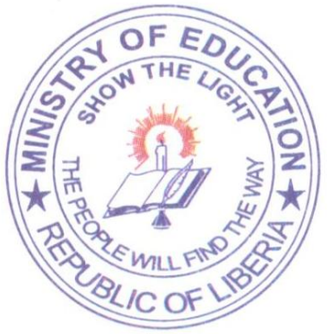
REPUBLIC OF LIBERIA

MINISTRY OF EDUCATION



NATIONAL CURRICULUM FOR GRADES 10 TO 12

BIOLOGY

February 2011

MESSAGE FROM THE MINISTER OF EDUCATION

I wish to extend my thanks and appreciation to ECSEL, UNESCO and all our partners for their immense contribution to this important task of revising and strengthening of the National Curriculum. Special thanks to USAID through LTTP for their funding and technical support in the harmonization or realignment of the curriculum. We extend sincere thanks and appreciation to the Bureau of Curriculum Development and Textbook Research, the National Curriculum Taskforce, and the subject specialists from various institutions for the level of professionalism that went into this exercise.

The revision and strengthening of our National Curriculum comes at a time when our nation is faced with the Herculean task or challenge of education transformation, national reconstruction, recovery and renewal in the aftermath of a devastating civil war. Hence, critical to this national challenge is the rebuilding of the education sector as Liberians can not achieve the desired socio-economic progress in the absence of a strong, vibrant and productive education and training system.

The revised national curriculum has two features which include the regular core subject areas of Mathematics, Science, Language Arts and Social Studies and emphasis is being given to the global challenge of HIV/AIDS, Peace, Citizenship, Human Rights and Environmental education. Secondly, the new curriculum is developed in line with international standards especially those practiced and enshrined in the curriculum of our sisterly Republic of Nigeria and Ghana who are also members of the West African Examinations Council (WAEC) .

We wish to urge all our education partners including students, teachers, principals, proprietors of schools and members of school boards to use this curriculum in our schools to enhance quality and relevant instruction and to enable our students to be adequately prepared to take the West African Senior Secondary Certificate Examinations (WASSCE) come 2013 as envisaged by us in the education sector.

May I conclude by once again saying big thank-you to all those who contributed to make this project a success.

Hon. E. Othello Gongar
MINISTER

INTRODUCTION

The senior high school revised Biology curriculum covers a biology course work over a three-year period at the 10^{th}, 11^{th} and 12^{th} grade levels. The overall goal of the course of study is to enable students to demonstrate and apply knowledge of the general principles associated with the nature and continuity of living things, including basic structures of microorganisms, multicellular plants, invertebrates, vertebrate and their relationship to man.

A student-centred approach is emphasized in this curriculum. This is based on the firm belief that learning becomes more permanent, meaningful, and exciting when students themselves take ownership of the learning process. Teachers are, therefore, urged to contrive those classroom strategies that would engage students actively in the teaching/learning process.

AIMS AND OBJECTIVES

Upon the completion of this course of study, students will be able to:

1. Name and define the different branches of biology
2. State the basic principles associated with the science of life, including living conditions
3. Explain the importance of biological knowledge in our everyday living
4. Identify and analyze the problems involved in the survival of living things, and develop an appreciation of nature
5. Acquire basic scientific and intellectual skills such as observing, classifying, and interpreting data
6. Acquire adequate laboratory and field skills to carry out experiments in Biology, and conduct projects requiring the collection of primary data
7. Develop the scientific attitude of problem solving, and an acute sense of curiosity, creativity, and critical thinking

SEMESTER: ONE

PERIOD: I

GRADE: 10

TOPIC : BIOLOGY: IT'S BRANCHES; THE STUDY OF CELL AS THE BASIC UNIT OF LIFE; AND MOVEMENT OF SUBSTANCES ACROSS CELL MEMBRANE

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. List and discuss the branches of biology
2. Name some contributors to the development of biology including
3. Describe the characteristics of living thing including reproduction
4. Describe the structure and composition of the cell and discuss their functions
5. Distinguish between the basic functions of tissues, organs and systems
6. Draw and label the parts of the light microscope
7. Demonstrate the use of the microscope in viewing specimen
8. Distinguish between Akaryotic, Prokaryotic and Eukaryotic cells
9. Outline differences between plant and animal cells
10. Discuss the movement of substances into and out of the cell

OUTCOMES	CONTENTS	ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Realize that all livings things are made of cells. Attain the concept that living things have specific characteristics, including reproduction, that distinguish them from nonliving things. Acquire the fundamentals of laboratory skills in biology and the use of the microscope.	• **Branches of Biology** a) Definitions of Botany, Zoology, Anatomy, Histology, Physiology, Ecology, Entomology, Cytology, Virology, Bacteriology, Microbiology, Mycology Parasitology, Endocrinology and Ichthyology. • **Biological tools** Light microscopes	1. Naming the branches of biology and explaining their interrelationships. 2. Identifying and discussing three contributors, including a Liberian, to the development of the field of biology. 3. Describing the branches of biology	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008). • Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000) Senior Secondary Guide **C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High*	• Students will be required to list the branches of biology, and briefly discuss each • Quizzes on the contributors to the development of biology • Short answer questions on: - Characteristics of living things - Composition and functions of cell - Functions of tissues, organs and system • Students should use the light microscope to observe onion

	• **Contributors:** Nationality and major contributions of: a) Aristotle b) Carolus c) Lineaus d) Louis Pasteur e) Koch f) Mendel g) Harvey h) Parlov, etc; • **Living and Non-living things:** a) processes by which living things can be distinguished from non-living things: nutrition, respiration, excretion, irritability, movement, growth and reproduction b) characteristics and examples of plants and animals c) distinguishing characteristics and examples - Euglena , a boarder organism between animals and plants • **Cell:** a) Basic structure and functions of parts of a cell. b) Movement of substances into and out of the cell: osmosis, diffusion, facilitated diffusion, active transport, endocytosis (pinocytosis, phagocytosis), and exocytosis	that give insight into STIs. 4. Describing the basic characteristics of living things including reproduction. 5. Drawing cells (animal & plant) and labeling their parts. 6. Drawing and labeling the parts of the light. Microscope and explaining their functions. 7. Identifying some laboratory materials and apparatus and stating their uses. 8. Microscope observing: a) onion skin;, b) chick cells; and c) elodea plant cells.	*Integrated Science* (Pearson, 2009) • Biological charts on branches of biology • Compound light microscopes • Onion bulbs • Tooth picks • Slides, prepared • Droppers • Razor blade • Elodea plants • Iodine solution	skin, chick cells, and elodea plant cells, and draw and label them • Practical assignments

SEMESTER: ONE

PERIOD: II

GRADE: 10

TOPIC : THE HIERACHY AND DIVERSITY OF LIVING THINGS AND UNICELLULAR ORGANISMS

SPECIFIC OBJECTIVES:

Upon completion of the topic, students will be able to:

1. Outline the diversity of living things and explain what classification (taxonomy) means
2. Discuss the basis of taxonomy
3. Discuss the basis on which living things are named/classified
4. Discuss the relationship of viruses to living and non living things
5. State the major characteristics of the kingdoms Prokaryotae (bacteria), Protista (protists), Fungi (fungi), Plantae (Plants) and Animalia (animals)
6. Draw and label a representative organism found in each kingdom
7. Classify organisms into kingdom, phylum, class, order, family, genus and species
8. State the basic characteristics of unicellular organisms
9. Draw and label ameba, paramecium, trypanosome and plasmodium
10. Describe those characteristics that qualify unicellular organisms to be considered living organisms
11. Name unicellular organisms that are causative agents of diseases and the diseases they cause

OUTCOMES	CONTENTS	ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Realize that organisms are classified systematically based on biological keys. Demonstrate knowledge of the similarities and differences among the five major kingdoms of living things.	**1. Classification of living things and the importance of this classification** **2. Organizational plan for classification (Kingdom, Phylum, Class, Order, Family, Genus and Species)** **3. Unicellular organisms** a) STI-causing agents: Fungus,	1. Selecting and classifying organisms on the basis of their characteristics and biological keys. 2. Listing the general characteristics of each kingdom. 3. Drawing and labeling a representative organism of each kingdom.	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008).	• Short answer questions on the general classification of living things with specific reference to some common West African organisms. • Students to state the causes, effects and preventions of malaria and dysentery. • Using a matching list,

