

**BIOLOGY SYLLABUS 2011**

**SENIOR 5**

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**UNIT 1 - THE ORGANISM: THE HUMAN BODY**

**1. Human nutrition**

1.1 Nutrition

- Define nutrition
- Nutrients: List the principal sources of, and describe the importance of:
  - carbohydrates
  - fats
  - proteins
  - vitamins (C and D only)
  - mineral salts (calcium and iron only)
  - fibre (roughage)
  - water
  - Describe the deficiency symptoms for:
    - vitamins (C and D only)
    - mineral salts (calcium and iron only)
- Describe the use of microorganisms in the food industry, with reference to yoghurt and single cell protein
- Describe the uses, benefits and health hazards associated with food additives, including colourings

1.2 Diet

- State what is meant by the term balanced diet and describe a balanced diet related to age, sex and activity of an individual
- Describe the effects of malnutrition in relation to starvation, coronary heart disease, constipation and obesity.

1.3 Food supply

- Discuss ways in which the use of modern technology has resulted in increased food production to include modern agricultural machinery, chemical fertilisers, pesticides and herbicide, artificial selection)
- Discuss the problems of world food supplies
- Discuss the problems which contribute to famine (unequal distribution of food, drought and flooding and increasing population)

1.4 Human alimentary canal:

- Identify the main regions of the alimentary canal and associated organs including mouth, salivary glands, oesophagus, stomach, small intestine: duodenum and ileum, pancreas, liver, gall bladder, large intestine: colon and rectum, anus.
- Describe the functions of the regions of the alimentary canal listed above, in relation to ingestion, digestion, absorption, assimilation and egestion of food.
- define ingestion, digestion, absorption, assimilation and egestion of food.

1.5 Mechanical and physical digestion

- Identify the types of human teeth and describe their structure and functions.
- State the causes of dental decay and describe the proper care of teeth.
- Describe the process of chewing and peristalsis.
- Describe how fluoride reduces tooth decay and explain arguments for and against the adding of fluoride to public water supplies.

### 1.6 Chemical digestion

- State the significance of chemical digestion in the alimentary canal in producing small, soluble molecules that can be absorbed.
- State where, in the alimentary canal, amylase, protease and lipase enzymes are secreted
- State the functions of a typical amylase, a protease and a lipase, listing the substrate and end-products.

### 1.7 Absorption - Identify the small intestine as the region for the absorption of digested food.

- Describe the significance of villi in increasing the internal surface area of the small Intestine
- Describe the structure of a villus, including the role of capillaries and lacteals
- State the role of the hepatic portal vein in the transport of absorbed food to the liver
- Identify the role of the small intestine and colon in absorption of water.

### 1.8 Assimilation

- Describe the role of the liver in the metabolism of glucose (glucose → glycogen) amino acids (amino acids → proteins and destruction of excess amino acids)
- Describe the role of fat as an energy storage substance
- Define *deamination*.
- State that the liver is the site of breakdown of alcohol and other toxins.

## 2- **Transport in humans**

- Describe the circulatory system and the double circulation.

### 2.1 Heart

- Describe the structure and function of the heart.
- Investigate, state and explain the effect of physical activity on pulse rate
- Describe coronary heart disease in terms of the blockage of coronary arteries and state the possible causes (diet, stress and smoking) and preventive measures.

### 2.2 Arteries, veins and capillaries

- Name the main blood vessels to and from the heart, lungs, liver and kidney
- Describe the structure and functions of arteries, veins and capillaries - explain how structure and function are related.
- Describe the transfer of materials between capillaries and tissue fluid.

### 2.3 Blood

- Identify red and white blood cells as seen under the light microscope on prepared slides, and in diagrams and photomicrographs.
- List the components of blood as red blood cells, white blood cells, platelets and plasma and their functions.
- Describe the immune system in terms of antibody production, tissue rejection and phagocytosis
- Describe the function of the lymphatic system in circulation of body fluids, and the production of lymphocytes .
- Describe the process of clotting (fibrinogen to fibrin only)

## 3- **Respiration**

- Define *respiration* as the chemical reactions that break down nutrient molecules in living cells to release energy.
- State the uses of energy in the body of humans: muscle contraction, protein synthesis, cell division, active transport, growth, the passage of nerve impulses and the maintenance of a constant body temperature.

3.1 Aerobic respiration - define *aerobic respiration*

- State the equation for aerobic respiration using words and symbols.

3.2 Anaerobic respiration – define *anaerobic respiration*

- State the equation for anaerobic respiration in muscles during hard exercise and the microorganism yeast, using words and symbols.
- Describe the role of anaerobic respiration in yeast during brewing and bread-making.
- Compare aerobic respiration and anaerobic respiration in terms of relative amounts of energy released.
- Describe the effect of lactic acid in muscles during exercise (include oxygen debt in outline only).

