal tract
                - Can occur in the esophagus, stomach and small intestine
                - The alternating waves of contraction and relaxation of muscle around the food to push the food down the tract
                - Very strong contractive force
        - **3. Mechanical breakdown**
            - Mouth- chewing and saliva

Lecture Notes

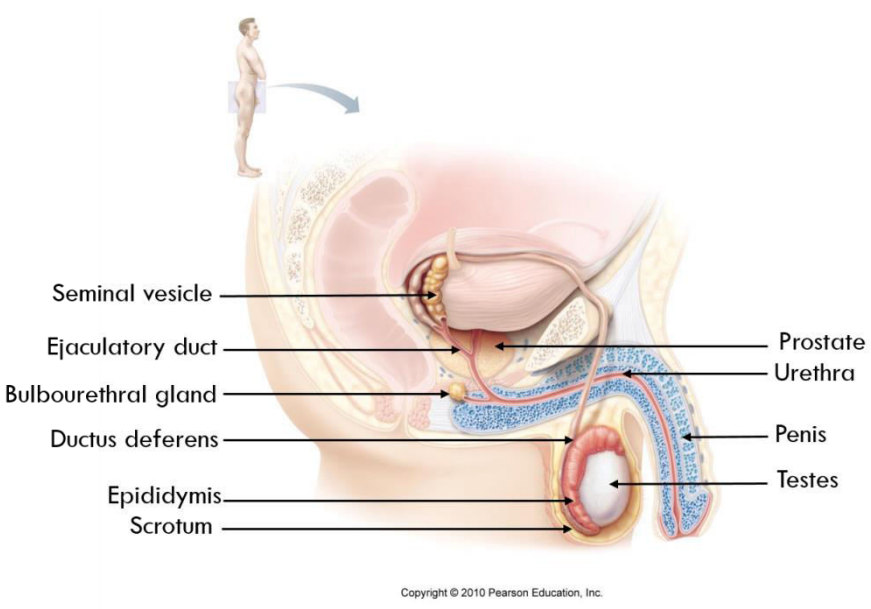
Week Eight- The Urinary (Renal) System

- **The urinary system**
  - The kidneys are the main organ of the urinary system
    - Functions
      - Regulates
        - Fluid volume
        - Solutes and electrolytes
        - Acid-base balance
      - Excretes wastes
        - Metabolic (e.g. urea)
        - Foreign (e.g. drugs)
      - Endocrine
        - Erythropoietin
        - Renin
        - ADH, aldosterone
      - Synthesise
        - Vitamin D
        - Glucose (gluconeogenesis)
  - Key concepts
    - The urinary system consists of the kidneys, ureters, bladder and urethra
    - The urinary system is responsible for a number of important functions including the regulation of blood composition and the removal of wastes
- **Anatomy of the kidney**
  - Three distinct regions
    - **1. Renal Cortex** (outer region)
      - Glomeralus, Proximal Convoluted Tubule & Distal Convoluted Tubule
    - **2. Renal Medulla** (next region in)
      - Nephron loops and collecting ducts
    - **3. Renal Pelvis**
      - Funnel



Lecture Notes
Week Ten- Reproduction

- Male reproductive anatomy



  - Consists of internal and external structures
    - **External structures**
      - **Penis-** organ consisting of erectile tissue and urethra. Allows deposition of sperm into female reproductive tract
      - **Scrotum**- sac of skin housing testes (and epididymis)
        - **Testes**- two oval shaped structures responsible for producing sperm and testosterone. These are the male gonads
        - **Epididymis**- a structure that sits behind each teste and acts to mature and store sperm
    - **Internal structures**
      - **Vas (ductus) deferens**- a tube that takes ejaculated sperm from the epididymis to the seminal vesicles
      - **Seminal vesicles**- a pair of glands that produce and secrete a substance that makes up the majority of semen (ejaculated fluid)
      - **Ejaculatory duct**- a short duct connecting the vas deferens to the urethra
      - **Prostate gland**- a single donut shaped gland that contributes secretions to semen
      - **Bulbourethral glands**- small pea-sized glands that produce a secretion that neutralizes acidic environment in urethra and lubricates tip of penis
      - **Urethra**- the tube running from the prostate through the penis, allowing males to pass both urine and semen

Lecture Notes

Week Eleven- Pregnancy and Fetal Development

- Meiosis: production of gametes
    - Recall that DNA is contained within genes, situated on chromosomes
    - Most body cells are **diploid (2n)** (two halves) and contain:
        - Two sets of chromosomes (one maternal, one paternal)
        - 23 pairs of "homologous" chromosomes, 46 in total
    - Gametes (sperm and oocytes) and **haploid (*n*)** (only half)and contain:
        - 23 chromosomes (one from each pair)- sperm has one half, oocyte has other
        - Gametes are made by meiosis
- Mitosis for growth, meiosis for gametes
    - Growth and replenishment of somatic cells involves mitosis
        - Mitosis= normal cell division
        - Normal cell → undergoes DNA replication (creates two sets of DNA) → cell divides into two cells
    - Gamete (sperm/ova) formation of involves meiosis (splits into 4)
    - Meiosis is specific to gametes
        - Leads to a halving of the chromosomes (from 2n to n)(e.g. 23 chromosomes at the end)
        - Produces four daughter cells
        - Introduces genetic variation over generations by:
            - Muddling up chromosomes from two different parents
            - Crossover (swapping of chromosomal sections)
        - When fertilisation occurs, the normal diploid chromosomal number is restored (in human, 2n=46)
    - Take home messages:
        - Gametes must have half the number of chromosomes compared to a normal body cell –this is achieved via meiosis
        - Meiosis results when a stem cell undergoes a single round of DNA replication followed by 2 rounds of cell division, and results in 4 daughter cells, each with half the number of chromosomes
        - Meoisis results in increased genetic variation through muddling of chromosomes from the male and female as well as crossing over of fragments from one chromosome to the next
        - Gametogenesis refers to the production of gametes. Spermatogenesis produces sperm and oogenesis produces oocytes
- Production of sperm and oocytes part 2- spermatogenesis and oogenesis
    - Spermatogenesis
        - Occurs in the seminiferous tubules
        - Produces sperm
        - Starts to occur at approximately 14 years of age
        - Results in 400 million new sperm per day
        - Continues throughout adult life