Attain the concept that life evolved from the simplest to the complex forms and that in its simplest form, living things can live as independent entities.	Bacteria, Virus, Protozoa Sarcodina – ameba – disease (dysentery) - effects & prevention b) Ciliate-paramecium c) Flagellates-euglena, trypanosomes d) Sporozoa (plasmodium) Malaria: - causes, effects & prevention - myths **4. Parasitic protozoa (others)** a) Entameba histolytica - Amebic dysentery (amebiasis) b) Giardia lamblia **5. Habitats and body structure** - Life processes: a) locomotion b) feeding c) respiration d) excretion e) reproduction f) responses	4. Drawing and labeling the structures of unicellular organisms; a) Ameba b) Paramecium c) Euglena. 5. Observing unicellular organisms under a microscope by examining a drop of water containing protozoans. 6. Drawing the life cycle of plasmodium. 7. Listing and discussing causative agents of STI and diseases they cause. 8. Discussion of the effects and preventions of malaria and dysentery.	• Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000) Senior Secondary Guide **C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High Integrated Science* (Pearson, 2009) • Specimens or drawings of various organisms, e.g. butterfly, cockroach, snail, earthworm, cat, man, etc. • Large beaker for setting up Hays infusion • Charts on kinds of Protozoans • Compound light microscopes • Empty slides • Prepared slides • Cover slips • Chemical (protoslo)	students should be able classify the characteristics of the five kingdoms of living things • Practical assessment of drawings

SEMESTER: ONE

PERIOD: III

GRADE: 10

TOPIC : TISSUES AND MULTICELLULAR ANIMALS

SPECIFIC OBJECTIVES

Upon completion of this topic, students will be able to:

1. Name and discuss the functions of the four types of tissues (epithelial, connective muscle and nervous)
2. Explain the concept of organ as a combination of tissues
3. Describe the characteristics of multicellular organisms
4. Describe the general characteristics of sponges
5. Describe the morphology and basic life characteristics of hydra
6. Classify worms, pointing out basic structural differences
7. Explain parasitism among the flat and roundworms, describing the life cycle and alternative hosts
8. State measures for preventing parasitic worm infections
9. Differentiate between the leech and earth worm from a morphological point of view
10. Describe the morphology, mode of nutrition, respiration, excretion and reproduction of the earth worm and its economic importance.

OUTCOMES	CONTENT	ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Realize that there is division of labor amongst cells and the development of tissues as working units in multicellular animals. Appreciate the need to prevent parasitic worm diseases; and demonstrate knowledge of doing so.	**1. Tissue and Organ systems** **2. Sponges** a) Morphology b) Sessile existence c) Nutrition d) Respiration**.** **3. Hydra** a) morphology b) adaptation c) locomotion d) nutrition e) respiration f) response to stimuli h) Reproduction	1. Explanation of tissue in relationship to organ systems 2. Drawing and labeling the body structure of a sponge and stating the functions of each 3. Drawing the three different cells of a sponge and stating the function of each 4. Drawing and labeling the parts of a hydra	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008). • Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000) Senior Secondary Guide	• Students should name and describe the types and functions of various body tissues and organs. • With the use of charts, students should draw and label sponges, hydra, flat worms, segmented worms, ascaris, tape worms and live earth worm. • Short answer questions on: - Classification of worms - Parasitism among flat and round

	and defense. **4. Worms:** a) flat worms Planarian (free living) - blood & liver flukes - tape worms b) Parasitic round worms - ascaris - hook worm - filarial worm - trichina worm c) Segmented worms - Earth worm and leeches	and stating their functions 5. Explanation of the conditions for oral transmission to the host of any intestinal parasite. 6. Stating the effects, symptoms and methods of prevention of any intestinal parasite. 7. Dissecting an earth worm and identifying its external and Internal features. 8. Observing and drawing the external structures of: a. filarial worm b. tape worm c. hook worm d. round worm	**C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High Integrated Science* (Pearson, 2009) • charts on various types of tissues and organs • charts on various kinds of multicultural invertebrate animals including sponges, hydras, • charts on various kinds of worms ➢ flat worms, ➢ segmented worms ➢ ascaris, ➢ tape worms ➢ live earth worms ➢ hook worm ➢ filarial worm ➢ trichina worm • dissecting tray • dissecting set • gloves • beakers • water	worms - Measures to prevent parasitic worm infections - Differentiation of leech and earthworm • Practical assessment of dissections

SEMESTER: TWO

PERIOD: IV

GRADE: 10

TOPIC : ARTHROPOD AND BIOLOGICAL CONTROL OF PESTS

SPECIFIC OBJECTIVES

Upon completion of this topic, students will be able to:

1. Discuss the general characteristics of the arthropod
2. Describe the external and internal features of the grasshoppers, weevils and cotton strainers; their mode of life, adaptation to their habitats and economic importance
3. Explain the process of metamorphosis (complete & incomplete) in arthropods;
4. Discuss the role of cockroach, mosquito and house-fly as vectors
5. Explain the general characteristics of butterfly
6. Discuss the economics importance of the honey bees and
7. Discuss pests, their economic importance and control measures.

OUTCOMES	CONTENT	ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Strong desire to destroy all breeding sites of arthropods that cause diseases and a realization that some arthropods can be used as food.	**1. Arthropod: general characteristics, classification with examples:** a) study specimen: grasshopper/locust or cockroach, weevils and cotton stainers b) morphology c) respiration d) mouth parts, food and feeding e) life cycle: metamorphosis (complete and incomplete) **2. Mosquitoes:** - Types, mouth parts and feeding, life cycle, transmission of plasmodia, teste fly as vector of trypanosomes, and control measure. **3. Transmission of diseases by house fly and cockroach** **4. Butterfly and moth:** - general characteristics - mouth parts and feeding **5. Honey bee** **6. Pests** - Economic importance - Chemical control - Biological control	1. Discussing the economic importance of arthropods 2. Diagramming the life cycle of mosquitoes (anopheles) in relationship to the plasmodium (malaria) 3. Collecting mosquito larvae/wigglers and bringing to the class for observation. 4. Listing methods of controlling the spread of malaria. 5. Collecting butterfly, grasshopper, cockroach, weevils, cotton strainers and fly and observing their external body structures 6. Drawing and labeling the parts of a grasshopper 7. Collecting and classifying some arthropods 8. Listing modes of transmission and methods of preventing diarrhea. 9. Stating the economic importance of honey bees 10. Discussing honey bee as social insects.	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008). • Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000) Senior Secondary Guide **C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High Integrated Science* (Pearson, 2009) • Charts on various kinds of arthropods and malaria cycle • Specimens: crab, crayfish, spiders, centipede, millipede, grasshoppers, butterflies cockroaches, weevils and cotton stainers • Insect collecting net • Dissecting set • Dissecting tray	• Collection and classification of arthropods; and discussion of the division of labor among honey bees. • Quizzes for students to: - Discuss the role of cockroach, mosquito and house fly as vectors - Explain the general characteristics of the butterfly • Short answer questions for students to discuss: - The economic importance of the honey bee - Pests and their economic importance as well as control measures • Questions & Answers Quizzes • Assignments • Tests • Discussion

			• Gloves	

SEMESTER: <u>TWO</u>

PERIOD: V

GRADE: <u>10</u>

TOPIC : PLANT-LIKE ORGANISMS (ALGAE, FUNGI, MOSSES, FERNS) AND PHOTOSYNTHEISIS

SPECIFIC OBJECTIVES

Upon completion of this topic, students will be able to:

1. Describe the general characteristics, structures and life cycles of algae, fungi, mosses and ferns
2. Explain the economic importance of algae and fungi to human
3. Describe the process of reproduction (sexual and asexual) in algae
4. Explain types of nutrition of fungi with terms such as *parasitic*, and *saprophytic*:
5. List common fungal diseases of plants and human such as athlete foot, ringworm dishcloth, blight
6. Explain the process of photosynthesis