3.2 Gas exchange

- List the features of gas exchange surfaces in animals.
- Identify on diagrams and name the larynx, trachea, bronchi, bronchioles, alveoli and associated capillaries
- State the differences in composition between inspired and expired air
- Use lime water as a test for carbon dioxide to investigate the differences in composition between inspired and expired air.
- Investigate and describe the effects of physical activity on rate and depth of breathing.
- Describe the role of the ribs, the internal and external intercostal muscles and the diaphragm in producing volume and pressure changes leading to the ventilation of the lungs
- Explain the role of mucus and cilia in protecting the gas exchange system from pathogens and particles
- Explain the link between physical activity and rate and depth of breathing in terms of changes in the rate at which tissues respire and therefore of carbon dioxide concentration and pH in tissues and in the blood

**4- Excretion in humans**

- Define *excretion*
- Describe the function of the kidney in terms of the removal of urea and excess water and the reabsorption of glucose and some salts
- Outline the structure of a kidney (cortex, medulla, and the start of the ureter) and outline the structure and functioning of a kidney tubule
- State the relative positions of ureters, bladder and urethra in the body
- State that urea is formed in the liver from excess amino acids
- State that alcohol, drugs and hormones are broken down in the liver
- Explain dialysis in terms of maintenance of glucose and protein concentration in blood and diffusion of urea from blood to dialysis fluid
- Discuss the application of dialysis in kidney machines
- Discuss the advantages and disadvantages of kidney transplants, compared with dialysis

**5- Coordination and response**

5.1 Nervous control in humans

- Describe the human nervous system in terms of the central nervous system (brain and spinal cord as areas of coordination) and the peripheral nervous system which together serve to coordinate and regulate body functions.
- Identify motor (effector), relay (connector) and sensory neurones from diagrams
- Describe a simple reflex arc in terms of sensory, relay and motor neurones, and a reflex action as a means of automatically and rapidly integrating and coordinating stimuli with responses.

- State that muscles and glands can act as effectors
- Describe the action of antagonistic muscles to include the biceps and triceps at the elbow  
Joint
- Define sense *organs* as groups of receptor cells responding to specific stimuli: light, sound, touch, temperature and chemicals
- Describe the structure and function of the eye, including accommodation and pupil reflex
- Distinguish between voluntary and involuntary actions
- Distinguish between rods and cones, in terms of function and distribution

### 5.2 Endocrine system

- Define a *hormone*.
- State the role of the hormone adrenaline in chemical control of metabolic activity, including increasing the blood glucose concentration and pulse rate
- Give examples of situations in which adrenaline secretion increases
- Compare nervous and hormonal control systems
- Discuss the use of hormones in food production

### 5.3 Homeostasis- define *homeostasis* as the maintenance of a constant internal environment

- Identify, on a diagram of the skin: hairs, sweat glands, temperature receptors, blood vessels and fatty tissue
- Describe the maintenance of a constant body temperature in humans in terms of insulation and the role of temperature receptors in the skin, sweating, shivering, vasodilation and vasoconstriction of arterioles supplying skin surface capillaries and the coordinating role of the brain.
- Explain the concept of control by negative feedback
- Describe the control of the glucose content of the blood by the liver, and by insulin and glucagon from the pancreas.

### 5.4 Drugs

- Describe the effect of alcohol and heroin, and the danger of their misuse.
- describe the personal and social problems arising from drug abuse, by reference to alcohol and heroin
- Explain why antibiotics kill bacteria but not viruses.

## **UNIT 2 – THE CONTINUITY OF LIFE**

### **1- Human reproduction**

- Identify on diagrams of the male and female reproductive systems and their functions.
- Describe the menstrual cycle in terms of changes in the uterus and ovaries, fertilisation and implantation.
- Outline the development of the fetus indicating the functions of the amniotic sac and fluid.
- Describe the function of the placenta and umbilical cord (no structural details are required).
- Describe the ante-natal care of pregnant women including special dietary needs and maintaining good health.

#### 1.1 Sex hormones

- Describe the roles of testosterone and oestrogen in the development and regulation of secondary sexual characteristics at puberty and the roles of oestrogen and progesterone in the menstrual cycle and in pregnancy.

#### 1.2 Methods of birth control

- Outline the following methods of birth control:
  - natural (abstinence, rhythm method)
  - chemical (contraceptive pill, spermicide)
  - mechanical (condom, diaphragm, femidom, IUD)
  - surgical (vasectomy, female sterilisation)

- Outline artificial insemination and the use of hormones in fertility drugs, and discuss their social implications.

### 1.3 Sexually transmissible diseases

- Describe the symptoms, signs, effects and treatment of gonorrhoea.
- Describe the methods of transmission of human immunodeficiency virus (HIV), the ways in which it can be prevented from spreading and how it affects the immune system.

## 2- Growth and development

- Define *growth* in terms of a permanent increase in size and dry mass by an increase in cell number or cell size or both.
- Define *development* in terms of increase in complexity.

## 3- Inheritance

- Define *inheritance* as the transmission of genetic information from generation to generation.

