

MINISTRY OF EDUCATION



Republic of Ghana

TEACHING SYLLABUS FOR BIOLOGY (SENIOR HIGH SCHOOL)

Enquiries and comments on this syllabus should be addressed to:

The Director
Curriculum Research and Development Division (CRDD)
P. O. Box 2739
Accra, Ghana.

Tel: 021-683668
021-683651

September, 2010

TEACHING SYLLABUS FOR ELECTIVE BIOLOGY

RATIONALE FOR TEACHING ELECTIVE BIOLOGY

The survival of humans and the development of nations would ever depend more and more on science and technology. Biology however is a branch of natural science which is devoted to the study of life and the activities of all living things from bacteria to high plants and animals. The survival of humans nevertheless depends greatly on the knowledge and understanding of the structure and functions of organisms and how they interact with one another and the environment. This invariably leads to the necessity of conservation of living things and other natural resources.

The need to teach Biology ultimately must be to explain the living world in terms of scientific principles although appreciating that, organisms behave in ways which often seem beyond the capabilities of their component parts. It is also to guide and inculcate in the learner skills in observing and measuring, formulating hypothesis, predicating and designing, investigating, recording data and interpreting results, drawing conclusions and **communicating** them.

The knowledge, skills and attitudes acquired through the study of Biology is to provide the learner with the necessary basic tools for employment in laboratory, industry, agriculture, horticulture, forestry, health care, work with animals, marine and fresh water biology, information science, administration, finance, management and teaching.

It further equips the learner for further studies and research in pure and applied science and technology that are vital areas for the advancement of society.

Teaching elective biology in totality guides the learner and makes him/her capable of critical thinking, making meaningful decisions and solving problems.

GENERAL AIMS

This syllabus is designed to help students to:

1. appreciate the diversity of living things.
2. understand the structure and functions of living things.
3. develop scientific approach to solving personal and societal (environmental, economic and health) problems.
4. develop practical skills required to work with scientific equipment, biological materials and living things.
5. collect, analyse and interpret biological data; and also present data graphically.
6. be aware of the existence of interrelationships between biology and other scientific disciplines.
7. sustain their interest in studying biology
8. appreciate and understand the interrelationships between organisms and themselves and with the environment.

9. recognize the value of biology to society and use it responsibly.
10. develop a sense of curiosity, creativity and critical mind.
11. provide a foundation for those who will develop a career in biological sciences.

SCOPE OF CONTENT

The content of the syllabus has been designed in such a way as to provide students with basic knowledge in biology for them to understand themselves and other organisms, which enable them make very informed choices as they interact with nature. The scope of the content of this syllabus also enables the learner pursue specialized careers relating to biology and fully prepares the students who wish to continue the study of biology at the tertiary level. The course covers the following:

- * Introduction to Biology
- * Cells

- * Life Processes

- * Diversity

- * Interactions in Nature

- * Humans and their Environment

- * Genetics and Evolution

- * Biotechnology

PRE-REQUISITE SKILLS AND ALLIED SUBJECTS

A good knowledge of Science and Mathematics at the Junior High School, plus good reading and communication skills are necessary for effective study of biology at the Senior High School. Students offering biology are advised to take elective mathematics in addition to chemistry and physics/ICT/geography

ORGANIZATION OF THE SYLLABUS

The syllabus has been structured to cover three years (Year 2 to Year 4) of senior high school education. Each year's work consists of a number of sections with each section comprising of a number of units. The structure is presented as follows:

YEAR ONE	YEAR TWO	YEAR THREE
<p>SECTION 1: INTRODUCING BIOLOGY (Pg1-4)</p> <p>Unit 1: Biology as a Science of life</p> <p>Unit 2: How Biologists Work</p> <p>Unit 3: Importance of Biology</p> <p>Unit 4: Body Symmetry and Orientation</p> <p>Unit 5: The microscope</p> <p>Unit 6: Biological Drawings</p>	<p>SECTION 1: DIVERSITY OF LIVING THINGS (Pg17-20)</p> <p>Unit 1: The five Kingdoms and the hierarchy of classification.</p> <p>Unit 2: Phyla of Kingdom Protocista and Kingdom Fungi</p> <p>Unit 3: Divisions and classes of Kingdom Plantae</p> <p>Unit 4: Phyla, classes and orders of the Kingdom Animalia</p> <p>Unit 5: Characteristics of some of the orders of Class Insecta.</p> <p>Unit 6: Identifying Organisms using Biological keys.</p> <p>Unit 7: Scientific Inquiry Skills</p>	<p>SECTION 1: PLANT STRUCTURE AND PHYSIOLOGY (Pg50-64)</p> <p>Unit 1: Morphology of Monocotyledonous and Dicotyledonous plants</p> <p>Unit 2: Internal structure of roots, stems and leaves</p> <p>Unit 3: Growth and Development of plants</p> <p>Unit 4: Photosynthesis and Mineral Nutrition</p> <p>Unit 5: Gaseous exchange</p> <p>Unit 6: Transport</p> <p>Unit 7: Excretion</p> <p>Unit 8: Reproduction</p> <p>Unit 9: Scientific inquiry skills</p>
<p>SECTION 2: CELL BIOLOGY (Pg 5-7)</p> <p>Unit 1: The Cell as a Unit of life</p> <p>Unit 2: Types/Classes of Cells</p> <p>Unit 3: Specialized Eukaryotic Cells</p> <p>Unit 4: Relationship of cell to tissue, organ and organ system</p> <p>Unit 5: Movement of substances into and out of cells.</p> <p>Unit 6: Scientific Inquiry Skills</p>	<p>SECTION 2: INTERACTIONS IN NATURE (Pg 21-26)</p> <p>Unit 1. Basic concepts in ecology</p> <p>Unit 2: Study of Specific Habitats: Aquatic and Terrestrial</p> <p>Unit 3: Biological Associations</p> <p>Unit 4: Population Dynamics</p> <p>Unit 5: Biological Pest Control</p> <p>Unit 6: Ecological Succession</p> <p>Unit 7: Soil</p> <p>Unit 8: Scientific Inquiry Skills</p>	<p>SECTION 2: CELL BIOLOGY, GENETICS & EVOLUTION (pg 65-70)</p> <p>Unit 1: Nucleic acids</p> <p>Unit 2: DNA Structure and replication and RNA transcription</p> <p>Unit 3: Protein Synthesis</p> <p>Unit 4: Cell cycle</p> <p>Unit 5: Heredity</p> <p>Unit 6: Variation</p> <p>Unit 7: Evolution</p> <p>Unit 8: Scientific Inquiry Skills</p>

<p>SECTION 3: LIFE PROCESSES IN LIVING THINGS (Pg 8 – 16) Unit 1: <i>Amoeba, Paramecium, Euglena</i> Unit 2: <i>Spirogyra, Rhizopus</i> Unit 3: Mosses and Ferns Unit 4: Cockroach and Butterfly UNIT5; Weevils or Cotton Stainers UNIT 6: Termites or Honey Bees Unit 7: <i>Tilapia</i> Unit 8: Toad or Frog Unit 9: Lizard (<i>Agama</i>) Unit 10: Domestic fowl. Unit 11: Scientific Inquiry Skill</p>	<p>SECTION 3: HUMANS AND THEIR ENVIRONMENT (Pg 27 – 32) Unit 1: Natural Resources Unit 2: Consequences of Human interference in Nature Unit 3: Humans and harmful microbes Unit 4: Health and Hygiene Unit 5: Scientific Inquiry Skills</p>	<p>SECTION 3: BIOLOGY & INDUSTRY (Pg 71 – 75) Unit 1: Biology and Water Industry Unit 2: Biology and Fishing Industry. Unit 3: Biology and Food Industry Unit 4: Biology and Agriculture Unit 5: Biotechnology Unit 6: Biological Fuel generation</p>
	<p>SECTION 4: MAMMALIAN ANATOMY AND PHYSIOLOGY (Pg 33– 49) Unit 1: Dissection of a small mammal(neck, chest and abdominal regions) Unit 2: Nutrition Unit 3: Transport Unit 4: Respiration Unit 5: Excretion Unit 6 Movement Unit 7 Reproduction Unit 8 Control and Co-ordination Unit 9: Scientific Inquiry Skills</p>	