OUTCOMES	CONTENT	ACTIVITIES	MATERIALS RESOURCES	EVALUATION
Realize that algae are producers of atmospheric oxygen and serve as food for marine organisms. Realize that penicillin is produced by fungus. Realize that mosses and ferns are non-flowering plants.	**1. Algae:** a) General characteristics b) classification c) phytoplankton (floating microbe) d) green algae e) Spirogyra-reproduction (sexual and asexual) f) economic importance of algae in food, medicine & industry) **2. Fungi:** a) General characteristics b) classification	1. Drawing and labeling the parts of a spirogyra 2. Drawing and labeling the stages of sexual reproduction in spirogyra 3. Examining and identifying a piece of molded bread under the microscope showing the hyphae of rhizopus,; drawing and labeling	**<u>A. Primary Text</u>** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **<u>B. Secondary Texts</u>** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008). • Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000)	• With the aid of the microscope, students should examine rhizopus, draw and label the parts. • Students explain the life cycles of mosses and ferns in short essays • Short answer questions for students to: - Describe the process of

	c) nutrition-parasitic, saprophytic d) diseases of plants & human, blight, smuts, rust, athletes foot, yeast infection, ringworm and dishcloth. **3. Economic importance** (food, medicine and industry) **4. Reproduction** (sexual & asexual) **5. Mosses**(e.g. brachymerium and Funaria) and Ferns (i.e. Nephrolepis, Platycerium) a) general characteristics b) reproduction: alternation of generations (sexual and asexual cycle) c) economic importance **6. Photosynthesis** a) Definition b) conditions of photosynthesis c) leaf adaptation of photosynthesis light dependent reactions d) light independent reactions e) products of photosynthesis f) fate of photosynthetic products	the parts. 4. Illustrating the life cycle of rhizopus. 5. Explaining the life cycle of a club fungus 6. Collecting and studying a bracket fungus and identifying the annual rings 7. Stating ways of preventing fungal infections 8. Diagramming reproduction in fungus 9. Drawing and labeling the sexual and asexual reproductive cycles of mosses, ferns 10. growing two plants, one in sunlight and one in the shade to observe the effects of the presence or absence of light on plant growth 11. Wrapping some leaves of a growing plant with aluminum fold and comparing it with other leaves of the same plants after four days.	Senior Secondary Guide **C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High Integrated Science* (Pearson, 2009) • Charts on algae & fungi • Specimens (yeast, stale bread) club fungi, bracket fungi • Microscope • Plain slide & prepared slide cover slips • Droppers • Beakers • Charts on the life cycles of mosses and ferns • Specimens of growing plants • Aluminum foil • Empty cans • Boiling water • White tile • Iodine solution • Dropper • Green leaf • Ethanol • Variegated leaf • Test tube • Test tube holder • Test tube rack • Clamp and Clamp stand • Bench lamp • Filter funnel • Aquatic plant	reproduction (sexual and asexual) - Explain types of nutrition of fungi - List common fungal diseases • Quizzes on processes of photosynthesis • Students to give short discussion of the light-dependent and light-independent reactions of photosynthesis • Practical assignments on conducting tests for starch, etc.

	g) Macronutrients and micronutrients: their effects in photosynthesis	12. Testing a leaf for starch 13. Testing to break down cell wall and stop the action of enzymes within a leaf 14. Testing to extract chlorophyll 15. Experimenting to demonstrate the need for chlorophyll in photosynthesis 16. Experimenting to demonstrate the need for light in photosynthesis		

SEMESTER: TWO

PERIOD: VI

GRADE: 10

TOPIC : FLOWERING PLANTS

SPECIFIC OBJECTIVES

Upon completion of this topic, students will be able to:

1. Identify the characteristics of flowering plants and distinguish them from one another
2. Explain what makes flowering plant successful
3. Classify flowering plants into *monocotyledonae* (monocots) and *dicotyledonae* (dicots)
4. State the distinguishing characteristics of monocots and dicots
5. Describe the structures and functions of roots, stems, and leaves; and flowers of flowering plants.

6. Explain sexual and asexual reproduction in flowering plants
7. Draw and label a flower, stating the function of each part
8. Determine and write the floral formulae of flowers such as flamboyant (*Delonix)*, Pride of Barbados (*Caesalpinia*) and Rattle Box (*Crotalaria)*
9. State types of pollination and list agents of pollination
10. Explain the process of zygote and embryo formation in flowering plants
11. Describe the conditions for seed germination
12. Name the types of fruits and explain fruit and seed dispersal
13. List and describe plant hormones and their functions
14. Explain transport system in plants
15. Discuss the process of excretion in plants
16. Describe the process of plant growth and development
17. Explain the process of gaseous exchange in plant

OUTCOMES	CONTENT	ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Accept that flowering plants are major food producers in the biosphere and are very important in the food chain. Appreciate the concept of how water, food and minerals are transported in vascular plants. Realize that plants excrete waste materials.	**1. Flowering plants:** a) classification (monocots & Discots) b) Success of flowering plants **2. Functions of roots, stems, leaves and flowers** **3. Floral formulae of flowers:** i.e. Flamboyant (Delonix), pride of Barbados (Caesalpinia) and rattle box (Crotalaria). **3. Types of plants tissues** **4. Root system:** a) types b) regions of root tip, c) functions and structures of root hairs **5. Modified roots, stems and leaves** **6. Leaf classification and arrangement of stem** **7. Germination: types** (epigeal and hypogeal) - conditions	1. Drawing and labeling the parts of a typical flower and stating their functions 2. Illustration of the types of vegetative propagation (cutting, grafting, etc) 3. Setting up an experiment to demonstrate the two types of germination - using corn seed (kernel) and bean seed.. 4. Examine the	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008). • Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000) Senior Secondary Guide **C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High Integrated Science*	• Short answer questions for students to: - Identify characteristics of flowering plants - Distinguish flowering plants from one another - Classify flowering plants in monocots and dicots • Asking students to use seeds to demonstrate germination in plants • Questions/answers on: - Sexual and asexual reproduction in

	8. Reproduction in flowering plants **9. Kinds of fruits and dispersal of fruits and seeds** – agents **10. Tropisms and plant growth hormones** **11. Primary and secondary growth in plants** **12. Masurement of growth in plants** **13. Nastic and Tactic Movements in plants** **14. Transport system in vascular plants** **15. Excretion in plants** **16. Excretory product of plants:** water, carbon(IV) oxide, oxygen, Alkaloids, tannis, resins, acids, gums **17. Movement of water and minerals through plants** **18. Movement of organic materials from leaves to roots** **19. Pressure flow hypothesis and cytoplasmic streaming of translocation** **20. Transpiration:** advantages and disadvantages **21. Environmental factors affecting transpiration** **22. Physiological factors affecting the rise of water in xylem:** root pressure, transpiration, cohesion-tension mechanism, adhesion, water potential gradient	internal structure of leaf under the microscope 5. Collecting as many fruits and seeds and classifying them into types. 6. Drawing and labeling cross section of monocot and dicot stems and roots. 7. Explaining the two types of pollination and listing agents of pollination 8. Observing the process of transpiration through experiments 9. Collecting and classifying different kinds of leaves 10. Examining sections of stems and roots, showing different stages of primary	(Pearson, 2009) • charts on plant tissues (ground vascular tissues and dermal tissues) • Charts on the cross section of decoct stem and monocot stem • Microscope and slides • Specimens • Whistle plant with roots, stem leaves & flowers • empty plastic jars/cans • Cups • Soil • Dried seed • Variety of fruits	flowering plants - Floral formulae of flowers - Types of pollination - Types of fruits and fruit and seed dispersal - Plant growth and development - Gaseous exchange in plants - Explaining transport system and excretion in plants - Explaining the primary and secondary growth patterns in plants • Quizzes • Tests • Assignments

	23. Gaseous exchange a) concentration gradient b) structure and function of stomata c) structure and function of lenticels **24. Explanation of metabolic equations** a) $C_6H_{12}O_6 + 6O2 \rightarrow 6CO_2 + 6H_2O$ + Heat energy b) $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ + Heat **25. Types of respiration compared** a) facultative aerobic b) facultative anaerobic	and secondary growth.		

SEMESTER: <u>ONE</u>

PERIOD: <u>I</u>

GRADE: <u>11</u>

TOPIC : VIRUSES AND BACTERIA

SPECIFIC OBJECTIVES

Upon completion of this topic, students will be able to:

1. List the characteristics of viruses
2. Describe the four methods used in studying viruses
3. Classify viruses based on nucleic acid (DNA & RNA) and the organisms they attack
4. Explain the life cycle of a virus
5. List some viral diseases, modes of transmission and methods of prevention
6. Describe bacteria of various kinds and observe them under the microscopes
7. Classify bacteria, and draw and label a typical bacterial cell
8. List and describe some common bacterial diseases and symptoms

9. State preventive measures of bacterial diseases
10. Distinguish between *autotrophic* and *heterotropic* nutrition; and *aerobic*, a*naerobic* and f*acultative* respiration
11. Explain the economic importance of bacteria

