OPTION D: Human Physiology Revision List

This pages gives outline details of the content of the topic together with essential questions and student skills and applications. Helpful for revision.

D1 Human Nutrition

- Essential nutrients have to part of the diet because they cannot be synthesized by the body, These include:
    - Dietary minerals (chemical elements)
    - Vitamins are chemically diverse carbon compounds.
    - Some fatty acids
    - some amino acids - needed for protein production.
- Malnutrition may be caused by a deficiency, imbalance or excess of nutrients in the diet.
- The hypothalamus controls appetite.
- Hypertension and type II diabetes are more likely if a person is overweight.
- Starvation can cause body tissue to be broken down.

Essential Question(s)

- Do pizza's contain all the essential nutrients for a healthy body?
- What are the essential nutrients?
- What is the role of vitamins and minerals in the diet?

- What are the effects of malnutrition?
- How can malnutrition involve eating too much, too little, or both?
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- How can combustion of food help us to calculate the energy content of the food?

Skills (can you ... ?)

- Know that ascorbic acid (Vit C) is produced by some mammals, but not others.

- Understanding of how phenylketonuria (PKU) caused by a genetic mutation, can be treated by controlling the diet.
- Know how rickets (or osteomalacia) is caused by a lack of Vitamin D or calcium leading to problems in bone mineralization.
- Understand that heart muscle is broken down in anorexia.
- Know how cholesterol in blood can be used as an indicator or coronary heart disease risk.
- Determine the energy content of food by combustion, heating water.
- Use databases to calculate nutritional composition of a daily diet.

D2 Digestion

- The structure of cells of the epithelium of the villi, including microvilli
- Exocrine glands secrete to the surface of the body or the lumen of the gut.
- Nervous and hormonal mechanisms control the secretion of digestive juices.
- The volume and content of gastric secretions are controlled by nervous and hormonal mechanisms.
- Acid conditions in the stomach favour some hydrolysis reactions and help to control pathogens in ingested food.
- The structure of cells of the epithelium of the villi, including microvilli and mitochondria, is adapted to the absorption of food.
- The rate of transit of materials through the large intestine is positively correlated with their fibre content.
- Materials not absorbed are egested.

Essential Questions

- What do we already know about the structure of lining of the digestive system?
- How does the body (brain) control the functioning of the organs?
- What do we know already about enzymes
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- Do your stomach lining, the pancreas and other digestive glands produce digestive juices all the time?

- Do these secretions always contain the same amounts of digestive enzymes?
- If not, how are these glands controlled?
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  How does the stomach protect itself from the hydrochloric acid and protein digesting enzymes it contains?
- What could happen if a gunshot wound or a bacteria like *H. pylori* damaged the stomach lining?

Skills (can you ... ?)

- Identify exocrine gland cells that secrete digestive juices and villus epithelium cells that absorb digested foods from electron micrographs
- Explain how the reduction of stomach acid secretion by proton pump inhibitor drugs.
- Understand dehydration due to cholera toxin.
- Use the example of *Helicobacter pylori* infection as a cause of stomach ulcers.

D3 The Liver

- The functions of the liver
    - removes toxins from the blood
    - detoxifies toxins - e.g. alcohol.
    - recycles components of red blood cells. (erythrocytes)
    - Iron is carried to bone marrow for production of hemoglobin for new red blood cells.
    - Surplus cholesterol is converted to bile salts.
    - blood is intercepted from the gut.
    - regulates nutrient levels, eg: glucose
    - stores some nutrients; e.g. vit. A & D
- Hepatocytes produce plasma proteins (e.g. fibrinogen) using their endoplasmic reticulum and Golgi apparatus.
- Temporary slides of hepatocytes can be prepared from fresh liver.
- Kupffer cells use phagocytosis to begin recycling of red blood cells.
- Sinusoids carry blood through the liver, they are different in structure to capillaries.

Essential Question(s)

- Liver cells were used as a model eukaryote animal cell in topic 1. How many different types of organelle do they contain.
- Why do liver cells make better cell models than motor neurones?
- What are the functions of rER, Golgi apparatus and lysosomes in cells?

- What is the role of the liver in the body?
- Which systems of the body would be most affected if the liver stops working?
- Hepatocytes and Kupffer cells are two specialised cells in the liver, what special jobs might they have.
- Sinusoids are special channels through which blood flows in the liver, why do they have 'fenestrated' walls (with holes)?