TIME ALLOCATION

A total of six periods a week, each period consisting of forty minutes, is allocated to the teaching of biology. It is recommended that the teaching periods be divided as follows:

Theory	-	3 periods per week (two 40-minutes periods)
Practical	-	3 periods per week (three continuous periods of 40 minutes each)

SUGGESTIONS FOR TEACHING THE SYLLABUS

The teaching of biology should be student-centred and activity oriented. The teacher acts as a facilitator. For effective teaching and learning in this course, it is recommended that the school should establish a small botanical garden, animals in a cage, fishpond and insects in a cage. Plan must be made for visiting well-established experimental and commercial farms, agricultural research institutes and other institutions. Visits must also be planned to scientific and manufacturing organisations, forest and game reserves, man-made lakes, the seashore, hospitals, where students will observe scientific work and the application of science in manufacturing, different types of habitats and interactions in nature. Video clips could also be shown where these are available.

The provision of well equipped laboratories will enhance teaching and learning biology. It is also suggested that well trained laboratory technicians be made available to play complementary role to the teacher.

The syllabus is presented in a teaching sequence. However, the teacher may change the teaching order in a particular year provided the linkage between the sections and the respective units is maintained and the syllabus for the year completed by the end of each year. It is important that classroom teaching be supplemented with field trips wherever appropriate.

Even though biological drawings, interpretation of biological data, writing of scientific reports are done as integral part of teaching of the biology syllabus, it is given as a unit on its own in the syllabus to emphasise its important and also make students appreciate it better.

Besides the above advice, the teacher's attention is drawn to some new concepts that have been introduced in the new set of syllabuses to help improve instructional delivery and learning. Please, read this section very carefully and relate the information to your repertoire of teaching methods and skills.

General Objectives

General objectives have been listed at the beginning of each section. The general objectives specify the skills and behaviours students should acquire by the end instruction in the units of a section. Read the general objectives very carefully before you start teaching the section. After teaching all the units in the section, go back and read the general objectives again to be sure that you have covered the objectives adequately in the course of your teaching.

Sections and Units

The syllabus has been planned on the basis of sections and units. Each year's work is divided into sections. A section consists of a fairly homogeneous body of knowledge within the subject. Within each section are units. A unit consist of a more related and homogenous body of knowledge and skills.

The syllabus is structured in five columns: Units, Specific Objectives, Content, Teaching and Learning Activities and Evaluation. A description of the contents of each column is as follows:

Column 1 – Units: The units in Column 1 are divisions of the major topics of the section. You are expected to follow the unit topics according to the linear order in which they have been presented. However, if you find at some point that teaching and learning in your class will be more effective if you branched to another unit before coming back to the unit in the sequence, you are encouraged to do so.

Column 2: Specific Objective: Column 2 shows the Specific Objectives of each unit. The specific objectives begin with numbers such as 1.3.5 or 2.2.1. These numbers are referred to as “Syllabus Reference Numbers”. The first digit in the syllabus reference number refers to the section; the second digit refers to the unit, while the third refers to the rank order of the specific objective. For instance, 1.3.5 means section 1, Unit 3 (of section 1) and Specific Objective 5 in other words, 1.3.5 refers to Specific Objective 5 of Unit 3 of Section 1. Similarly, the syllabus reference number 2.2.1 simply means Specific Objective number 1 of Unit 2 of section 2. Using syllabus reference numbers provides an easy way of communication among teachers and other educators. It further provides an easy way for selecting objectives for test construction. Let’s say for instance, that Unit 2 of Section 2 has five Specific Objectives: 2.2.1 – 2.2.5. A teacher may want to base his/her test items/questions on objectives 2.2.3 and 2.2.4 and not use the other three objectives. In this way, a teacher would sample the objectives within units and within sections to be able to develop a test that accurately reflects the importance of the various skills taught in class.

You will notice that the specific objectives have been stated in terms of the student, i.e. what the student will be able to do after instruction and learning in the unit. Each specific objective hence starts with the following, “The student will be able to”. This in effect, means that you have to address the learning problems of each individual student. It means individualising your instruction as much as possible such that the majority of students will be able to master the objectives of each unit of the syllabus.

PROFILE DIMENSIONS

A central aspect of this syllabus is the concept of profile dimensions that should be the basis for the instruction and assessment. Learning may be divided into a number of classes. A student may acquire some knowledge through learning. The student may also learn to apply the knowledge acquired in some new context. For instance, “dirty water contains particles and disease causing organisms” is a knowledge fact the student learn in class.

To help the student to understand that fact, the student should be required to filter dirty water and examine water through the microscope, if there is a microscope available. If not, the student should be required to filter the dirty water and examine the sediments left on the cotton wool in the filtering bed. Since there could still be dangerous organisms and chemicals in the filtered water, the student should then be taught the process of boiling and distilling dirty water. By filtering, boiling and distilling dirty water, the student acquires scientific process skills. At another period, the teacher may give the student a type of dirty water, and ask the student to indicate which of the three treatment methods i.e. filtering, boiling and distilling, should be used for its treatment. This particular requirement is asking the student to apply” the knowledge gained in the treatment of dirty water to a particular type of water. You will see from various steps that the student has gone through acquisition of basic knowledge, and acquired “process skills and has been given the experience of applying his/her knowledge to a particular problem situation.

The four learning behaviours, “knowledge”, understanding”, “application” and “process “are referred to as dimensions of knowledge. Knowledge is a dimension; application of knowledge is also a dimension. More than one dimension forms a profile of dimensions. A specific objective may be stated with an action verb as follows: The student will be able to describe ... etc. Being able to describe something after the instruction has been completed means that the student has acquired “knowledge”. Being able to explain, summarise, give examples, etc. means that the student has understood the lesson taught.

Similarly being able to develop, plan, construct, etc. means that the student has learnt to create, innovate or synthesize knowledge. You will note that each of the specific objectives in this syllabus contains an action verb that describes the behaviour the student will be able to demonstrate after the instruction. “Knowledge application”, etc. are dimensions that should be the prime focus of teaching and learning in schools. Instruction in most cases has tended to stress knowledge acquisition to the detriment of other higher-level behaviours such as application, analysis, etc. The focus of the new form of teaching and learning as indicated in this syllabus and in all others, is to move teaching and learning from the didactic acquisition of “knowledge and rote memorisation to a new position where students will be able to apply their knowledge, develop analytical thinking skills, develop plans, generate new and creative ideas and solutions and use their knowledge in a variety of ways to solve problems. Each action verb indicates the underlying profile dimension of each particular specific objective. Read each objective carefully to know the profile dimension toward which you have to teach.

Column 3 – Content: The “content” in the third column of the syllabus presents a selected body of core ideas that you will need in teaching a particular specific objective. In some cases, the content presented is quite exhaustive. In some other cases, you could add some more information to the content presented.

