

BIOLOGY SYLLABUS – GRADE 13

2017-2018

UNIT 2: BIOENERGETICS, BIOSYSTEMS AND APPLICATION

TERM 1

MODULE 1: BIOENERGETICS

Energy Flow and Nutrient Cycling

- Define terms – ecosystem, habitat, ecological niche
- Energy flow in an ecosystem – food chains, food webs
- Efficiency of energy transfer between trophic levels
- Biological pyramids – numbers, biomass, energy, limitations of each
- Nitrogen cycle
- Difference between energy flow and nutrient cycling
- Importance of energy flow and nutrient cycling in an ecosystem

Photosynthesis and ATP Synthesis

- Structure of a dicotyledonous leaf, palisade cell and chloroplast – relate structure to function in photosynthesis
- Process of photophosphorylation – production of ATP and reduced NADP, O₂ as by-product
- Calvin cycle – stages, production of triose sugar using ATP and reduce NADP
- Limiting factors in photosynthesis – temperature, pH, CO₂ concentration, water, light etc., improving plant productivity

Cellular Respiration and ATP Synthesis

- Outline of the breakdown of glucose in respiration
- Structure and function of the mitochondria in respiration
- Process of glycolysis
- Link reaction
- Krebs cycle – significance in ATP formation
- Oxidative phosphorylation
- Fate of pyruvate in absence of oxygen – alcoholic and lactic acid fermentation

Ecological Systems, Biodiversity and Conservation

- Ecosystems as dynamic systems – interaction between biotic and abiotic factors
- Biodiversity – genetic, species and ecosystem diversity

- Importance of the maintenance of biodiversity – intrinsic, direct and indirect values such as medicinal, natural products, tourism
- Importance of species diversity in the stability of an ecosystem
- Use of *in situ* and *ex situ* conservation methods to maintain biodiversity – protected areas, reserves, seed banks, botanic gardens, zoos, sperm banks, gene banks, embryo banks

MODULE 2: BIOSYSTEMS MAINTENANCE

The Uptake and Transport of Water and Minerals

- Structure of roots, uptake of ions by active transport
- Entry and transport of water in plant roots – 3 pathways
- Structure and function of xylem vessels
- Ascent of water in plants – root pressure, cohesion and adhesion, transpiration pull
- Role of stomata in transpiration

Transport in the Phloem

- Phloem and sieve tube structure
- Translocation of food – source to sink, loading of sieve tubes
- Mass/Pressure Flow Hypothesis
- Evidence for and against the hypothesis

The Circulatory System of Mammals

- Need for a circulatory system
- Open and closed systems
- Blood vessels – capillaries, veins, arteries; relate structure to function
- Structure of the heart
- Cardiac cycle
- Maintaining the heart's rhythmic beat
- Definitions – pulse, blood pressure
- Factors affecting blood pressure
- Nervous and hormonal control of heart rate
- Role of haemoglobin in oxygen and carbon dioxide transport
- Oxygen dissociation curves
- Effect of carbon dioxide on oxygen dissociation curves (Bohr effect)

TERM 2

MODULE 3: APPLICATION OF BIOLOGY

Immunology

- Define – immune response
- Mode of action of phagocytes
- Origin and maturation of B- and T-lymphocytes – compare, include function of different types of B and T cells
- Difference between humoral and cell-mediated immune responses
- Role of memory cells in long term immunity – B and T memory cells
- Molecular structure of an antibody related to function
- Differences between active and passive immunity, natural and passive immunity
- Role of vaccines
- Monoclonal antibodies – what are they, use in diagnosis and treatment

MODULE 2: BIOSYSTEMS MAINTENANCE

Homeostasis and Hormonal Action

- Concept of homeostasis – receptors, effectors, feedback mechanism etc.
- General principles of hormonal action in animals – ductless glands, target cells and receptors
- Insulin and glucagon function in relation to blood glucose concentration
- Effect of ethylene on fruit ripening
- Commercial use of ethylene to supply market-ready fruit

The Kidney, Excretion and Osmoregulation

- Need to remove nitrogenous and other metabolic waste products
- Structure of the kidney and nephrons
- Function of the kidney – excretion, Osmoregulation, role of ADH
- Clinical significance of glucose and protein in urine

Nervous Co-ordination

- Structure of motor and sensory neurons
- Nerve cell membranes in establishing and maintaining resting potential
- Conduction of an action potential along the nerve membrane – speed of transmissions
- Synaptic transmission – structure of cholinergic synapse
- Role of synapse

MODULE 3: APPLICATION OF BIOLOGY

Health and Disease

- Define health – physical, mental, social
- Categories of disease or illness – physical, mental, social, chronic, infection, degenerate, inherited, self-inflicted, deficiency; examples of each
- Regional distribution of AIDS, diabetes and cancer – discuss reasons

Social and Preventative Medicine

- Causative relationship among diet, obesity and diabetes – concept of balanced diet, BMI, Type 1 and 2 diabetes
- Effects of fats on the cardiovascular system – atherosclerosis, coronary heart disease, hypertension, stroke
- Effects of exercise and maintaining a physically fit body – long-term and short-term consequences, VO_2 max, cardiac efficiency
- AIDS and Dengue fever – mechanisms of infection, causative agent, transmission, social and economic impact regionally and the social, economic and biological factors in their prevention and control

Substance Abuse

- Define – drug abuse, legal and illegal drugs, physiological and physical dependence
- Short-term and long-term consequences of alcohol consumption on the liver
- Social consequences of excessive alcohol use
- Effects of the components of cigarette smoke on the respiratory and cardiovascular systems