OUTCOMES	CONTENTS	ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Recognize that viruses are agents of diseases some of which are the common diseases around us, like polio, mumps, measles and some sexually transmitted infections (HIV/AIDS, Herpes). Realize that some bacteria are useful to humans.	**1. Virus:** a) General characteristics a) definition b) size & shape c) Composition Structure **2. Classification:** a) bacterial viruses b) animal viruses c) plant viruses **3. Structure of bacteriophage** **4. Life cycles** **5. Common viral Diseases:** cold, flu mumps, chicken pox, rabies, polio, HIV/ ADDS 6**. Sexually transmitted Infections (STIs):** a) modes of transmission and prevention	1. Listing and discussing viruses that cause diseases. 2. Drawing and labeling bacteriophage. 3. Diagramming the life cycle Of bactriophage. 4. Identifying and listing common viral diseases. 5. Discussing STIs caused by viruses, modes of 6. Transmission and prevention. Discussing the importance of HIV testing and support. 7. Role playing the causes and 8. Prevention of STIs.	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008). • Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000) Senior Secondary Guide **C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High Integrated Science* (Pearson, 2009) • Biological charts of the various types of viruses • Chart of HIV trend in Liberia • Prepared slides of bacteria • Charts for the shape and types of bacteria microscope • Microscope • Prepared slides of bacteria • Charts of shapes and types of bacteria	• Students to classify viruses and bacteria, and list the characteristics of viruses • Paper and pencil tests for students to: - Describe methods in studying viruses - Classify viruses, and explain their life cycles - List some viral diseases - Classify and describe bacteria of various kinds • Written and oral assignments • Written quizzes/ test • Role play

SEMESTER: ONE

PERIOD: II

GRADE: 11

TOPIC: NUTRITION AND FOOD PRESERVATION

SPECIFIC OBJECTIVES

Upon completion of this topic, students will be able to:

1. Explain the concept of nutrition
2. Explain why living things need energy
3. Outline and classify the types of nutrients found in food
4. Write the structural formulae of carbohydrates, proteins and lipids
5. State the importance of nutrients found in food
6. Demonstrate the presence of various nutrients found in food
7. Determine the dental formula of a mammal
8. Explain the importance of dental care in humans
9. Explain the concept of a balance diet
10. Explain the concept of malnutrition
11. Name and discuss various methods of preserving and storing food
12. Preserve food using local resources
13. Explain the biological basis for preserving and storing food

OUTCOMES	CONTENTS	ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Realize that all organisms require food for the production of energy to support life processes. Accept that there are different types of nutrition. Realize that proper methods of preserving food prevent food poisoning (spoilage)	**1. Nutrition - Definition and types:** a) Autotrophic nutrition b) Heterotrophic nutrition c) Holozoic nutrition d) Saprobiontic (sarprophytic) nutrition e) Parasitic nutrition f) Mutualistic nutrition **2. Food, nutrients** (carbohydrates, lipids, proteins, vitamins, etc.) and energy	1. Testing for: (a) carbohydrate (b) reducing sugar (Benedict's test) (c) non-reducing sugar(e.g. sucrose) (d) starch (the iodine/potassium iodide test) (e) lipid-present (the emulsion test) (f) proteins (biuret test)	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008). • Doris Koto, et al., *Senior*	• Student should write short descriptions of their concepts of nutrition, importance of energy, etc. • Short answer questions for students to: - Outline and classify the types of nutrients found in foods

	3. Structure of carbohydrates, lipids and proteins **4. Teeth and dental formulae** **5. Dental care** **6. Balance diet** **7. Malnutrition** **8. Methods of food preservation:** a) ionization radiations (X-Rays, etc) b) drying c) salting d) smoking e) parboiling f) dehydration g)refrigeration h) frying i) use of oil j) incubation k) Importance of food preservation	(g) vitamin C 2.Classifying the nutrients found in different types of food 3.Identifying structure of carbohydrate, proteins and lipids 4. Using preservative methods on samples of food and comparing them with other food stuffs that have not been Preserved.	*Secondary Guide – Biology* (Pearson, 2000) Senior Secondary Guide **<u>C. Other Resources/Supplementary Readings</u>** • Bob McDuell, *Senior High Integrated Science* (Pearson, 2009) • Glucose solution • Benedict's solution • Fehling's solution • Test tubes • Test tube rack • Cassava • Potato • Iodine • Potassium • Vitamin C powder • Filter paper • Ethyl alcohol • Egg albumin • Milk • Copper (II) sulphate • Syringe • Droppers • Orange juice • Lemon juice • Grapefruit juice • Diclorophenolindophenol (DCPIP) dye • Ascorbic acid • Pipette • Sodium hydroxide solution • Filter paper	- Determine dental formula of a mammal, and the importance of dental care - Explain the concepts of balance diet and malnutrition - Name and discuss various methods of preserving and storing food using local resources • Written and oral assignments • Written quizzes/tests • Case Study • Practical assignments

			• Distill water • Groundnuts, fish, milk and pawpaw • Mortar and pestle • Specimens of various food stuffs • Salt • Incubator • Fire wood • Locally made dryer • Charcoal • Coal pot • Pot • Palm oil	

SEMESTER: ONE

PERIOD: III

GRADE: 11

TOPIC : SOIL FORMATION (DIFFERENT METHODS) – MAINLY SEDIMENTARY PROCESS, ROCK AND PARTERNS IN NATURE,

ENERGY AND ECOLOGY – PATTERNS IN NATURE, ENERGY AND MATERIALS

SPECIFIC OBJECTIVES

Upon completion of this topic, students will be able to:

1. Distinguish between the different types of soil (loamy, sandy and clay soil)
2. State the effects of erosion on soil fertility
3. List the composition of soil
4. Explain the effects of the overuse of the soil
5. Explain the processes of soil conservation, maintenance, and renewal of fertility
6. Explain the advantages and disadvantages of the slash and burn methods in farming
7. Characterize the reproductive isolating mechanisms of species
8. Distinguish the habitat of an organism from its ecological niche
9. Define population and explain the concept of population diversity
10. Describe the concept of ecological succession
11. Describe the various types of inter-specific interactions among organisms
12. Discuss with the aid of a diagram atrophic structures of ecosystem from food chains and food webs pyramids of numbers
13. Define the productivity of an ecosystem and distinguish between gross primary productivity and net primary productivity
14. Discuss energy flow through the trophic system, the water cycle, the carbon dioxide cycle, the nitrogen cycle, the phosphorus cycle and the sulfur cycle
15. Explain some ways of conserving natural resources
16. Explain the concept of *species* as it relates to the environment and characterize the reproductive isolating mechanisms of species
17. Distinguish between the habitat of an organism and its ecological niche
18. Define population growth and explain the concept of population density
19. Calculate population growth rate, doubling time and percent growth rate, death rate and birth rate
20. Distinction between density dependent and density independent factors that affect population size
21. Distinguish between immigration and emigration
22. Discuss exponential growth curve, sigmoid growth curve and the logistic model

OUTCOMES	CONTENTS	ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Advocate for the proper disposal of non-biodegradable substances (plastics) into the soil for proper yield of food and cash crops Appreciate the concept of ecosystem and the interdependence of organisms within ecosystems. Realize that organisms interact with their nonliving environment:	**1. Soil:** a. formation b. composition of soil c. types of soil d. fertility e. erosion: causes and prevention f. conservation g. maintenance h. renewal of fertility d) Weathering (a) Physical weathering (b) Chemical weathering' **2. Liberia food and cash crops production** **3. Effects of non- biodegradable substances on soil fertility** **4. Isolation mechanisms of species** **5. Inter-specific interactions** (Biological associations) (a) mutualism (b) commensalism (c) predation (d)parasitism (e) competition **6. Trophic levels:** (a) autotrophs (producers) (b) heterotrophs (consumers) (c) Food chains and webs **7. Conservation of nature** (a) soil conservation	1. Explaining soil formation 2. Collecting, observing and classifying soil types 3. Listing and discussing the composition of soil 4. Observing and discussing the effects of erosion on soil fertility 5. Demonstrating the presence of air in the soil 6. Listing food and cash crops in Liberia 7. Digging in the school yard to observe non-biodegradable substances (plastic materials) 8. Discussing the various inter-specific interactions between species 9. Taking field trips to visit ecosystems such as ponds and forest regions 10.Listing and diagramming	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008). • Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000) Senior Secondary Guide **C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High Integrated Science* (Pearson, 2009) • Samples of different types of soil • Empty cups and jars • Plastic materials • Shovel • Charts of inter-specific interactions • Diagrams of trophic levels • Charts of biocycles	• Essay tasks for students to: - Distinguish between different types of soil - State effects of erosion - List composition of soil; and effect sof erosion - Explain processes of soil conservation; and the advantages and disadvantages of slash and burn methods in farming • Students should discuss the effects of biodegradable substances on soil fertility • Written quizzes/ tests for students to: - Characterize the reproductive isolating mechanisms of species - Distinguish the habitat of an organism from its ecological niche

