**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