Column 4 – Teaching and Learning Activities (T/L): T/L activities that will ensure maximum pupil participation in the lesson are presented in Column 4. Try to avoid rote learning and drill-oriented methods and rather emphasise participatory teaching and learning in your lessons. As much as possible, try to emphasise the cognitive, affective and psychomotor domains of knowledge in your instructional system wherever appropriate. You are encouraged to re-order the suggested teaching and learning activities and also add to them where necessary in order to achieve optimum student learning. As implied already, the major purpose of teaching and learning is to make students able to apply their knowledge in dealing with issues both in and out of school. A suggestion that will help your students acquire the habit of analytical thinking and the general capacity for problem solving is to begin each lesson with a practical problem. Select a practical problem for each lesson. The selection must be made such that students can use knowledge gained in the previous lesson and other types of information not specifically taught in class. At the beginning of a lesson, state the problem, or write the problem on the board. Let students analyse the problem, suggest solutions, etc., criticise solutions offered, justify solutions and evaluate the worth of possible solutions. The learning of any skill considered important must start early.

Column 5 – Evaluation: Suggestions and exercises for evaluating the lessons of each of the unit are indicated in column 5. Evaluation exercises can be in the form of oral questions, quizzes, class assignments, essays, project work, etc. Try to ask questions and set tasks and assignments etc; that will challenge students to apply their knowledge to issues and problems as we have already mentioned above, and not exhaustive. You are encouraged to develop other creative evaluation tasks to ensure that students have mastered the instruction and behaviours implied in the specific objectives of each unit.

Lastly it is important to bear in mind that the syllabus cannot be taken as a substitute for lesson plans. It is necessary that you develop a scheme of work and lesson plans for teaching the units of this syllabus.

DEFINITIONS OF PROFILE DIMENSION

As already stated, profile dimension describes the underlying behaviour for teaching, learning and assessment. In biology, the three profile dimensions that have been specified for teaching, learning and testing are:

Knowledge and Comprehension	30%
Application of Knowledge	40%
Practical and Experimental Skills	30%

Each of the dimensions has been given a percentage weight that should reflect in teaching learning and testing. The weights indicated on the right of the dimensions, show the relative emphasis that the teacher should give in the teaching, learning and testing processes. The focus of this syllabus is to get students not only to acquire knowledge but also to be able to understand what they have learnt and apply them practically. Combining the three dimensions in your teaching will ensure that Biology is taught not only at the factual knowledge level but that students will also acquire the ability to apply scientific knowledge to issues and problems, and will also acquire the capacity for practical and experimental skills that are needed for scientific problem solving.

Knowledge and Understanding (RU)

Knowledge The ability to:
Remember, recognize, retrieve, locate, find, do bullet pointing, highlight, bookmark, network socially, bookmark socially, search, google, favourite, recall, identify, define, describe, list, name, match, state principles, facts and concepts. Knowledge is simply the ability to remember or recall material already learned and constitutes the lowest level of learning.

Understanding The ability to:

Interpret, explain, infer, compare, explain, exemplify, do advanced searches, categorize, comment, twitter, tag, annotate, subscribe, summarize, translate, rewrite, paraphrase, give examples, generalize, estimate or predict consequences based upon a trend.

Understanding is generally the ability to grasp the meaning of some material that may be verbal, pictorial, or symbolic and is also referred to as “Comprehension”.

Application of Knowledge (AK)

The ability to use knowledge or apply knowledge, as implied in this syllabus, has a number of learning/behaviour levels. These levels include application, analysis, innovation or creativity, and evaluation. These may be considered and taught separately, paying attention to reflect each of them equally in your teaching. The dimension “Applying Knowledge” is a summary dimension for all four learning levels. Details of each of the four sub levels are as follows:

Application

The ability to:

Apply rules, methods, principles, theories, etc. to concrete situations that are new and unfamiliar. It also involves the ability to produce, solve, operate, demonstrate, discover, implement, carry out, use, execute, run, load, play, hack, upload, share, edit etc.

Analysis

The ability to:

Break down a piece of material into its component parts, to differentiate, compare, deconstruct, attribute, outline, find, structure, integrate, mash, link, validate, crack, distinguish, separate, identify significant points etc., recognize unstated assumptions and logical fallacies, recognize inferences from facts etc. Analytical ability underlies discriminate thinking.

Innovation/Creativity

The ability to:

Put parts together to form a new whole, a novel, coherent whole or make an original product. It involves the ability to synthesize, combine, compile, compose, devise, construct, plan, produce, invent, devise, make, program, film, animate, mix, re-mix, publish, video cast, podcast, direct, broadcast, suggest (an idea, possible ways), revise, design, organize, create, and generate new ideas and solutions. The ability to create or innovate is the highest form of learning. The world becomes more comfortable because some people, based on their learning, generate new ideas, design and create new things.

Evaluation

The ability to:

Appraise, compare features of different things and make comments or judgement, contrast, critique, justify, hypothesize, experiment, test, detect, monitor, review, post, moderate, collaborate, network, refractor, support, discuss, conclude, make recommendations etc. Evaluation refers to the ability to judge the worth or value of some material based on some criteria and standards. We generally compare, appraise and select throughout the day. Every decision we make involves evaluation. Evaluation is a high level ability just as application, analysis and innovation or creativity since it goes beyond simple knowledge acquisition and understanding.

A number of examination questions at the Secondary School level begin with the word “Discuss”. Discuss belongs to the evaluation thinking skill and implies the ability to analyse, compare, contrast, make a judgement, etc. The word “discuss” asks for a variety of thinking skills and is obviously a higher order thinking behaviour. Students consequently do poorly on examination questions that start with “Discuss”. For this reason, and also for the reasons that discussion of issues, discussion of reports, etc. are some of the major intellectual activities students will be engaged in, in work situations and at higher levels of learning after they have left Secondary School, it will be very helpful if you would emphasize discussion questions etc. both in class and in the test you set.

Scientific Inquiry Skills (SIS)

These are a combination of practical and experimental skills that one needs to develop to become a good biologist. In view of the importance of the skills to the biologist, this syllabus has a unit in almost each section dubbed **scientific enquiry** skills to help the teacher consciously teach and facilitate certain activities to help the student develop these skills.

Practical Skills involve the demonstration of manipulative skills using tools, machines and equipment for practical problem solving. The teaching of practical skills should involve projects, case studies and field studies where students will be intensively involved in practical work and in search for practical solutions to problems and task.

Experimental Skills involve the demonstration of the inquiry processes in science and refer to skills in planning and designing of experiments, observation, manipulation, classification, drawing, measurement, interpretation, recording, reporting and conduct in the laboratory/field. Practical and Experimentation Skills refer to the psychomotor domain.

A summary of skills that are required for effective practical and experimental work is as follows:

1. Equipment Handling
2. Planning and designing of experiments
3. Observation
4. Manipulation
5. Classification
6. Drawing
7. Measuring
8. Interpretation
9. Recording
10. Reporting
11. Conduct in Laboratory/Field

Equipment Handling: Proper equipment handling and use of tools and equipment for practical and experimental work. The teacher should ensure that students acquire a high level of proficiency in the use of tools and equipment for scientific work.

Planning and designing of Experiments: Development of hypotheses, planning and designing of experiments, persistence in the execution of experimental activities, modification of experimental activities where necessary, in order to reach conclusion.