	(b) forest conservation (c) wildlife conservation (d) oil conservation (e) mineral conservation **8. Biocycles in nature** (a) the water cycle (b) the carbon cycle (c) the nitrogen cycle (d) the phosphorus cycle (e) the sulfur cycle **9. Organisms habitat and ecological niche** **10. population:** a) population density b) population growth rate c) doubling time d) percent growth rate e) birth rate, death rate f) immigration, emigration, density–dependent and density independent factors **11. Ecological succession:** (a) primary and secondary successions (b) pioneer and climax communities	food chains and food webs 11. Diagramming and discussing the bicycles – water, carbon, nitrogen, phosphorus and sulfur cycles.		- Define population and explain the concept of population diversity - Describe the concept of ecological succession - Describe the various types of inter-specific interactions among organisms - Explain the various inter-specific relationships among organisms - Explain the differences between autotrophs and hererotrophs - Explain the importance of biocycles • Practical assessments • Group work

SEMESTER: TWO

PERIOD: IV

GRADE: 11

TOPIC : CELL GROWTH AND REPRODUCTION (MITOSIS AND MEIOSIS)

SPECIFIC OBJECTIVES

Upon completion of the topic, students will be able to:

1. Distinguish between asexual and sexual reproduction
2. List and explain the forms of asexual reproduction
3. Describe the phases of the cell cycle
4. List the events of mitosis and diagram the phases
5. Compare mitosis and meiosis and explain the importance of meiosis in sexual reproduction

OUTCOMES	CONTENTS	ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Accept that reproduction is a characteristic of living things and it begins with cell division	**1. Cell growth & reproduction:** a) asexual reproduction - propagation - Fission - budding b) Sexual reproduction -cell cycle i. interphase ii. mitosis iii cytokinesis c) Meiosis - sperm and egg formation	1. Drawing and labeling stages of mitosis and meiosis 2. Examining thin slices of onion root tip to study the stages of mitosis under the microscope 3. Comparing mitosis and meiosis 4. Explaining sperm and egg formation 5. Explaining terms such as gametes, diploid, haploid	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008). • Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000) Senior Secondary Guide **C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior*	• Short essays to discuss the importance of meiosis in sexual reproduction • -Written quizzes, tests for students to: - Distinguish between asexual and sexual reproduction - List and explain the forms of asexual reproduction - Describe the phases of the cell cycle - List the events of mitosis and

			High Integrated Science (Pearson, 2009) ▪ Microscopes ▪ Slides ▪ Onion bulbs ▪ Scalpels ▪ Charts of mitosis and meiosis ▪ Methalene blue (chemical) ▪ Razor blades ▪ Dropper ▪ Beakers	diagram the phases - Compare mitosis and meiosis and explain the importance of meiosis in sexual reproduction • Oral questions and answers • Class discussion • Practical assignments

SEMESTER: <u>TWO</u>

PERIOD: <u>V</u>

GRADE: <u>11</u>

TOPIC : NUCLEIC ACIDS, PROTEIN SYNTHESIS, HEREDITY, GENETICS, SEXUALITY AND EVOLUTION

Upon completion of this topic, students will be able to:

1. Explain the term nucleic acids and name the types of nucleic acids
2. Describe the double helix model of DNA structure
3. Outline the process of DNA replication
4. Outline the process of RNA transcription
5. Outline the process of protein synthesis
6. Explain the process of protein synthesis and give examples of the proteins synthesized by humans
7. Explain the meanings of heredity, genetics and sexuality
8. Describe how trait are passed from parents to offspring
9. Explain Mendel's contributions to the understanding of the principles of heredity
10. List factors affecting evolution
11. Demonstrate genetic principles on Mendel's experiment with garden peas.
12. Explain the concept of sexuality and apply it in different situations
13. Discuss linkage and sex-linked characters
14. Describe three sources of evidence of evolution
15. Discuss two theories of the mechanisms of evolution

OUTCOMES	CONTENTS	ACTIVITIES	MATERIALS RESOURCES	EVALUATION
Acquire the concept that DNA and RNA are the principal transmitters of genetic characteristics. Realize that proteins play a fundamental role in sustaining the processes that support the survival of living things. Accept that traits are inherited from parents, through the DNA and that genetic disorders are inherited. Therefore, it is important to do medical examination when selecting a partner. Develop positive behaviors and values about oneself. Recognize the effects of gene interactions. Accept the concept of genetic variation.	**1. The two types of nucleic acids**: a) DNA b) RNA **2. Structures of nucleotides** **3. Complementary base pairing** **4. Structure of DNA and RNA** **5. DNA replication** **6. RNA transcription** **7. Stages of protein synthesis** **8. Types of RNA** **9. The importance of protein synthesis** **10. Heredity and genetics:** a) principles of genetics b) Mendel's experiment with garden peas; c) Genetic terms: phenotype, genotype, alleles hybrid, homozygous, heterozygous, monohybrid, dihybrid, dominant and recessive genes **11. Heredity Traits:** hemophilia, mental disorder, sickle cell, color blindness, baldness, heavy ear lobes, etc. a) Indolence of environment on heredity b) Development of traits: Intelligence **12. The ABO blood grouping**	1. Using DNA model to demonstrate the process of DNA replication 2. Using charts to explain the process of RNA transcription 3. Using chart to demonstrate the process of protein synthesis 4. Explaining heredity 5. Describing Mendel's contributions to principles of heredity 6. Describing Mendel's experiments and results 7. Solving monohybrid and dihybrid problems using punnett square 8. Stating the importance of the punnett square 9. Discussing some genetic disorders and diseases. 10. Defining reproductive health and rights. 11. Listing reproductive rights	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008). • Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000) Senior Secondary Guide **C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High Integrated Science* (Pearson, 2009) • Integrated Science for SHS – (Pearson) ▪ DNA model ▪ RNA model ▪ Charts of DNA structure and replication ▪ Charts of RNA structure and transcription ▪ Charts of the process of protein synthesis ▪ Garden peas ▪ Biological charts showing genetically	• Students to explain the structure of DNA and the process of DNA replication • Asking questions to explain the process of protein synthesis • Explain how the sex of an organism is determined. • Explain the sources and theories of evolution. • Written quizzes, tests for students to: - Describe how trait are passed from parents to offspring - Explain Mendel's contributions to the understanding of the principles of heredity - List factors affecting evolution - Demonstrate genetic principles on Mendel's experiment with

	and rhesus factor **13. Evolution and natural selection (Darwin)** **14. Sexuality:** a) reproductive health and rights b)sex determination c) infertility d) cycles of sexuality **15. Variation**: a)continuous variation b) discontinuous variations **16. Sources of variation:** a) crossing over b) independent assortment a) random fusion of gametes **17.Causes of variation:** a) genetic factors b) environmental factors **18. Consequence of variation**– natural selection **19. Population genetics** **20. Convergent evolution** **21. Divergent evolution** **22. Evidence of evolution:** a) fossil records b)comparative (Paleontology) embryology c) comparative biochemistry anatomy **14. Theories of evolution** a) Lamark's theory b) Charles Darvin's theory	12. Discussing the causes of infertility in both man and woman 13. Explaining the five cycles of sexuality 14. Outlining similarity. and differences among different species of vertebrates 15. Studying charts of the comparative anatomy of various classes of vertebrates. 16. Studying charts on developmental stages of vertebrates.	disorder individuals ▪ Explain different stages of vertebrates ▪ Charts of evolution ▪ Charts of comparative anatomy of vertebrates ▪ Charts on developmental stages of vertebrates	garden peas. - Explain the concept of sexuality and apply it in different situations - Discuss linkage and sex-linked characters - Describe three sources of evidence of evolution - Discuss two theories of the mechanisms of evolution • Oral questions and answers • Class discussion

SEMESTER: TWO

PERIOD: VI

GRADE: 11

TOPIC : CHORDATA: FISHES, AMPHIBIANS AND REPTILES

SPECIFIC OBJECTIVES

Upon completion of this topic, students will be able to:

1. Explain the general characteristics of the phylum Chordata
2. Classify the phylum chordata with its three major phyla
3. Describe the differences between vertebrates and invertebrates
4. List the general characteristics of the fish and explain the differences among the three groups (jawless, cartilaginous and bony)
5. State the economic importance of fishes
6. List the general characteristics of amphibians
7. Describe the external & internal features of the amphibians using a frog
8. Differentiate the structural differences between frog and toad
9. Explain the success of reptiles on land as opposed to amphibians.

