**Heavy Hitters Topic 11.1**

* Principles of vaccination
  + vaccine is a modified/weakened/attenuated form of a pathogen / contains antigens from pathogens;
  + vaccine injected/ingested/introduced to patient;
  + pathogen/antigens stimulates specific immune response called primary/initial responses;
  + antigens stimulate macrophages/lymphocytes/T-cells;
  + which stimulate cloning of B-cells/plasma cells;
  + including development of memory (B-)cells;
  + that produce specific antibodies;
  + (upon second exposure) production of antibodies is much faster;
  + higher level of antibody production / person has immunity;
  + called secondary response;
  + labelled graph showing curve with higher slope/peak for secondary response than primary response;
  + may need booster shot to maintain immunity;
  + this is an example of active/artificial immunity;
* Explain immune response
  + a. each antibody corresponds to a specific antigen
  + b. antibodies are necessary for immunity/resistance to «infectious» disease
  + c. macrophage/phagocyte ingests/engulfs pathogen
  + d. macrophage/phagocyte digests pathogen
  + e. macrophage/phagocyte displays antigen from pathogen
  + f. antigens of a pathogen correspond to a specific T lymphocytes/cells  
    ***OR***  
    T lymphocytes/cells are activated by antigen binding
  + g. T lymphocytes/cells activate B lymphocytes/cells
  + h. «B cells» divide by mitosis to form many/clones of plasma cells
  + i. plasma cells secrete specific antibody
  + j. some «activated» B lymphocytes/cells act as memory cells
* Process of making monoclonal antibodies
  + B lymphocytes are produced in laboratory animal after injection with an antigen;
  + animal cells/these cells are fused with tumour cells (to form hybridomas which) produce antibodies;
* Active vs passive immunity
  + immunity is the ability of an organism to resist infection;
  + due to presence of (specific) antibodies;
  + immunity can be active or passive;
  + passive due to receiving antibodies from external sources/across placenta/from breast milk/injection;
  + active results from facing an infection directly/through vaccination;
  + pathogen/foreign cell invades body;
  + leads to clonal selection/formation of B memory cells;
  + B-cells produce specific antibodies;
  + if same pathogen enters body again memory cells activated/stimulated to divide;
  + antibodies produced faster and in greater amounts;
* Antibiotics will not work on viruses (only kill biotic (living) things, like bacteria)
* HIV infection – review from SL – look at bioninja

**Heavy Hitters Paper 2 Topic 11.2**

* Draw and label a diagram of a sarcomere
  + a. actin filaments – drawn as thin lines;
  + b. myosin filaments (with heads) – drawn as thick lines;
  + c. regions of overlap between fibres should follow diagram of sarcomere;
  + d. correct labelling of the A or H band/Z line;
* Explain the process of muscle contraction
  + a. sliding filament model / filaments/actin and myosin slide past each other;
  + b. action potential/depolarisation/nerve impulse arrives at end of motor neurone;
  + c. neurotransmitter/acetylcholine released causing action potential (in muscle fibre);
  + d. sarcoplasmic reticulum releases calcium ions;
  + e. calcium ions cause binding sites on actin/for myosin to be exposed;
  + f. myosin heads bind to sites on actin/form cross-bridges;
  + g. myosin (head) moves actin filament using energy from ATP;
  + h. actin moved towards the centre of sarcomere/M line/M band;
  + i. sarcomeres shortened;
  + j. (binding of) ATP causes release of myosin head from actin;
  + k. conversion of ATP to ADP and Pi causes myosin heads to change angle;
  + l. cycle (of events) repeated (during muscle contraction);
* Explain role of ATP in muscle contraction
  + a. ATP binds to myosin heads;
  + b. ATP used to break cross bridges;
  + c. energy released when ATP forms ADP and phosphate;
  + d. myosin head reset;
  + e. actin slides over myosin;
* Label structures of elbow diagram (muscles, bones, joint, tendon, ligament)