Research evidence show that when confronted with a problem, scientists who excel in their respective fields of work develop a number of hypotheses within a short time, and design experiments to test how far each hypothesis is true. Weaker scientists on the other hand, tend to focus on only one or two hypotheses. The implication of this for the teacher of Biology is to lead students to learn to generate a number of hypotheses for every problem tackled in class; critique each hypothesis generated before selecting the best one. Some of the critical characteristics to encourage in students are:

- observation
- identification of the problem
- hypothesis generation
- testing hypothesis through experiment
- analysis of experimental results
- drawing conclusion
- review hypothesis

Observation: Use of the senses to make accurate observations. The student for instance, should be able to tell the colour, form, texture and structure of specimens provided and be able to classify them.

Manipulation: Manipulation involves the skills of handling scientific objects and tools for accomplishing specific tasks. It involves setting up laboratory apparatus, prepared specimens and other material for observation.

Classification: Group specimens and objects according to their common properties or characteristics.

Drawing: Draw clearly and label specimens, objects, etc.

Measuring: Refers to the accurate use of measuring instruments and equipment for measuring, reading and making observations.

Interpretation: The ability to:
Evaluate data in terms of its worth, good, bad, reliable, unreliable, etc.
Make inferences and predictions from written or graphical data
Extrapolate
Derive conclusions

Interpretation is also referred to as “Information Handling”

Recording: Draw or make graphical representations boldly and clearly, well labelled and pertinent to the issue at hand.

Reporting: Students should be able to present pertinent and precise reports on projects they undertake. Reports, oral or written, should be concise, clear and accurate.

Conduct in Laboratory/Field: Observation of safety measures in the laboratory; care and concern for the safety of one’s self and for others; ability to work alone and with others; good co-operative spirit, economical use of materials; maintenance of clean and orderly work area; persistence in achieving results; creative use of materials.

The action verb and definitions provided in the explanations of the three profile dimensions should help you to structure your teaching such as to achieve the effects needed. Select from action verbs provided for your teaching, in evaluating learning before, during and after instruction. Use the action verb also in writing your test questions. This will ensure that you give your students the chance to develop good thinking skills, and the capacity for excellent performance in Biology and in examinations. Check the weights of the profile dimensions to ensure that you have given the required emphasis to each of the dimensions in your teaching and assessment.

FORM OF ASSESSEMENT

In developing assessment procedures, select specific objectives in such a way that you will be able to assess a representative sample of the syllabus objectives. Each specific objective in the syllabus is considered a criterion to be achieved by the student. When you develop a test that consists of items or questions that are based on a representative sample of the specific objectives taught, the test is referred to as a “Criterion-Referenced Test”. In many cases, a teacher cannot test all the objectives taught in a term, in a year, etc. The assessment procedure you use i.e. class test, homework, projects, etc. must be developed in such a way that it will consist of a sample of the important objectives taught over a period.

Table 1 shows an examination consisting of two papers, Paper 1 and Paper 2, and continuous assessment. Paper 1 consists of two sections A and B lasting 2½ hours. Section A consists of multiple-choice objective questions lasting 1 hour. Section B consists of essay questions, essentially testing “Application of Knowledge”, but also consisting of some questions on “Knowledge and Understanding”. Paper 2 is Practical test lasting two hours. and Continuous Assessment will be based on all the dimensions as indicated. The distribution of marks for the objective test items, essay type questions and the practical questions in the two Papers and in the continuous assessment should be in line with the weights of the profile dimensions already indicated and as shown in the last column of Table 1.

In the examination structure presented in the table, Paper 1 is marked out of 140 Paper 2 is marked out of 60; totalling 200, which is scaled down to 70%. The continuous assessment is marked out of 100 but scaled down to 30%. The last row shows the weight of the marks allocated to each of the four test components. The two papers are weighted differently.

Table 1 Distribution Of Examination Paper Weights and Marks

Dimensions	Paper 1	Paper 2	Continuous Assessment	Total Marks	% Weight of Dimension
Remembering and Understanding	60	-	30	90	30
Applying Knowledge	84	-	36	120	40
Practical and Experimental Skills	-	60	30	90	30
Total Mark	144	60	96	300	
% Contribution of Papers	40	30	30		100

You will note that Paper 1 has a contribution of 40% to the total marks; Paper 2 has a contribution of 30% to the total marks; and Continuous Assessment has a contribution of 30% to the total marks. The numbers in the cells indicate the marks to be allocated to the items/questions that test each of the dimensions within the respective test papers.

The last but one column shows the total marks allocated to each of the dimensions. Note that the numbers in this section are additions of the numbers in the cells and they agree with the profile dimensions weights indicated in the last column.

Of the total marks of 300, 90 marks equivalent to 30% of the total marks are allocated to Knowledge and Comprehension. 120 marks, equivalent to 40 % of the total marks are allocated to application of Knowledge and 30% to Practical/Experimental skills. The weight of each of the three dimensions is indicated in the last column. The ratio of theory to practice in Biology is 70:30.

Item Bank: Obviously, the structure of assessment recommended in this syllabus will need a lot of work on the part of the teacher. In preparation for setting examination papers, try to develop an item bank. The term “item bank” is a general term for a pool of objective items, a pool of essay questions or a pool of practical test questions. As you teach the subject try to write objective test items, essay questions, structured essay questions and practical test questions to fit selected specific objectives which you consider important to be tested. If you proceed diligently, you will realise that you have written more than 100 objective test items, and more than 30 essay questions in a space of one year. Randomly select from the item bank to compose the test papers. Select with replacement. This

means that, as items/questions are selected for testing, new ones have to be written to replace those items/question already used in examinations. Items and questions that have been used in examination may also be modified and stored in the item bank.

An important issue in the preparation for a major examination such as SHSCE is the issue of test wiseness. To be “test wise” means that the student knows the mechanics for taking a test. These mechanics include writing your index number and other particulars accurately and quickly on the answer paper; reading all questions before selecting the best question to answer; apportioning equal time to each question or spending more time on questions that carry more marks; making notes on each question attempted before writing the answer; leaving extra time to read over one’s work; finally checking to see that the personal particulars supplied on the answer sheet are accurate. Some good students sometimes fail to do well in a major examination because of weakness in the mechanics of test taking; because they are not test wise. Take your students through these necessary mechanics so that their performance on major examinations may not be flawed by the slightest weakness in test taking.

GUIDELINES FOR SCHOOL BASED ASSESSMENT

A new School Based Assessment system (SBA) will be introduced into the school system in 2011. The new SBA system is designed to provide schools with an internal assessment system that will help schools to achieve the following purposes:

- Standardize the practice of internal school-based assessment in all Senior High Schools in the country
- Provide reduced assessment tasks for subjects studied at SHS
- Provide teachers with guidelines for constructing assessment items/questions and other assessment tasks
- Introduce standards of achievement in each subject and in each SHS class
- Provide guidance in marking and grading of test items/questions and other assessment tasks
- Introduce a system of moderation that will ensure accuracy and reliability of teachers’ marks
- Provide teachers with advice on how to conduct remedial instruction on difficult areas of the syllabus to improve class performance.

The arrangement for SBA may be grouped in categories as follows. Laboratory work, Projects, Group Work and End of Term Examinations

1. Laboratory Work:
Students will be required to keep laboratory notebook. It is of utmost importance that records be neatly and accurately kept by both student and teacher.
2. Projects/Field Work: These are tasks assigned to students to be completed over an extended time.