OUTCOMES	CONTENTS	ACTIVITIES	MATERIALS RESOURCES	EVALUATION
Accept the economic importance of fishes, amphibians and reptiles and their nutritional values	**1. Chordates:** general characteristics: a) primitive chordates - amphioxus b) vertebrate: i. Primitive fish ii. Cartilaginous fish iii. Bony fish c) differences among the three groups d) general characteristics of fish e) Adaptation, locomotion, respiration and economics importance. **2. Amphibians:**	1. Identifying and describing the internal and external structures of a fish 2. Explaining the importance of a fish 3. Collecting and dissecting fish and frog to study the digestive and circulatory systems 4. Collecting and dissecting a lizard	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008). • Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000)	• Explain the nutritional value of fishes • Written quizzes, tests and exams for students to: - Explain the general characteristics of the phylum Chordata - Classify the phylum chordata with its three major phyla - Describe the differences between vertebrates and invertebrates

	general characteristics a) External & internal features of a frog, b) metamorphosis **3. Reptiles:** a) general characteristics b) external & internal features of lizard c) internal fertilization and the amniotic egg	and studying the external features, digestive, circulatory and respiratory systems 5. Drawing and labeling the amniotes egg and studying the extra-embryonic membranes.	Senior Secondary Guide **C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High Integrated Science* (Pearson, 2009) • Integrated Science for SHS – (Pearson) • Live frog, fish and lizard • Dissecting sets • Dissecting tray • Biological charts of amphioxus, shark, fish, amphibians and reptiles • Gloves • Pins • Scissors • Razor blades • Water	- List the general characteristics of the fish and explain the differences among the three groups (jawless, cartilaginous and bony) - State the economic importance of fishes - List the general characteristics of amphibians - Describe the external & internal features of the amphibians using a frog - Differentiate between the structures of the frog and the toad - Explain the success of reptiles on land as opposed to amphibians. • Oral questions and answers • Class discussion • Practical assignments

SEMESTER: ONE

PERIOD: I

GRADE: 12

TOPIC : CHORDATA: BIRDS AND MAMMALS

SPECIFIC OBJECTIVES

Upon completion of this topic, students will be able to:

1. State the general characteristics of birds and mammals
2. Explain the adaptations made by birds for flight
3. Describe the external and internal features of birds
4. Name and classify the different kinds of mammals
5. Describe and state functions of some internal organs of mammals
6. Classify mammals on the basis of the methods of reproduction and the structure of the foot
7. Explain the control mechanisms of body temperature of aquatic, flying and primitive mammals

OUTCOMES	CONTENTS	ACTIVITIES	MATERIALS RESOURCES	EVALUATION
Identify and appreciate the shared characteristics of human and other higher chordates.	**1. Birds:** a) general charcteristics b) external and internal features c) types of birds (flight and non-flight) d) adaptation to flight e) types of feathers **2. Mammals:** a) general characteristics -male and female	1. Examining the external features of birds a)studying, drawing and labeling the three types of feathers studying and examining contents of chicken egg 2. Listing the general characteristics of mammals a) stating the structures and functions of	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008). • Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000) Senior Secondary Guide	Paper and pencil tests for students to: - State the general characteristics of birds and mammals - Explain the adaptations made by birds for flight - Describe the external and internal features of birds - Name and classify the

	reproductive systems b) orders of mammals c) features of each order d) structure of a typical mammalian molar tooth e)dentition and dental formulae **3. control mechanisms of body temperature of aquatic, flying and primitive mammals**	the male and female reproductive systems 3. Describing features of each order a) Drawing and labeling a typical mammalian molar tooth b) Writing dental formulae of rabbit, dog and man c) Describing of the control mechanisms of the body temperature of aquatic, flying and primitive mammals.	**C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High Integrated Science* (Pearson, 2009) • Integrated Science for SHS – (Pearson) • Charts of birds and mammals • Live bird (chicken) • Live animal (rat, cat, dog. • Chicken eggs • Preserved specimen of birds and mammals	different kinds of mammals - Describe and state functions of some internal organs of mammals - Classify mammals on the basis of the methods of reproduction and the structure of the foot - Explain the control mechanisms of body temperature of aquatic, flying and primitive mammals - Describe adaptation made by birds for flight. • Written quizzes, tests and exams • Oral questions and answers • Class discussions • Practical assignments

SEMESTER: ONE

PERIOD: II

GRADE: 12

TOPIC : SKELETAL, MUSCULAR AND REPRODUCTIVE SYSTEMS

SPECIFIC OBJECTIVES

Upon completion of this topic, student will be able to:

1. List the regions of the human skeletal system
2. State the functions of the human skeletal system
3. Name and describe the locations of the various types of joints
4. List and describe the functions of the three types of muscle tissues
5. Describe the effects of sexually transmitted infections (STIs) and substance abuse on the skeletal and muscular systems
6. Describe the body changes during adolescence development
7. Explain the process of gamete formation
8. Explain the functions of the male and female reproductive organs
9. Draw the male and female reproductive organs
10. Describe the structure and function of a sperm cell
11. Explain the menstrual cycle
12. Explain the reproductive health consequences of Gender Based Violence
13. State the benefits of family planning and various methods used

OUTCOMES	CONTENTS	ACTIVITIES	MATERIALS RESOURCES	EVALUATION
Outline the importance of bones and muscles in body movement and coordination Take appropriate preventive measures to prevent sexually transmitted infections that destroys the skeletal	**1. Division of the human body** a) (head, neck, trunk and appendages) b) Body cavities **2. Skeletal system:** a) composition: bones, cartilage, ligaments and tendons b) Regions:	1. Discussion of cell and tissue of the skeletal and muscular systems 2. Drawing and labeling the skeletal and muscular systems	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann,	• Written test for students to: - List the regions of the human skeletal system - State the functions of the human skeletal system - Name and describe the locations of the

system Articulate the emotions that accompany adolescence sexual development which will enable them to prevent STIs and teenage pregnancy.	- axial skeleton - appendicular skeleton c) Functions of the skeleton/bones d) Types of joints, functions and locations **3. Muscular system:** a) types and functions of muscle tissues **4. Effects of sexually transmitted infections and substance abuse on the skeletal, muscular and reproductive systems** **5. Adolescence development** **6. Gamete formation:** a) oogenesis b) spermatogenesis **7. Male and female reproductive organs** **8. Sperm and egg** **9. Menstrual cycle** **10. Fertilization and conception** a) sex determination b) infertility **11. Cycles of sexuality** **12. Sexually transmitted infections (STIs):** -modes of transmission and methods of prevention **13. HIV/AIDS:** - immune system, risky behaviors, care and support, stigma and discrimination and importance of testing **14. Gender Based Violence** **15. Family Planning**	3. Examining and studying bone cells under the microscope 4. Listing the bones of the skeletal system 5. Explaining types and functions of the muscle tissues 6. Listing the effects of Sexually Transmitted Infections (STIs) and substances abuse on the human system and their methods of prevention 7. Describing the stages of adolescence 8. Demonstrating oogenesis and spermatogenesis by use of model and diagram 9. Describing the male and female reproductive organs and their functions 10. Drawing and labeling	2008). • Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000) Senior Secondary Guide **C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High Integrated Science* (Pearson, 2009) • Charts of the human skeletal, muscular and reproductive systems • Prepared slides of bone cells and cartilage cells • Chart of the human body regions and cavities • Models and charts of oogenesis and spermatogenesis • Charts of the male and female reproductive organs • Chart of the menstrual cycle • Chart showing stages of fetal development from the zygote (fertilized egg) • Chart of family planning methods	various types of joints - List and describe the functions of the three types of muscle tissues - Describe the effects of sexually transmitted infections (STIs) and substance abuse on the skeletal and muscular systems - Describe the body changes during adolescence development - Explain the process of gamete formation - Explain the functions of the male and female reproductive organs - Draw the male and female reproductive organs - Describe the structure and function of a sperm cell - Explain the menstrual cycle - Explain the reproductive health consequences of Gender Based Violence - State the benefits of family planning and

		11. the structure of sperm cell 12. Describing the stages of menstrual cycle 13. Explaining fertilization and development of the fetus 14. Stating causes of infertility 15. Discussing sexually transmitted diseases, with emphasis on HIV/AIDS 16. Explaining and discussing the reproductive health consequences of gender based violence 17. Describing the benefits of family planning		various methods used • Written quizzes, tests and exams • Oral questions and answers • Class discussion • Using charts of the male and female reproductive organs to draw and label organs and sperm cell.

