



Las Cumbres  
COLEGIO

## PROGRAMA

**SUBJECT:** BIOLOGY

**GROUP:** SENIOR 5

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### TOPIC 1 THE AMAZING HUMAN BODY

**Nutrition** - define nutrition as the *obtaining of organic substances and mineral ions from which organisms obtain their energy and their raw materials for growth and tissue repair*

#### 1.1. Nutrients

- list the chemical elements that make up: carbohydrates – fats - proteins
- describe the synthesis of large molecules from smaller basic units, i.e. simple sugars to starch and glycogen; amino acids to proteins; fatty acids and glycerol to fats and oils
- describe tests for: starch (iodine solution), reducing sugars (Benedict's solution), protein (biuret test) and fats (ethanol)
- list the principal sources of, and describe the importance of: carbohydrates, fats and proteins; fibre (roughage) and 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, bread and single cell protein
- describe the uses, benefits and health hazards associated with food additives, including colourings

#### 1.2. Diet

- understand the concept of a balanced diet
- describe: a balanced diet related to age, sex and activity of an individual the effects of malnutrition in relation to starvation, coronary heart disease, constipation and obesity the effects of alcohol and the dangers of its misuse
- discuss: the problems of world food supplies the problems which contribute to famine (unequal distribution of food, drought and flooding and increasing population)

#### 1.3. Human alimentary canal

- identify the gross structure of the alimentary canal and associated organs (mouth, oesophagus, stomach, small intestine: duodenum and ileum, large intestine: colon and rectum, anus, pancreas, liver)
- define ingestion, digestion, absorption, assimilation and egestion
- describe the functions of the alimentary canal's various parts in relation to ingestion, digestion, absorption, assimilation and egestion of food

#### 1.4. Mechanical and physical digestion

- identify the types of human teeth and describe their functions
- state the causes of dental decay and describe the proper care of teeth
- describe the processes of chewing and peristalsis

- explain the probable action of fluoride in reducing tooth decay and present arguments for and against its addition to public water supplies

### 1.5. Chemical digestion

The significance of producing small, soluble molecules

- describe: digestion in the alimentary canal the functions of a typical amylase, protease and lipase, listing the substrate and end-products

### 1.6. 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
- describe the structure of a villus, including the role of capillaries and lacteals
- indicate the role of the hepatic portal vein in the transport of absorbed food to the liver

### 1.7. Assimilation

- describe the role of the liver in the metabolism of glucose and in the destruction of excess amino acids;
- describe the role of fat as a storage substance
- define deamination as *removal of the nitrogen containing part of amino acids as urea, followed by release of energy from the remainder of the amino acid*

## **2. Transport in humans**

### 2.1 Heart

- describe the gross structure and function of the heart
- describe the effect of exercise on heart beat
- list the likely causes of a heart attack (diet, smoking and stress), and preventive measures

### 2.2 Arteries, veins and capillaries

- describe: the structure and functions of arteries, veins and capillaries
- describe the double circulatory system
- explain how structure and function are related in arteries, veins and capillaries

### 2.3 Blood

- identify blood cells, as seen under a light microscope
- describe: the components of blood, the functions of blood including clotting (no details of clotting required); the transfer of materials between capillaries and tissue fluid
- describe the immune system in terms of antibody production, tissue rejection and phagocytosis
- describe the process of clotting (fibrinogen to fibrin only)
- describe the function of the lymphatic system in circulation of body fluids, and the production of lymphocytes

## **3. Respiration**

- define respiration as *the release of energy from food substances in all living cells*

### 3.1 Aerobic respiration

- define aerobic respiration
- state the equation for aerobic respiration, using words
- name and describe the uses of energy in the body of humans
- state the equation for aerobic respiration using symbols

### 3.2 Anaerobic respiration

- define anaerobic respiration
- state the equation for anaerobic respiration in muscles (glucose → lactic acid) and the microorganism yeast (glucose → alcohol + carbon dioxide), using words
- describe the role of anaerobic respiration in brewing and breadmaking
- describe the production of lactic acid in muscles during exercise
- compare aerobic respiration and anaerobic respiration in terms of relative amounts of energy released
- state the equation for anaerobic respiration in muscles ( $C_6H_{12}O_6 \rightarrow 2 C_3H_6O_3$ ) and the microorganism yeast ( $C_6H_{12}O_6 \rightarrow 2 C_2H_5OH + 2 CO_2$ ), using symbols