These will involve the following:
 - i) Practical work
 - ii) Experiment
 - iii) Investigative study (including case study)A report must be written for each project undertaken.
3. Mid-Term Test: The mid-term test following a prescribed format will form part of the SBA
4. Group Exercise: This will consist of written assignments or practical work on a topic(s) considered important or complicated in the term’s syllabus
5. End-of-Term Examination: The end-of-term test is a summative assessment system and should consist of the knowledge and skills students have acquired in the term. The end-of-term test for Term 3 for example, should be composed of items/questions based on the specific objectives studied over the three terms, using a different weighting system such as to reflect the importance of the work done in each term in appropriate proportions. For example, a

teacher may build an End-of-Term 3 test in such a way that it would consist of the 20% of the objectives studied in Term 1, 20% of objectives studied in Term 2 and 60% of the objectives studied in Term 3. The end-of-term 3 test should therefore sample the knowledge and skills acquired over the three school terms in appropriate proportions.

GRADING PROCEDURE

To improve assessment and grading and also introduce uniformity in schools, it is recommended that schools adopt the following WASSCE grade structure for assigning grades on students' test results.

Grade A1:	80 - 100%	-	Excellent
Grade B2:	70 - 79%	-	Very Good
Grade B3:	60 - 69%	-	Good
Grade C4:	55 - 59%	-	Credit
Grade C5:	50 - 54%	-	Credit
Grade C6:	45 - 49%	-	Credit
Grade D7:	40 - 44%	-	Pass
Grade D8:	35 - 39%	-	Pass
Grade F9:	34% and below	-	Fail

In assigning grades to students' test results, you are encouraged to apply the above grade boundaries and the descriptors which indicate the meaning of each grade. The grade boundaries i.e., 60-69%, 50-54% etc., are the grade cut-off scores. For instance, the grade cut-off score for B2 grade is 70-79% in the example. When you adopt a fixed cut-off score grading system as in this example, you are using the criterion-referenced grading system. By this system a student must make a specified score to be awarded the requisite grade. This system of grading challenges students to study harder to earn better grades. It is hence a very useful system for grading achievement tests.

Always remember to develop and use a marking scheme for marking your class examination scripts. A marking scheme consists of the points for the best answer you expect for each question, and the marks allocated for each point raised by the student as well as the total marks for the question. For instance, if a question carries 20 marks and you expect 6 points in the best answer, you could allocate 3 marks or part of it (depending upon the quality of the points raised by the student) to each point, hence totaling 18 marks, and then give the remaining 2 marks or part of it for organisation of answer. For objective test papers you may develop an answer key to speed up the marking.

SENIOR HIGH SCHOOL - YEAR 1

SECTION 1: INTRODUCING BIOLOGY

General Objectives: The student will:

1. understand biology as a science of life, its importance and how biologists work
2. appreciate body symmetry and orientation of objects/organisms
3. be able to manipulate the light microscope
4. acquire skills of preparing wet-mounts and observing them under the microscope

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 BIOLOGY AS A SCIENCE OF LIFE	The student will be able to: 1.1.1 explain the term biology. 1.1.2 explain what organisms are. 1.1.3 List some of the branches/fields of biology.	Explaining biology Living things as organisms. Branches of biology: Botany, Zoology, Bacteriology, Biochemistry, Molecular biology, Histology, Cell biology, Ecology, etc.	Let students: Brainstorm to bring out the meaning of biology. Revise as in SHS integrated science pg 3 to bring out the meaning of living things. Discuss the activities of living things e.g. respiration, excretion, etc Brainstorm to bring out a list of branches/fields of biology and discuss what each entails.	Explain the meaning of biology. What is the difference between a living thing and an organism? List five branches of biology and explain what each entails.
UNIT 2 HOW BIOLOGISTS WORK	1.2.1 describe skills used by biologists in their work. 1.2.2 describe the methods of science used to solve problems.	Skills required by biologists in their work Methods of science – identifying the problem, defining the problem, hypothesizing, experimenting, recording, analyzing and concluding.	Discuss the skills biologists require to work. These should include: observing, manipulating measuring, formulating hypotheses, predicting, designing investigations, recording data, interpreting results, drawing conclusions and communicating/reporting. Discuss how the skills are acquired. Discuss methods of science used in solving problems	describe the skill of i. observing ii. manipulating Identify three biological problems in your locality and outline the steps you will take to solve the problems.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) HOW BIOLOGISTS WORK	The student will be able to: 1.2.3 describe the steps for writing a report on biological investigation.	Steps for writing report on biological experiment or investigation e.g. <ul style="list-style-type: none"> • Aim/Title • Hypothesis/scientific framework • Materials/Drawing of set up • Method • Results/Observation • Discussion • Conclusion 	Let students: Discuss the steps for writing a report on biological experiment or investigation.	
UNIT 3 IMPORTANCE OF BIOLOGY	1.3.1 list some application of biology in everyday life. 1.3.2 enumerate careers that require knowledge of biology.	Application of biology to everyday life Careers associated with the study of biology	Brainstorm to bring out instances of the application of biology in everyday life. Brainstorm to bring out the careers associated with the study of biology.	Enumerate ways by which biology is applied in the home, hospital, industry and agriculture. State three examples in each case.
UNIT 4 BODY SYMMETRY AND ORIENTATION	1.4.1 explain the term Body Symmetry. 1.4.2 distinguish among the various types of sectioning in biology.	Body Symmetry: Bilateral Symmetry <u>Note:</u> Bilateral e.g. Small mammal, mango fruit, human body, etc. Radial Symmetry e.g. Orange, okro fruit, <i>Hydra</i> , etc. Longitudinal, transverse and vertical sections of objects e.g. lime, orange, tomato fruit, plant root, stem and leaf, bean seed.	Brainstorm to bring out the meaning of body symmetry. Use objects to explain bilateral and radial symmetries. Discuss the differences among longitudinal, transverse and vertical sections of objects. Cut transverse, longitudinal and vertical sections of biological specimens.	Distinguish between radial and bilateral symmetry using named specimens. Distinguish among the longitudinal, transverse and vertical sections of specimens.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 (CONT'D) BODY SYMMETRY AND ORIENTATION	The student will be able to: 1.4.3 describe the various orientations of specimens.	Orientation of specimens	Let students: discuss the various orientations/views of specimens; anterior, posterior, lateral, dorsal and ventral views. draw and label various orientation of the views of an insect/fish/toad/lizard/small mammal.	Name the parts of a bony fish/lizard/toad/small mammal when looking at : i. Lateral view ii. Dorsal view iii. Ventral view iv. Posterior view v. Anterior view
UNIT 5 THE MICROSCOPE	1.5.1 identify the various parts of the simple light and compound light microscopes. 1.5.2 handle and care for the microscope. 1.5.3 use the compound light microscope to view objects on slides. 1.5.4 prepare wet-mount of slides of onion epidermis or any suitable material. 1.5.5 explain the concept: resolution and magnification of the light microscope. 1.5.6 identify the parts of the electron microscope.	Parts and functions of the simple light and compound light microscopes Handling and caring for the microscope Observing slides under the simple/compound light microscope Preparation of wet-mounts of slides Resolution and magnification of microscopes (compound light and electron). Determination of magnification of drawings Parts of the electron microscope	Examine the simple, light and compound light microscopes and identify the various parts. Discuss the functions of each of the parts of the microscopes. Discuss how to handle and care for microscopes. Practice how to use the simple/compound light microscope to observe prepared slides. Prepare wet-mounts of any suitable material e.g. onion epidermis. Discuss the concepts: resolution and magnification of the microscope (compound light and electron). Determine magnification of drawings made from the compound light microscope Visit any research institute (eg. Noguchi Memorial Institute) to observe the electron microscope or observe drawings or photographs of the electron microscope.	Describe the parts and function of the simple light and compound light microscopes and their uses. outline the steps you would take to prepare a wet-mount of slides of an onion epidermis.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 5 (CONT'D) THE MICROSCOPE	The student will be able to: 1.5.7 take measurements with compound light microscope.	Measuring length using the compound light microscope	Let students: Practice how to measure length of specimen using compound light microscope.	
UNIT 6 BIOLOGICAL DRAWINGS	1.6.1 list the materials required for making biological drawings 1.6.2 give appropriate heading to biological drawings. 1.6.3 write correctly, the magnification of a biological drawing. 1.6.4 draw the outline of biological drawing should be made. 1.6.5 describe how guidelines are made. 1.6.6 describe how labels of drawings are written.	Biological drawings, Materials required Heading of biological drawings Writing of magnification of biological drawing. Outline of biological drawing Guidelines of biological drawing Labels of biological drawings	Discuss the materials to use when making drawings in biology: e.g. HB pencil ,sharpener, ruler/straight edge, eraser, cutting instrument and A4 bond sheets or drawing book. Practice giving appropriate heading to biological drawings. Note: The heading should be on top of the drawing. Practice writing magnification of biological drawing(s). Note: The size of a drawing must be reasonable (not too small and not too large). Draw the outline of a number of objects and biological specimens. Note: show the distinction between biological drawing and an art work. Discuss how guidelines should be done. draw guidelines for the drawings in the TLA for 1.6.4 Discuss how labels are written for biological drawings. Write labels for the drawings in the TLA for 1.6.3	What materials would you require to produce a biological drawing? What are the characteristics of a good biological drawing?