Skills (can you ... ?)

- Suggest causes of jaundice, and link them to liver function?
- Explain that liver damage due to infection or alcohol, disrupts the liver's ability to process bilirubin,
- Say that bilirubin is a waste product of red blood cells break down normally made into bile in the liver.
- Explain the dual blood supply to the liver.
- Describe the differences between sinusoids and capillaries.

D4 The Heart

- Structure of cardiac muscle cells includes branching and intercalated discs.
- This structure aids propagation of stimuli through the heart wall.
- Control of heart beat within the heart.
- Signals from the sinoatrial node that cause contraction of atria cannot pass directly from atria to ventricles.

- There is a delay between the arrival and passing on of a stimulus at the atrioventricular node.
- This delay allows time for atrial systole before the atrio-ventricular valves close in ventricular systole.
- Conducting fibres ensure coordinated contraction of the entire ventricle wall.
- Normal heart sounds are caused by the atrio-ventricular valves and semilunar valves closing & causing changes in blood flow.

Essential Question(s)

- What is special about the structure of cardiac muscle?
- The heart is myogenic, it can beat on its own. How does this happen?

- What is the function of the valves in the heart & how do they change blood flow?

Skills (can you ... ?)

- Say how artificial pacemakers can regulate the heart rate.
- Suggest how defibrillation can treat life-threatening cardiac conditions.
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- Outline the causes and consequences of hypertension and thrombosis.
- Measure and interpret the heart rate under different conditions.
- Interpret systolic and diastolic blood pressure measurements, e.g. 120 / 80 or 12 / 8.
- Map the cardiac cycle to a normal ECG trace.
- Analyse epidemiological data relating to the incidence of coronary heart disease.

D5 Hormones

- Endocrine glands secrete hormones directly into the bloodstream.
- Steroid hormones

        - bind to receptor proteins in the cytoplasm of the target cell to
        - form a receptor–hormone complex.
        - which promotes the transcription of specific genes.
    - Peptide hormones
        - bind to receptors in the plasma membrane of the target cell.
        - this binding activates a cascade of reactions
        - mediated by a second messenger inside the cell.
    - The hypothalamus controls hormone secretion by the anterior and posterior lobes of the pituitary gland.
    - Hormones secreted by the pituitary control growth, developmental changes, reproduction and homeostasis.

Essential Question(s)

- How can a chemical released into the blood cause a change in the functioning of another cell
- What different types of hormones are there?
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- How can nerves in the hypothalamus control a gland like the pituitary gland?
- Could a neurone make a hormone?

Skills (can you ... ?)

- Say why some athletes take growth hormones to build muscles.
- Outline the control of milk secretion by the hormones oxytocin and prolactin?

D6 Respiratory gases

- Oxygen dissociation curves show the oxygen affinity of hemoglobin.
- The increased release of oxygen by hemoglobin in respiring tissues is explained by the Bohr shift.
- Fetal hemoglobin is different from adult hemoglobin. This allows the transfer of oxygen in the placenta from mother's hemoglobin to fetal hemoglobin.

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- Carbon dioxide is carried in the blood in three ways:
    - in solution
    - bound to hemoglobin
    - transformed in red blood cells into hydrogencarbonate ions which diffuse into the blood plasma.
- changes in blood pH caused by changes in CO_2 concentration are detected by chemoreceptors.
- The respiratory control centre in the medulla oblongata controls the the rate of ventilation in response to the amount of CO_2 in the blood. (during exercise!)

Essential Question(s)

- What does "partial pressure" represent?
- If the hemoglobin in the lungs attaches to oxygen molecules, how do the muscles take this oxygen away from the hemoglobin?
- A fetus must also take the oxygen from the mother's hemoglobin, how can it do that?

- How many ways can you think of that carbon dioxide could exist in a solution. think of the carbon cycle.
- What does CO_2 do to the pH of a solution?
- Which part of the brain control pulse rate.

Skills (can you ... ?)

- Analyse oxygen dissociation curves for hemoglobin and myoglobin.
- Describe the consequences of high altitude for gas exchange.
- Say how breating helps the pH of blood to be regulated to stay within the narrow range of 7.35 to 7.45.
- Give causes and treatments of emphysema.
- Identify pneumocytes, capillary endothelium cells and blood cells in light micrographs and electron micrographs of lung tissue.