### 3.3 Gaseous exchange

- list the features of gaseous exchange surfaces in animals
- state the differences in composition between inspired and expired air
- describe a test for carbon dioxide

- describe: the effects of physical activity on rate and depth of breathing the effects of tobacco smoke and its major toxic components on the respiratory system
- 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 link between physical activity and rate and depth of breathing in terms of changes in respiratory rate and therefore of carbon dioxide concentration and pH in tissues and in the blood

#### **4. Excretion in humans**

The necessity to remove toxic waste products of metabolism

- define excretion as *the removal of toxic materials, the waste products of metabolism and substances in excess of requirements from organisms*
- describe the function of the kidney simply in terms of the removal of urea and excessive water and the reabsorption of glucose and some salts (details of kidney structure and nephron are not required), the relative positions of ureters, bladder and urethra in the body the formation of urea and the breakdown of alcohol, drugs and hormones in the liver
- outline the structure of a kidney (cortex, medulla, ureter) and outline the structure and functioning of a kidney tubule including role of renal capsule in filtration from blood of water, glucose, urea and salts, and role of tubule in reabsorption of glucose, most of the water and some salts back into the blood, leading to concentration of urea in the urine as well as loss of excess water
- explain dialysis and discuss its application in kidney machines
- discuss the advantages and disadvantages of kidney transplants, compared with dialysis

#### **5. Coordination and response**

The ability to detect and to respond to internal and external stimuli

##### **5.1 Hormones**

- define hormone
- describe the chemical control of metabolic activity by adrenaline
- compare hormonal and nervous systems
- discuss the use of hormones in food production

##### **5.2 Tropic and taxic responses**

- define geotropism and phototropism
- describe simple behaviour in terms of the taxic responses of invertebrates
- explain the chemical control of plant growth by auxins including geotropism and phototropism in terms of auxins regulating differential growth, and the effects of synthetic plant hormones used as weedkillers

##### **5.3 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
- define sense organs as *groups of receptor cells responding to specific stimuli: light, sound, touch, temperature and chemicals*
- identify motor and sensory neurones from diagrams
- describe effectors in terms of muscles and glands
- describe the action of antagonistic muscles in terms of the biceps and triceps and the associated bones
- describe a simple reflex arc in terms of sensory, relay and motor neurones, and a reflex action as a means of integrating and coordinating stimuli with responses
- describe the structure and function of the eye, including accommodation and pupil reflex
- compare nervous and hormonal control systems
- distinguish between voluntary and involuntary actions
- distinguish between rods and cones, in terms of function and distribution

##### **5.4 Homeostasis**

- define homeostasis as *the maintenance of a constant internal environment*
- describe temperature regulation, and explain the effects of sweating, vasodilation and vasoconstriction only
- describe the control of the glucose content of the blood by the liver, and by insulin and glucagon from the pancreas
- discuss the general role of negative feedback in homeostasis

##### **5.5 Drugs**

- describe the effects of alcohol and heroin, and the dangers of their misuse
- describe the personal and social problems arising from drug abuse, by reference to alcohol and heroin

## **TOPIC 2 THE CONTINUITY OF LIFE**

### **1. Reproduction**

#### **1.1.1 Asexual reproduction**

- define asexual reproduction
- describe asexual reproduction in bacteria, spore production in fungi and tuber formation in potatoes
- discuss the advantages and disadvantages to the species of asexual reproduction

#### **1.1.2 Sexual reproduction**

- define sexual reproduction - discuss the advantages and disadvantages of sexual reproduction

#### **1.2. Sexual reproduction in humans**

- describe the structure and function of human male and female reproductive systems, including the menstrual cycle
- describe sexual intercourse, fertilisation and implantation
- describe the development of the fetus in terms of placenta, maternal and fetal blood supplies and exchange of materials
- describe ante-natal care in terms of dietary requirements and maintaining good health
- describe birth
- indicate the functions of the amniotic sac and amniotic fluid
- describe the advantages of breast-feeding compared with bottle-feeding