SENIOR HIGH SCHOOL - YEAR 1

SECTION 2: CELL BIOLOGY

General Objectives: The student will:

1. understand that the cell is a unit of life and building block of all living things.
2. appreciate the differences between the various types of cells including the specialized eukaryotic cells.
3. understand the relationship between cell, tissue, organ, organ system and organism.
4. understand the physiological processes involved in the movement of substances into and out of the cell.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 THE CELL AS A UNIT OF LIFE	The pupil will be able to: 2.1.1 explain the concept of cell as the basic unit of life and all cells evolving from pre-existing cell (s) 2.1.2 distinguish between akaryotes, and prokaryotes. 2.1.3 describe mode of life of viruses and bacteria. 2.1.4 describe eukaryotic cell structure and functions.	The concept of cell Akaryotes and Prokaryotes Mode of life of viruses and bacteria eukaryotic cell structure and functions	Let students: Observe a group of cells under the microscope e.g. onion cells, cheek cells, red blood cells of a toad. Brainstorm to bring out the meaning of cell. View bacterial cells and viruses from charts and electron micrographs. Draw and label the structures viewed. Discuss the structural differences between the two kinds of structures viewed. Discuss mode of life of viruses and bacteria. Review eukaryotic cell structure from S.H.S integrated science syllabus. Page 7 Observe typical plant and animal cell under the light microscope.	Explain why the cell is considered as a unit of life. Why is a virus not considered as a cell? What are the structural characteristics of prokaryotic and eukaryotic cells? Tabulate the differences between plant and animal cells. Make annotated drawings of five types of specialized eukaryotic cells
UNIT 2 SPECIALIZED EUKARYOTIC CELLS	2.2.1 identify specialized eukaryotic cells and outline their functions	Specialized eukaryotic cells. e.g. red blood cells, sperm cells, leaf epidermal cells, nerve cells and palisade cells, ciliated cells, muscle cells	Observe specialized eukaryotic cells under the simple light or compound light microscopes. Draw and label the various types of specialized eukaryotic cells and discuss their functions.	Make annotated drawings of five types of specialized eukaryotic cells

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 RELATIONSHIP OF CELL, TO TISSUE, ORGAN AND ORGAN SYSTEM	<p>The student will be able to:</p> <p>2.3.1 explain the terms cell, tissue, organ, organ system and organism.</p> <p>2.3.2 describe the relationship between cell, tissue, organ, organ system and organism.</p> <p>2.3.3 list the forms in which cells can exist.</p>	<p>Cell as the building block of all living things</p> <p>Levels of organization of living things</p> <p>Forms in which cells can exist</p>	<p>Let students:</p> <p>Observe slides of cells, tissues e.g. muscle tissue, T.S of leaf or stem under the microscope. Discuss the observations to bring out the meaning of tissue, organ, organ system and organism.</p> <p>Discuss the organization of living things</p> <p>(a) unicellular living things e.g. <i>Amoeba</i>, <i>Euglena</i>, <i>Paramecium</i></p> <p>(b) Tissue, e.g. palisade tissue, epidermis, lining of the mouth, etc</p> <p>(c) Organ, e.g. bulb, rhizome, heart.</p> <p>(d) Organ system (in mammals and flowering plants. e.g. reproductive system, excretory system, etc.</p> <p>(e) Organism- mango, plant, man etc.</p> <p>Observe charts of living things showing the various levels of organization.</p> <p>Use the microscope to observe the different forms in which living cells can exist. These should include:</p> <p>(a) single and free living e.g. <i>Amoeba</i>, <i>Paramecium</i>, <i>Euglena</i>, <i>Chlamydomonas</i></p> <p>(b) Colony: <i>Volvox</i></p> <p>(c) Filament – <i>Spirogyra</i></p> <p>(d) Part of multicellular organism – cheek cell, onion cell, root tip cell and leaf epidermal cell</p> <p>Draw and label their observations.</p>	<p>Differentiate between a unicellular living thing and an organism.</p> <p>What level of organization is <i>Hydra</i>? Give reasons</p>
UNIT 4 MOVEMENT OF SUBSTANCES INTO AND OUT OF CELLS	<p>2.4.1 explain the need for movement of substances across the cell surface membrane.</p>	<p>Transport across the cell surface membrane</p>	<p>Discuss the necessity or importance of movement of substances in and out of cells.</p> <p>Note that the importance of the movement of substances to include the following: e.g. -to obtain nutrients;</p> <ul style="list-style-type: none"> - to excrete waste; - to secrete useful substances; -to generate ionic gradient for nervous and muscular activity; -to maintain suitable pH and ionic concentration within the cell for enzyme activity. 	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 MOVEMENT OF SUBSTANCES INTO AND OUT OF CELLS. (CONT'D)	<p>The student will be able to:</p> <p>2.4.2 explain the concepts of plasmolysis, active transport, endocytosis (phagocytosis and pinocytosis) and exocytosis.</p> <p>2.4.3 perform experiment to demonstrate diffusion, osmosis and plasmolysis</p>	<p>Physiological processes by which substances move into and out of the cell</p> <p>Experiment on diffusion, osmosis and plasmolysis.</p>	<p>Let students:</p> <p>Review topics in SHS Integrated Science syllabus pg.14 on diffusion, osmosis, plasmolysis and active transport.</p> <p>Discuss and bring out the meaning of endocytosis and exocytosis (bulk transport)</p> <p>Perform experiment to demonstrate diffusion, osmosis and plasmolysis</p> <p>observe electron micrographs or charts showing endocytosis and exocytosis</p> <p>Discuss the mechanism of plasmolysis. Describe what happens Discuss the mechanism of plasmolysis. Note: <i>Rheo discolor</i> or <i>Zebrina</i> should be used</p>	<p>Describe experiments to demonstrate</p> <p>(a) diffusion (b) Osmosis (c) plasmolysis</p> <p>State</p> <p>(a) conditions under which endocytosis and exocytosis occur (b) Examples of phagocytosis and pinocytosis</p>
UNIT 5 SCIENTIFIC INQUIRY SKILLS	<p>2.5.1 prepare a temporary slide of plant and animal cells.</p> <p>2.5.2 mount microscope slide and bring what needs to be observed into focus.</p> <p>2.5.3 draw cells under the microscope.</p>	<p>Preparation of temporary slide of epidermal cells</p> <p>Note: use the onion or cocoyam leaves; and cheek epithelial cells.</p> <p>Mounting variety of specialized eukaryotic cells</p> <p>Cells as seen under the microscope.</p>	<p>Bring onion or cocoyam leaves; and clean disposable spoon (for scraping the cheeks) to class. Prepare temporary slides of epidermal cells of the leaf and cheek cells. Collect prepared slides of cells noted in the content column.</p> <p>Mount the slides one after the other and observe the structures of the cells. Note: The following cells must be provided: Cheek cells, nerve cells, sperm cells, red blood cells, muscle cells, root tip cells, leaf epidermal and palisade cells</p> <p>Draw and label as many of the cells as possible Describe what happens. Discuss the mechanism of plasmolysis.</p>	