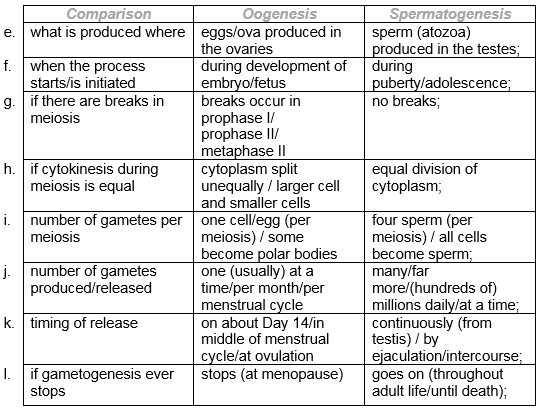
**Heavy Hitters Topic 11.3**

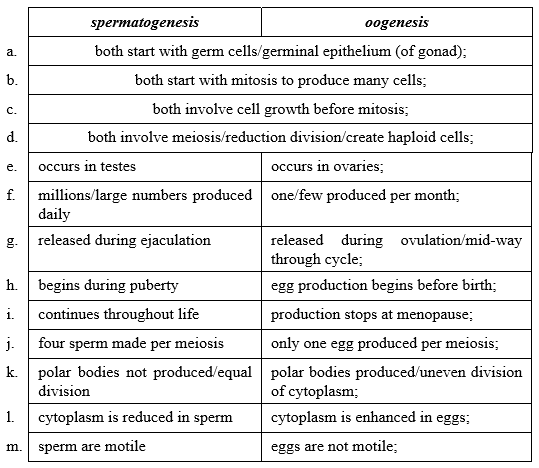
* Compare blood in the renal artery vs renal vein
  + a. less urea/excretory waste products/creatinine in renal vein
  + b. less oxygen in the renal vein
  + c. more carbon dioxide in renal vein
  + d. less glucose in renal vein
  + e. concentration of sodium ions/chloride ions/pH at normal level in the renal vein whereas it is variable in renal artery
  + f. solute concentration/osmolarity/water balance at normal level in the renal vein whereas it is variable in renal artery
* Explain the process of ultrafiltration
  + blood (in the glomerulus) under high pressure caused by difference in diameter of (afferent and efferent) arterioles;
  + fluid plasma and small molecules forced into kidney tubule/Bowman’s capsule/ through fenestrations/basal membrane;
  + which prevent larger molecules/blood cells from passing through;
* How does the structure of the nephron enable the kidney to function
  + Osmoregulation/excretion of nitrogenous waste/urea «is a function of the» kidney
  + Ultrafiltration in the glomerulus/smaller molecules filtered out in the glomerulus  
    ***OR***  
    capillary walls/glomerulus permeable to smaller molecules   
    *Reject ultrafiltration in the Bowman’s capsule.*
  + Basement membrane/filtration slits/podocytes act as filter/prevent loss of «large» «proteins»/prevent loss of blood cells
  + High «blood» pressure in glomerulus due to larger afferent than efferent arteriole
  + «Selective» reabsorption of glucose/useful substances in proximal convoluted tubule
  + Microvilli/coiling/convolutions give large surface area  
    ***OR***  
    pump proteins to reabsorb specific solutes «in proximal convoluted tubule»
  + Water reabsorbed in descending limb «of loop of Henle»  
    ***OR***  
    descending limb permeable to water
  + Active transport/active pumping of sodium ions/Na+ out of ascending limb «from filtrate to medulla»
  + Ascending limb is impermeable to water
  + Loop of Henle creates solute gradient/high solute concentration/hypertonic conditions in medulla
  + Distal convoluted tubule adjusts pH/adjusts concentration of Na+/K+/H+
  + Water reabsorbed in collecting duct
  + Collecting duct permeability to water varies due to number of aquaporins/ADH
  + Osmoregulation by varying the amount of water reabsorbed «in the collecting duct»
* Explain the role of the nephron in maintaining water balance in the blood (osmoregulation)
  + water is filtered freely from blood to Bowman’s capsule;
  + majority/80 % of water in filtrate reabsorbed in proximal convoluted tubule;
  + water balance in blood controlled as filtrate passes through collecting duct;
  + descending loop of Henle has water channels/aquaporins/is permeable to water;
  + loop of Henle creates hypertonic conditions in medulla;
  + water moves from tubule to hypertonic more concentrated medulla;
  + ascending loop (of Henle) impermeable to water;
  + Na+/NaCl actively transported out of (thick portion of) ascending limb;
  + anti-diuretic hormone/ADH controls permeability of collecting duct to water;
  + ADH released when blood too concentrated/hypertonic / *vice versa;*
  + aquaporin channels (in collecting duct) allow water to exit;
  + collecting duct passes through increasing gradient in kidney/medulla;
  + gradient causes reabsorption of more water by osmosis;
  + small volumes excreted if solute concentration too high/blood too concentrated / *vice versa*;
* Explain the process of ADH secretion and how it is controlled
  + control of ADH secretion by negative feedback;
  + ADH controls water reabsorption in kidney;
  + osmoreceptors in hypothalamus monitor water content (in blood);
  + ADH produced by neurosecretory cells in the hypothalamus;
  + transported (down axons of these cells) to the posterior pituitary;
  + low water content/high solute concentration in blood ((usually) causes action potential to be sent to posterior pituitary);
  + posterior pituitary releases ADH which travels to collecting ducts of kidney;
  + more water reabsorbed (by collecting ducts) making water content (of blood) higher/solute concentration lower;
  + less ADH released;
* Explain how nephron changes the composition of the blood
  + a. higher nitrogen/urea as blood enters nephron/Bowman’s capsule than when it leaves the nephron (in the renal vein);
  + b. most small soluble molecules/glucose/nutrients/ions are removed from blood in Bowman’s capsule;
  + c. through ultrafiltration;
  + d. proteins / blood cells / large molecules remain in the blood;
  + e. as filtrate moves through the nephron (tubule), water is returned to the blood (by osmosis);
  + f. glucose/nutrients is returned to blood by active transport (and diffusion) / selective reabsorption;
  + g. in the proximal convoluted tubule;
  + h. urea / uric acid remain in the filtrate / removed from blood;
  + i. sodium is pumped into the medulla in the loop of Henlé;
  + j. water reabsorption is enhanced by a high sodium gradient (in the medulla);
  + k. permeability of the collecting duct membrane is regulated by hormones / ADH;
  + l. water concentration in urine is variable to maintain homeostasis in the blood;
  + m. more oxygen/less carbon dioxide in blood entering (kidney) than in blood leaving (kidney);
* Outline processes in kidney related to osmoregulation
  + osmoregulation is maintenance of water balance of blood/tissues;
  + loop of Henle creates hypertonic conditions in the medulla;
  + water reabsorbed as filtrate passes through collecting duct;
  + hypothalamus monitors/controls water balance/content of blood;
  + controls secretion of ADH by (posterior) pituitary gland;
  + ADH is released when blood too concentrated/too little water/hypertonic;
  + ADH makes the collecting duct more permeable to water;
  + due to more aquaporins;
  + more water reabsorbed (in response to ADH);
  + less water in urine/urine more concentrated/urine hypertonic;
  + no/less ADH when blood too dilute/too much water/hypotonic;
  + collecting duct less permeable/less water reabsorption/more water in urine;