#### **1.3 Sex hormones**

- describe the roles of testosterone and oestrogen in the development and regulation of secondary sexual characteristics at puberty
- describe the sites of production and the roles of oestrogen and progesterone in the menstrual cycle and in pregnancy

#### **1.4 Methods of birth control**

- name and describe the following methods of birth control: natural, chemical, mechanical and surgical
- discuss the social aspects of artificial insemination and the use of hormones in fertility drugs

#### **1.5 Sexually transmissible diseases**

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

### **2. Growth and development**

- define growth in terms of increase in dry mass
- define development in terms of increase in complexity
- describe the environmental conditions affecting germination

### **3. Inheritance**

The transmission of genetic information from generation to generation, leading to continuity of, and variation within, the species

#### **3.1 Chromosomes**

- define the terms chromosome, gene, allele, haploid and diploid nuclei
- describe the inheritance of sex in humans (XX, XY)

#### **3.2 Mitosis**

- describe mitosis simply, in terms of the exact duplication of chromosomes resulting in identical daughter nuclei (details of stages are not required)

#### **3.3 Meiosis**

- describe the production of gametes by meiosis simply, in terms of halving of chromosome number leading to variation (details of stages are not required)

#### **3.4 Monohybrid inheritance**

- define the terms gene, allele, genotype, phenotype, homozygous, heterozygous, dominant and recessive

- calculate and predict the results of monohybrid crosses involving 1 : 1 and 3 : 1 ratios
- explain codominance and inheritance of A, B, AB and O blood groups (IA, IB and IO)

### 3.5 Variation

- describe continuous and discontinuous variation as influenced by the environment and genes, illustrated by height and A, B, AB and O blood groups in humans
- define mutation
- describe mutation as a source of variation, as shown by Down's syndrome
- outline the effects of 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 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

## **TOPIC 3 ECOLOGY**

### **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, ecosystems and trophic level
- describe energy losses between trophic levels, and the advantages of short food chains
- describe and interpret pyramids of biomass, numbers and energy
- recognise that 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
- discuss the effects of the combustion of fossil fuels and the cutting down of forests on the balance between oxygen and carbon dioxide

### **4. Population size**

- state the factors affecting the rate of population growth, and describe their importance (e.g. food, supply, predation and disease)
- identify the phases of a sigmoid curve of population growth resulting from the action of a limiting factor
- explain the factors that lead to the lag phase, exponential phase and stationary phase in the sigmoid curve of population growth
- describe the increase in population size in the absence of limiting factors (human population growth) and the social implications of current human survival rate
- interpret graphs and diagrams of human population growth

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

With emphasis on examples of international importance (e.g. tropical rain forests, oceans and rivers)

### **5.1 Agriculture**

- discuss, using suitable examples, ways in which the use of modern technology has resulted in increased food production
- describe the undesirable effects of deforestation
- describe the overuse of fertilisers on the land

### **5.2 Pollution**

- describe the undesirable effects of water pollution by sewage and chemical waste, air pollution by sulfur dioxide and pollution due to pesticides and herbicides and nuclear fall-out
- assess the significance of non-biodegradable plastics and other, materials used in the manufacturing industry
- discuss the causes and apparent 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 of natural resources
- describe the principle of recycling materials including sewage (water) and paper

## **TOPIC 4 BIODIVERSITY**

### **1. Characteristics of living organisms**

- list and describe the characteristics of living organisms
- define the terms nutrition, excretion, respiration, sensitivity, reproduction, growth and movement

### **2. Classification and diversity of living organisms**

#### **2.1 Concept and use of a classificatory system**

- list the main features used in the classification of the following groups: viruses, bacteria and fungi, and their adaptation to the environment, as appropriate
- define and describe the binomial system of naming species and classify the five main classes of vertebrates using visible, external characteristic features only

#### **2.2 Adaptations of organisms to their environment**

- list the main features used in the classification of the following groups: flowering plants (monocotyledons and dicotyledons), arthropods (insects, crustaceans, arachnids and myriapods), annelids, nematodes and molluscs, using visible, external characteristic features only
- list the main features used in the classification of the following groups: viruses, bacteria and fungi, and their adaptation to the environment, as appropriate

### **3. Simple keys**

- use simple dichotomous keys based on easily identifiable features