SENIOR HIGH SCHOOL - YEAR 1

SECTION 3

LIFE PROCESSES IN LIVING THINGS

General Objectives: The student will:

1. understand the life processes of living things.
2. relate the structure to functions of living things at various stages of their life cycles.
3. recognize the external features of vertebrates.
4. appreciate how insects and vertebrates are adapted to their habitat
5. appreciate the economic importance of selected insects and vertebrates.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 <i>Amoeba, Paramecium, and Euglena</i>	The student will be able to: 3.1.1 describe the structure of <i>Amoeba, Paramecium</i> and <i>Euglena</i> . 3.1.2 explain the life processes of <i>Amoeba Paramecium</i> and <i>Euglena</i> .	External structure of <i>Amoeba, Paramecium</i> and <i>Euglena</i> Life processes of <i>Amoeba, Paramecium</i> and <i>Euglena</i>	Let students: Collect water from ponds and ditches and look for these organisms under the microscope . <i>Amoeba, Paramecium</i> and <i>Euglena</i> . Draw and label them Note. Use permanent slides where available. Discuss the life processes of <i>Amoeba, Paramecium</i> and <i>Euglena</i> Note <i>Euglena</i> should be studied as a living thing exhibiting both plant and animal features.	Explain how <i>Amoeba, Paramecium</i> and <i>Euglena</i> regulate the water content of their body. List the plant and animal features of <i>Euglena</i> .
UNIT 2 <i>Spirogyra</i> and <i>Rhizopus</i>	3.2.1 identify <i>Spirogyra</i> and <i>Rhizopus</i> .	Structure of <i>Spirogyra</i> and <i>Rhizopus</i>	Collect specimen of <i>Spirogyra</i> from stagnant water or fringes of slow running streams. Culture <i>Rhizopus</i> on a piece of moist bread/kenkey/agar or any organic food substance. Draw, label and discuss the structure of each specimen.	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) <i>Spirogyra and rhizopus</i>	The student will be able to: 3.2.2 explain nutrition and reproduction in <i>Spirogyra</i> and <i>Rhizopus</i> .	Nutrition and Reproduction in <i>Spirogyra</i> and <i>Rhizopus</i> Note both <i>Spirogyra</i> and <i>Rhizopus</i> exhibit all the other life processes.	Let students: Discuss nutrition and reproduction in <i>Spirogyra</i> and <i>Rhizopus</i> Draw and label to illustrate the various stages of sexual reproduction of the two specimens.	Explain how <i>Spirogyra</i> survives in a dry pond. Explain why bread goes mouldy
UNIT 3 Mosses and ferns	3.3.1 identify Mosses and Ferns. 3.3.2 describe the external features of mosses and ferns. 3.3.3 explain nutrition and reproduction in mosses. 3.3.4 outline the reproduction in ferns.	Structure of Mosses e.g. <i>Brachymerium</i> , <i>Funaria</i> ; and Ferns, e.g. <i>Nephrolepis</i> / <i>Platynerium</i> / <i>Phymatodes</i> External features of Mosses and Ferns Nutrition and Reproduction in Mosses Reproduction in Ferns	Collect Specimens of Mosses and ferns Observe the specimens using hand lens Discuss observations after using the hand lens Draw to show the external features of mosses and ferns Discuss nutrition and reproduction in mosses Draw and label features of various stages in the life cycle of a named fern Note: Detailed structure of antheridium and archegonium are not required Discuss the relationship between their structure and functions. Discuss how the stages in the life cycle of ferns are adapted to the habitat.	Describe the stages of reproduction in a named moss. Draw and label the prothallus of a fern. What do you understand by the term alternation of generation?

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 COCKROACH AND BUTTERFLY	<p>The student will be able to:</p> <p>4.4.1 identify cockroach and Butterfly.</p> <p>4.4.2 describe the external features of the nymph and adult cockroach.</p> <p>4.4.3 discuss the life cycle and other life processes of the cockroach.</p> <p>4.4.4 relate the structures at the various stages of development of a cockroach to their function.</p> <p>4.4.5 describe the external features of the larva (caterpillar), pupa and adult butterfly .</p>	<p>External features of cockroach and butterfly</p> <p>External features of the nymph and adult stages of cockroach.</p> <p>Life processes of the cockroach</p> <p>Structural changes in the life cycle of the cockroach</p> <p>External features of the larva, pupa and adult butterfly.</p>	<p>Let students:</p> <p>Collect eggs, nymphs and adults of cockroach. Collect eggs, caterpillars, pupae of butterflies and adults butterflies. Examine the specimens collected and note any structural differences.</p> <p>Examine and discuss the external features of the nymph and adult cockroach.</p> <p>Draw and label the specimens collected.</p> <p>Discuss the life processes of the cockroach.</p> <p>Discuss, draw and label stages in the life cycle of the cockroach</p> <p>Collect and examine larva, pupa and adult butterfly.</p> <p>Discuss the external features of the larva, pupa and adult butterfly.</p> <p>Draw and label the specimens collected. Discuss the external features of the weevil/cotton stainer.</p> <p>Collect weevil from infested cereals (rice, maize), bean, dried chips of cassava (konkonte).OR Collect cotton stainer from kapok, silk cotton, cotton, kola, and baobab fruits.</p> <p>Examine the weevils/cotton stainers using hand lens. Discuss the external features of the weevil/cotton stainer.</p>	<p>Make a labelled drawing of the adult cockroach to show the external features</p> <p>Describe how the caterpillar is adapted to its habitat.</p>
UNIT 5 WEEVILS OR COTTON STAINERS	<p>5.1.1 describe the external features of the weevil or cotton stainer.</p>	<p>External structures of a weevil or cotton stainer</p>	<p>Collect weevil from infested cereals (rice, maize), bean, dried chips of cassava (konkonte).OR Collect cotton stainer from kapok, silk cotton, cotton, kola, and baobab fruits.</p> <p>Examine the weevils/cotton stainers using hand lens. Discuss the external features of the weevil/cotton stainer.</p>	<p>Describe how the caterpillar is adapted to its habitat.</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 6 TERMITES OR HONEY BEES	The students will be able to:		Let students:	
	6.1.1 identify the caste of termites or honey bees.	External features of the castes of termites/honey bees.	Examine the external features of the castes of termites/honey bees Draw and label the castes of termites/honey bees.	Outline the economic importance of the (a) weevil OR (b) cotton stainer
	6.1.2. describe the mode of life of the castes of termites/honey bees.	Mode of life of termites/honey bees.	Discuss the mode of life of castes of termites/honey bees	
	6.1.3 relate the structure of the castes of termite/honey bees to their function.	Adaptations of the castes of termites/honey bees to their habitats.	Discuss the features of adaptation of the castes of termites/honey bees.	Name the various castes of: Termites or Honey bees
UNIT 7 Tilapia	6.1.4 explain the economic importance of the castes of termites/honey bees	Economic importance of the caste of termites/honey bees.	Discuss the economic importance of the castes of termites/honey bees.	Enumerate the economic importance of: Termites or Honey bees
	3.7.1 describe the external features of <i>Tilapia</i>	External features of <i>Tilapia</i> .	Examine the external features of <i>Tilapia</i> critically. Note: any bony fish can be used. Discuss the external features and suggest the uses or importance of those features. Make a labelled drawing of <i>Tilapia</i> , showing the external features	List all observable features of a named bony fish
	3.7.2 describe the life processes of <i>Tilapia</i> .	Life processes of <i>Tilapia</i> : Movement, nutrition, gaseous exchange, excretion, and reproduction.	Name and discuss the life processes of <i>Tilapia</i> Visit a fish farm and observe feeding, movement and gaseous exchange as carried out by <i>Tilapia</i> or any bony fish.	
	3.7.3 discuss the adaptation of <i>Tilapia</i> to its habitat.	Adaptation of <i>Tilapia</i> to aquatic life.	Discuss the adaptive features of <i>Tilapia</i> in aquatic ecosystem	How is <i>Tilapia</i> adapted to aquatic life?
3.7.4 outline the ecological significance of <i>Tilapia</i> .	Ecological significance of <i>Tilapia</i> .	Discuss the role of <i>Tilapia</i> in the aquatic ecosystem		