**Heavy Hitters Topic 11.4**

* Explain process of spermatogenesis
  + a. germinal cells / spermatogonia undergo mitosis to keep a supply of germinal cells present;
  + b. some germinal cells / spermatogonia grow larger to become primary spermatocytes;
  + c. primary spermatocytes go through meiosis I;
  + d. to form secondary spermatocytes;
  + e. these secondary spermatocytes go through meiosis II;
  + f. to produce spermatids;
  + g. spermatids differentiate/grow a tail and reduce their cytoplasm
  + h. spermatids associated with nurse cells (Sertoli cells);
  + i. sperm detach from Sertoli cells and enter lumen of the seminiferous tubule;
  + j. testosterone stimulates sperm production;
* Compare the process of spermatogenesis and oogenesis

a. both produce haploid cells / both produce (mature/male/female) gametes;  
b. both have mitosis at start/in epithelium / both involve mitosis and meiosis;  
c. both have cell growth before meiosis;  
d. both involve differentiation (to produce a specialised gamete);





* Explain the structure and function of the placenta
  + disc-shaped structure;
  + connected to the fetus by an umbilical cord;
  + placenta is embryonic and maternal tissue;
  + placental villi increase the surface area (for exchange);
  + fetal capillaries in placenta/placental villi;
  + inter-villous spaces/sinuses through which mother’s blood flows;
  + fetal and mother’s blood do not mix / small distance between fetal and mother’s blood;
  + transfer of foods/nutrients/glucose from mother to fetus;
  + fetal gas exchange/transfer of oxygen from mother to fetus;
  + transfer of excretory/waste products/CO2 from fetus to mother;
  + transfer of antibodies/hormones from mother to fetus;
  + secretion of estrogen/progesterone/HCG;
* Describe the process of fertilization in humans
  + sperm breaks through follicle cells/cells surrounding the ovum;
  + triggers acrosome reaction;
  + proteases/hydrolytic enzymes (of acrosome) released;
  + digestion of zona pellucida;
  + plasma membranes of sperm and egg fuse;
  + sperm nucleus enters egg;
  + cortical reaction;
  + hardening/cross linking of glycoproteins in zona pellucida;
  + preventing sperm from entering;
* Outline hormonal control of the process of birth
  + level of progesterone decreases (drastically) just before birth;
  + removing inhibition of oxytocin secretion;
  + oxytocin produced by pituitary gland;
  + oxytocin causes contractions of uterus;
  + uterine contractions cause impulses to be sent leading to more oxytocin secretion;
  + positive feedback;
* Annotate drawings of mature egg and sperm, as well as ovaries and testis to show stages of gametogenesis