SEMESTER: ONE

PERIOD: III

GRADE: 12

TOPIC : DIGESTIVE, CIRCULATORY AND LYMPHATIC SYSTEMS

SPECIFIC OBJECTIVES

Upon completion of this topic, students will be able to:

1. Describe the organs of the digestion system
2. Explain nutrition, and classes of food and their specific uses
3. State the functions of enzyme in the process of digestion
4. Define minerals and vitamins and discuss the importance of vitamins to the body
5. List the components of blood and describe their functions and blood clotting process
6. Examine blood under the microscope to observe the white and red blood cell
7. State the functions of the heart
8. Explain the functions of arteries, veins and capillaries
9. Identify and explain the types of circulation
10. Discuss the lymphatic system, and the functions and composition of lymph
11. Describe the structure and functions of lymph nodes
12. Name and give the function of other lymphoid organs (tonsils, spleen, thymus)

OUTCOMES	CONTENTS	ACTIVITIES	MATERIALS RESOURCES	EVALUATION
Outline the nutritional benefits of eating a balanced diet of locally available food. Appreciate the role of the lymphatic system in the defense mechanism of the body. Accept that both the lymphatic and circulatory systems are transport systems.	**1. Digestive system:** a) nutrition – classes of food and their specific uses **2. Alimentary canal:** a) mouth (teeth & tongue b) esophagus c) stomach d) intestines, exocrine glands (salivary and pancreatic glands) e) liver & functions **3. Circulatory system** a) heart	1. Drawing and labeling the alimentary canal 2. Stating the functions of digestive enzymes 3. Describing absorption through the villi and hepatic portal veins 4. Listing and describing classes of	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008). • Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson,	• Paper and pencil tests to get students to: - Describe the organs of the digestion system - Explain nutrition, and classes of food and their specific uses - State the functions of enzyme in the process of digestion - Define minerals and vitamins and discuss the importance of

	b) blood vessels c) blood cells and plasma b) types of circulations systematic and pulmonary **4. Blood types and Rh Factor** **5. Effects of substance abuse on the circulatory system** **6. Lymphatic system:** a) lymph b) lymphatic vessels c) lymph node d) lymphocytes (T-cells and B-cells)	food and their importance 5. Discussing the effects of malnutrition on growth and development, and on the immune system 6. Describing the steps or processes of nutrition: digestion -absorption -assimilation 7. Testing for carbohydrates, proteins and oils 8. Stating the functions of the liver in digestion 9. Discussing the effects of alcohol & drugs on the organs of these systems 10. Describing the composition of the blood and its functions 11. Explaining the process of blood clothing	2000) Senior Secondary Guide **C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High Integrated Science* (Pearson, 2009) • Integrated Science for SHS – (Pearson) • Charts of: a) Circulatory system; d) Heart e) Blood vessels f) Digestive system g) Mouth, teeth, tongue h) Esophagus i) Stomach j) Intestine • Microscope • Slides • Prepared slides • Peeling needle • Model and charts of the lymphatic system	vitamins to the body - List the components of blood and describe their functions and blood clotting process - State the functions of the heart - Explain the functions of arteries, veins and capillaries - Identify and explain the types of circulation - Discuss the lymphatic system, and the functions and composition of lymph - Describe the structure and functions of lymph nodes - Name and give the function of other lymphoid organs (tonsils, spleen, thymus) • Students should examine blood under the microscope to observe the white and red blood cell, and record their observation • Case studies • Written quizzes, tests and exams • Oral questions and

		12. Listing the various blood groups and the Rh factor 13. Drawing and labeling the heart and liver 14. Studying charts of the lymphatic system 15. Drawing and labeling the lymphatic system		answers • Class discussion

SEMESTER: <u>TWO</u>

PERIOD: IV

GRADE: 12

TOPIC : EXCRETORY, RESPIRATORY SYSTEMS AND GASEOUS EXCHANGE: THE PROCESS OF CELLULAR RESPIRATION (GLYCOLYSIS, PYRUVATE AND KREB CYCLE)

SPECIFIC OBJECTIVES

Upon completion of this topic, students will be able to:

1. Explain the process of excretion
2. List and describe the functions of the kidney, ureter and urinary bladder
3. Describe the excretory function of other organs such as skin, liver, lungs, and large intestine
4. Explain the homeostatic role of the excretory system
5. State the characteristics of the two types of respiration
6. List the tissues and organs in the mechanic of breathing.
7. Explain the effects of substance abuse and STIs on the two systems (excretory and respiratory)
8. Discuss cellular respiration citing the major sequential stages making a metabolic pathway of numerous reactions (Glycolysis, link reaction, Krebs cycle and electron transport chain)
9. Distinguish between aerobic and anaerobic respiration
10. Discuss anaerobic respiration in the muscle and yeast/fruits (alcoholic respiration)
11. Discuss the significance of phosphorylation in glycolysis
12. Identify the final products of glycolysis
13. Discuss the fate of pyruvate
14. Discuss oxidation and reduction with regards to oxygen, hydrogen and electrons
15. Distinguish between decarboxylation reactions and dehydrogenation reactions
16. Identify the four main events during glycolysis
17. Explain the summary equation for respiration ($C_6H_{12}O_6 + 6O_2$ ---→ $6OCO_2 + 6H_2O$)
18. Identify the three types of electron carriers located in the inner membrane of the mitochondria (flavoproteins, quinones and cytochromes)
19. Summarize the events in the Krebs cycle

OUTCOMES	CONTENT	ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Take appropriate steps to prevent damage to the excretory and respiratory organs. Realize that the energy released in gaseous	**1. Excretory system:** organs a) kidneys b) urinary bladder c)Urethra d)Skin, Liver, Lungs **2. Respiratory system:**	1. Explaining the process of excretion 2. Describing the functions of tissues and organs in both external & internal	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts**	• Written quizzes, tests and exams for students to: - Explain the process of excretion - List and describe the functions of the

exchange (respiration) is key to the survival of all living organisms. Realize that there are two principal types of respiration.	organs **3. Kinds of respiration** a) internal & external b) phases (inspiration and expiration) **4.Artificial resuscitation** **5. Effects of substance abuse and STIs on the organs of the two systems** **6. Definition of cellular respiration** (aerobic and anaerobic) **7. The formation of ATP**, a phosphorylated nucleotide **8. An overview of respiration:** a) glycolysis b) link reaction c) Krebs cycle d) electron transport chain **9. Coenzymes and respiration** **10. Nicotinamide adnine dinucleotide (NAD) and dehydrogenase enzymes** **11. Events of glycolysis** **12. Pyruvate and its fate** **13. Alcoholic fermentation** (anaerobic and aerobic respiration in yeast and fruits) **14. Anaerobic respiration** in muscles and Oxygent debt **15. Recations of the Krebs cycle** (tricarboxylic acid – TCA cycle/cirtic acid cycle): a) decarboxylation	respiration 3. Describing the lungs and the air passage ways 4. Drawing and labeling the longitudinal section of the kidney 5. Discussing the role of the diaphragm, intercostal muscles and ribs in respiration 6. Stating the effects and naming of organs affected by substance abuse and STIs 7. Vigorous exercise 8. Obtaining palm wine and placing it in a plastic gallon to observe alcoholic fermentation	• Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008). • Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000) Senior Secondary Guide **C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High Integrated Science* (Pearson, 2009) • Charts of kidneys, ungs and kin • Palm wine • Grape fruits • Plastic gallons • Knife • Strainer • Large container (pan)	kidney, ureter and urinary bladder - Describe the excretory function of other organs such as skin, liver, lungs, and large intestine - Explain the homeostatic role of the excretory system - State the characteristics of the two types of respiration - List the tissues and organs in the mechanic of breathing. - Explain the effects of substance abuse and STIs on the two systems (excretory and respiratory) - Discuss cellular respiration citing the major sequential stages making a metabolic pathway of numerous reactions (Glycolysis, link reaction, Krebs cycle and electron transport chain) - Distinguish between aerobic and anaerobic respiration - Discuss anaerobic respiration in the

	b) dehydrogenation c) oxidative phosphorylation **16. Electron transport chain** (Etc) and ATP synthesis: a) flavoproteins b) quinones c) cytochromes			muscle and yeast/fruits (alcoholic respiration) - Discuss the significance of phosphorylation in glycolysis - Identify the final products of glycolysis - Discuss the fate of pyruvate - Discuss oxidation and reduction with regards to oxygen, hydrogen and electrons - Distinguish between decarboxylation reactions and dehydrogenation reactions - Identify the four main events during glycolysis - Explain the summary equation for respiration ($C_6H_{12}O_6 + 6O_2$ --- → $6OCO_2 + 6H_2O$) - Identify the three types of electron carriers located in the inner membrane of the mitochondria (flavoproteins, quinones and cytochromes)

				- Summarize the events in the Krebs cycle • Oral questions and answers • Class discussion • Drama or role play • Quizzes • Practical and written assignments • Short answer tests