### 3.1- Chromosomes

- Define the terms: chromosome, gene, allele, haploid and diploid.
- Describe the inheritance of sex in humans (XX and XY chromosomes).

### 3.2 Mitosis

- Define *mitosis* as nuclear division giving rise to genetically identical cells in which the chromosome number is maintained by the exact duplication of chromosomes (details of stages are **not** required)
- State the role of mitosis in growth, repair of damaged tissues, replacement of worn out cells and asexual reproduction

### 3.3 Meiosis

- Define *meiosis* as reduction division in which the chromosome number is halved from diploid to haploid (details of stages are **not** required)
- State that gametes are the result of meiosis
- State that meiosis results in genetic variation so the cells produced are not all genetically identical.

### 3.4 Monohybrid inheritance

- Define the terms: genotype, phenotype, homozygous, dominant, recessive.
- Calculate and predict the results of monohybrid crosses involving 1 : 1 and 3 : 1 ratios.
- Explain codominance by reference to the inheritance of ABO blood groups, phenotypes, A, B, AB and O blood groups and genotypes IA, IB, and IO.

### 3.5 Variation

- State that continuous variation is influenced by genes and environment, resulting in a range of phenotypes between two extremes, e.g. height in humans.
- State that discontinuous variation is caused by genes alone and results in a limited number of distinct phenotypes with no intermediates e.g. A, B, AB and O blood groups in humans
- Define *mutation* as a change in a gene or chromosome
- Describe mutation as a source of variation, as shown by Down's syndrome
- Outline the effects of ionising radiation and chemicals on the rate of mutation
- Describe sickle cell anaemia, and explain its incidence in relation to that of malaria.

### 3.6 Selection

- Describe the role of artificial selection in the production of varieties of animals and plants with increased economic importance
- Define *natural selection* as the greater chance of passing on of genes by the best adapted organisms
- Describe variation and state that competition leads to differential survival of, and reproduction by, those organisms best fitted to the environment.
- Assess the importance of natural selection as a possible mechanism for evolution.

- Describe the development of strains of antibiotic resistant bacteria as an example of natural selection.

### 3.7 Genetic Engineering

- Define *genetic engineering* as taking a gene from one species and putting it into another species
- Explain why, and outline how, human insulin genes were put into bacteria using genetic engineering.

## **UNIT 3 - ORGANISMS AND THEIR ENVIRONMENT**

### **1- Energy flow**

- State that the Sun is the principal source of energy input to biological systems
- Describe the non-cyclical nature of energy flow

### **2- Food chains and food webs (emphasis on examples occurring locally)**

- Define the terms: food chain, food web, producer, consumer, herbivore, carnivore, decomposer, ecosystem and trophic level.
- Describe energy losses between trophic levels
- Draw, describe and interpret pyramids of biomass and numbers.
- Explain why food chains usually have fewer than five trophic levels
- Explain why there is an increased efficiency in supplying green plants as human food and that there is a relative inefficiency, in terms of energy loss, in feeding crop plants to animals.

### **3-Nutrient cycles**

- Describe the carbon and the water cycles
  - Describe the nitrogen cycle in terms of: the role of microorganisms in providing usable nitrogen-containing substances by decomposition and by nitrogen fixation in roots; the absorption of these substances by plants and their conversion to protein, followed by passage through food chains, death, decay, nitrification and denitrification and the return of nitrogen to the soil or the atmosphere (names of individual bacteria are not required)
- Discuss the effects of the combustion of fossil fuels and the cutting down of forests on the oxygen and carbon dioxide concentrations.

### **4- Population size**

- Define *population*
- State the factors affecting the rate of population growth for a population of an organism (limited to food supply, predation and disease), and describe their importance.
- Identify the phases in the sigmoid population growth curve for a population growing in an environment with limited resources.
- Describe the increase in human population size and its social implications
- Interpret graphs and diagrams of human population growth.

### **5- Human influences on the ecosystem**

- Outline the effects of humans on ecosystems, with emphasis on examples of international importance (tropical rain forests, oceans and important rivers).

#### 5.1 Agriculture

- List the undesirable effects of deforestation (to include extinction, loss of soil, flooding, carbon dioxide build up)
- Describe the undesirable effects of overuse of fertilisers (to include eutrophication of lakes and rivers).



### 5.2 Pollution

- Describe the undesirable effects of pollution to include: water pollution by sewage and chemical waste, air pollution by sulfur dioxide and greenhouse gases (carbon dioxide and methane) contributing to global warming, pollution due to pesticides, herbicides and nuclear fall-out.
- Discuss the effects of non-biodegradable plastics in the environment
- Discuss the causes and effects on the environment of acid rain, and the measures that might be taken to reduce its incidence.

### 5.3 Conservation

- Describe the need for conservation of species and their habitats and natural resources (limited to water and nonrenewable materials including fossil fuels)
- Explain how limited and non-renewable resources can be recycled (including recycling of paper and treatment of sewage to make the water that it contains safe to return to the environment or for human use)