SEMESTER: TWO

PERIOD: V

GRADE: 12

TOPIC : NERVOUS AND ENDOCRINE SYSTEMS (CONTROL AND CO-ORDINATION OF BODY ACTIVITIES)

SPECIFIC OBJECTIVES

Upon the completion of this topic, students will be able to:

1. Compare and contrast the operations of the nervous and endocrine systems
2. Describe the structure and functions of the brain and a neuron
3. Give the classification of neurons
4. Draw the nervous system and list the major parts
5. Describe the structure and functions of the spinal cord
6. Name the various regions of the spinal cord
7. Name and give the functions of the central and peripheral nervous systems
8. Differentiate between voluntary and involuntary actions
9. Discuss the causes and effects of substance abuse on the nervous system
10. Describe the structures and functions of the eye and ear
11. Explain the effects of some STIs on the nervous system
12. State the functions of exocrine glands, endocrine gland and hormones
13. Explain the regulation of hormone secretion through negative feedback
14. Describe the two basic mechanisms of hormones action

OUTCOMES	CONTENTS	ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Outline the perfect coordination features in the control of body activities by both nervous and chemical control in the body. .	**1. The nervous system** a) Composition: - central nervous system -Peripheral nervous system **2. reflex action** **3. The nervous system** Spinal cord: (a) structure and function	1. Listing and describing parts of the nervous system 2. Examining and explaining models of the brain and spinal cord 3. Identifying various parts of the brain and spinal cord	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008).	Written quizzes, tests and exams for students to: - Compare and contrast the operations of the nervous and endocrine systems - Describe the structure and functions of the brain and a neuron

	(b) sensory and motor Neurons (c) structure and types Of neurons (d) structure of the brain **4. Generation and transmission of nerve impulses:** (a) resting potential (b) action potential (c) refractory period (d) conduction of nerve impulses (e) role of the myelin Sheath (f) synapses and synaptic transmission (g) structure and function of synapse **5. Voluntary and involuntary actions** **6. Reflexes and reflex arc** **7. Autonomic nervous system: functions and importance** **8. Structure & function of eye and ear** **9. Effects of STIs in the organs of the nervous system** **10. Substance abuse: causes effects and prevention**	4. Drawing and labeling the parts of the brain and spinal cord 5. Describing the peripheral nervous system 6. Describing the structures and functions of the eye and ear 7. Explaining reflex reaction 8. Listing organs of the nervous system that STIs and substance abuse affect 9. Explaining the causes and corrections of vision defects 10. Drawing, labeling and discussing, the skin as a sense organ 11. Drawing and labeling a typical motor neuron 12. Examining the model and chart of mammalian eye 13. Drawing and labeling the whole eyeball to show its external and internal structures	• Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000) Senior Secondary Guide **C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High Integrated Science* (Pearson, 2009) • Charts of nervous system, endocrine system, eye & ear • Dissecting set • Dissecting tray • Microscope • Prepared slides • Model of brain, spinal cord, eye and ear	- Give the classification of neurons - Draw the nervous system and list the major parts - Describe the structure and functions of the spinal cord - Name the various regions of the spinal cord - Name and give the functions of the central and peripheral nervous systems - Differentiate between voluntary and involuntary actions - Discuss the causes and effects of substance abuse on the nervous system - Describe the structures and functions of the eye and ear - Explain the effects of some STIs on the nervous system - State the functions of exocrine glands, endocrine gland and hormones - Explain the regulation of

	11. Endocrine system a) glands b) The role of the testes and ovaries as endocrine glands b) Hormone deficiency diseases	14. Examining model and charts of the mammalian ear and identifying the parts 15. Drawing and labeling the ear to show its external and internal parts		hormone secretion through negative feedback - Describe the two basic mechanisms of hormones action • Oral questions and answers • Class discussion and home assignment

SEMESTER: <u>TWO</u>

PERIOD VI

GRADE: <u>12</u>

TOPIC : HUMAN ECOLOGY, HEALTH, NATURAL RESOURCES AND POLLUTION

<u>SPECIFIC OBJECTIVES</u>

Upon the completion of this topic, students will be able to:

1. Explain the concept of natural resources
2. Distinguish between renewable and non-renewable natural resources
3. Discuss the importance of natural resources
4. Explain methods of conserving natural resources
5. Explain ecosystem approach to natural resource management
6. Define and explain the term *pollution*
7. State the causes and effects of pollution
8. Discuss ways and means of controlling pollution
9. Explain the importance of vaccination and inoculation as a means of preventing human diseases
10. Explain the importance of personal as well as community health
11. State the dangers posed by drugs, alcoholic drinks and smoking
12. Define and explain the term *sewage disposal*
13. Discuss different methods of sewage disposal
14. Identify economic uses of sewage

15. Discuss sources of water, modes of contamination and methods of purification
16. Discuss methods of refuse collection and disposal
17. State the importance of first aid and be able to treat a numbers of conditions

OUTCOMES	CONTENTS	ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Appreciate the importance of conservation of natural resources. Accept the concept that natural resources contribute towards the wealth of a nation Accept the concept that pollution is harmful to human, plant and animal lives. Realize that renewable natural resources need to be regenerated and must be stained/used wisely. Realize the non-renewable natural resources need to be used wisely Realize that the usefulness of flow renewable resources. Realize that water is an indispensable value to man's survival and therefore should be conserved.	**1 .Definition of natural resources** **2. Renewable and non-renewable natural resources** **3. Definition and examples of flow renewable resources** **4.Conservation of natural resources** **5. Definition of pollution** **6. Causes of pollution:** a) air pollution b) fresh water c) soil d) sea e) thermal f) noise **7. Control of pollution** **8. vaccination and immunization** **9. Personal hygiene** **10. Drug abuse**	1. Group discussion on the importance of conservation or natural resources 2. Making field trips and viewing sites of natural resources such as rain forests, gold mines, diamond mines, rivers, lakes, ocean/beach, coal mine, iron ore, rubber factory, petroleum refinery, etc. 3. Taking field trips to observe: a) solar radiation, b) tides c) Winds, etc. 4. Field trips to water purification plant 5. Field trips to sewage treatment plant 6. Discussing different methods of sewage disposal	**A. Primary Text** Baffour Asante-Owusu, et al. *Senior High Biology* (Longman, 2009) **B. Secondary Texts** • Sue Hocking, et al. *OCR Biology* (OCR/Heinemann, 2008). • Doris Koto, et al., *Senior Secondary Guide – Biology* (Pearson, 2000) Senior Secondary Guide **C. Other Resources/Supplementary Readings** • Bob McDuell, *Senior High Integrated Science* (Pearson, 2009) • Charts of various kinds of natural resources • Samples of natural resources • Beaker • Contaminated water • Microscope • Slides • Cover slips	• written quizzes, tests, assignments and exams to get students to: - Explain the concept of natural resources - Distinguish between renewable and non-renewable natural resources - Discuss the importance of natural resources - Explain methods of conserving natural resources - Explain ecosystem approach to natural resource management - Define and explain the term *pollution* - State the causes and effects of pollution - Discuss ways and means of controlling pollution - Explain the importance of vaccination and inoculation as a means of preventing human diseases - Explain the

Realize that immunization prevents people against diseases. Accept the concept that drug abuse is harmful to the well-being of people.	**11. Community hygiene** **12. Sewage disposal:** a) definitions of sewage and sewage disposal k) methods of sewage disposal l) economic uses of sewage **13. Water:** a) Sources b) mode of contamination/pollution c) methods of purification **14. Refuse collection and disposal**	7. Discussing uses of sewage 8. Purifying water by boiling, chlorination and sand filtration (pumping water through sand filter to remove particles greater then 0.002mmdiameter). 9. Testing water for contaminants 10. Filtering contaminated water using clean cloth 11. Practicing first aid exercises on partners 12. Observing nitrogen-fixing bacteria under microscope 13. Estimating the alcohol content of various drinks	• Roots of legume plants • Filter paper • Pipette • Methylene blue • Thermometer • Flask • Stopper • Alcohol • Gauze mat • Tripod • Buncen burner • Gas light • Clean cloth • Funnel • Porcelain filter • Soil • Rocks • Coal and coal pot • Petroleum product (kerosene, fuel oil) • Sand • Wood • Chlorine • Charts on water purification system • Charts on sewage disposal • Fertilizers	importance of personal as well as community health - State the dangers posed by drugs, alcoholic drinks and smoking - Define and explain the term *sewage disposal* - Discuss different methods of sewage disposal - Identify economic uses of sewage - Discuss sources of water, modes of contamination and methods of purification - Discuss methods of refuse collection and disposal - State the importance of first aid and be able to treat a numbers of conditions • oral questions and answers • brainstorming and class discussion

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