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 8 TOAD OR FROG	The student will be able to: 3.8.1 describe the external features of toad or frog. 3.8.2 discuss the adaptation of toad or frog to its habitat. 3.8.3 Describe the life processes of toad or frog.	External features of toad or frog. Adaptation of toad or frog to its habitat. Life processes of toad or frog	Let students: Examine and discuss the external features of toad or frog Draw and label the toad or frog to show external features Observe a toad or frog and discuss the features which adapt the toad or frog to its habitat Discuss the life processes of toad or frog	Annotated diagram to show the external features of toad/frog. Describe how toad/ frog feeds?
UNIT 9 LIZARD (<i>Agama</i>)	3.9.1 describe the external features of lizard (<i>Agama</i>). 3.9.2 describe the life processes of the lizard. 3.9.3 relate the structural features of the lizard to their functions.	External features of lizard (<i>Agama</i>) Life processes of the lizard Adaptation of lizard to terrestrial habitat	Examine and discuss the external features of the lizard (<i>Agama</i>). Draw and label the external features of the <i>Agama</i> lizard. Discuss the life processes of lizard Discuss the adaptive features of lizard to terrestrial habitat.	How is the lizard adapted to terrestrial habitat?
UNIT 10 DOMESTIC FOWL	3.10.1 describe the external features of domestic fowl. 3.10.2 describe the life processes of domestic fowl. 3.10.3 explain the adaptation of domestic fowl to its habitat. 3.10.4 explain the different uses of the feathers of domestic fowl.	External features of domestic fowl. Life processes of domestic fowl Adaptation of domestic fowl to the terrestrial habitat Types and functions of feathers of domestic fowl.	Examine and discuss the external features of domestic fowl Draw the domestic fowl and label the external features. Discuss the life processes of domestic fowl. Discuss the adaptive features of domestic fowl to the terrestrial habitat Examine and draw the different types of feathers Discuss the functions of each type of feather.	Identify the different types of feathers and state their functions.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
<p>UNIT 11</p> <p>SCIENTIFIC INQUIRY SKILLS</p>	<p>The student will be able to:</p> <p>3.11.1 perform the skill of observing.</p> <p>3.11.2 mount <i>Euglena</i> under the compound light microscope.</p> <p>3.11.3 identify stages of conjugation of <i>Spirogyra</i>.</p> <p>3.11.4 use a hand lens to examine biological specimens.</p>	<p>Observing <i>Paramecium</i></p> <p>Mounting of <i>Euglena</i> under the compound light microscope</p> <p>Observing <i>Spirogyra</i></p> <p>Observing moss plant with hand lens.</p>	<p>Let students:</p> <p>Mount prepared slides of <i>Paramecium</i> under the compound light microscope</p> <p>Observe <i>Paramecium</i> and describe its structural features.</p> <p>Discuss how the structural features are related to the functions they perform.</p> <p>Obtain water from a pond or ditch preferably near a farm yard.</p> <p>CAUTION: Avoid infection from the water by wearing appropriate footwear, clothing and gloves.</p> <p>Mount a drop of the water under the microscope and look out for <i>Euglena</i>.</p> <p>Watch its movement.</p> <p>Draw and label as many of the structures that are observable.</p> <p>Collect a mass of <i>Spirogyra</i> filaments and handle them between the thumb and the index finger.</p> <p>Describe how they feel.</p> <p>Prepare wet-mount of the filaments and observe under the microscope.</p> <p>Examine carefully as many filaments as possible and identify stages of conjugation.</p> <p>Draw and label any stages they observe.</p> <p>Collect a cluster of moss plants and isolate a single plant and observe using a hand lens.</p> <p>Note: The technique of using hand lens must be emphasized. Describe how the leaf-like structures are arranged on the “stem”. Draw the moss plant and label fully.</p>	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 11 (CONT'D) SCIENTIFIC INQUIRY SKILLS	<p>The student will be able to:</p> <p>3.11.5 make biological drawing of an insect.</p> <p>3.11.6 observe and record biological data.</p> <p>3.11.7 draw biological specimen accurately.</p> <p>3.11.8 make inference from biological observation/data.</p>	<p>Drawing an insect. Note: Use the cockroach</p> <p>Observing and recording biological data Note: Use the life cycle of citrus swallowtail butterfly or moth.</p> <p>Drawing of biological specimen Note: Use freshly killed or preserved <i>Tilapia</i> or any bony fish</p> <p>Drawing of biological specimen. Note: Use anaesthetized lizard (<i>Agama</i>)</p> <p>Making inference from biological data.</p>	<p>Let students:</p> <p>Collect adult anaesthetized cockroaches Discuss how biological drawings are done. Make a drawing of the dorsal view of the cockroach and label.</p> <p>Study the life cycle of the citrus swallowtail butterfly or moth. Record the date, stage of the cycle and the observation made. Note Record daily observation. Discuss the life cycle of the butterfly or moth.</p> <p>Examine the external features of <i>Tilapia</i> or any bony fish. Discuss the structure of the fish. Draw the lateral view of the fish and label fully.</p> <p>Examine the external features of lizard. (<i>Agama</i>). Discuss the structure of the lizard (<i>Agama</i>). Draw the lateral view of the lizard (<i>Agama</i>) and label fully.</p> <p>Examine beaks and claws of birds and discuss their structure and function. Infer from the structure of the beaks and claws the type of food the birds eat.</p> <p>Handle and discuss already prepared data and draw inferences from them.</p>	

SENIOR HIGH SCHOOL - YEAR 2

SECTION 1: DIVERSITY OF LIVING THINGS

General Objectives: The student will:

1. appreciate the diversity of living things
2. assign organisms to their various economic groups
3. distinguish between various organisms, based on their characteristics.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 THE FIVE KINGDOMS AND THE HIERARCHY OF CLASSIFICATION	The student will be able to: 1.1.1 state the importance of classification of living organism. 1.1.2 outline the general characteristics of the five kingdoms of living things. 1.1.3 identify and classify organisms into their respective kingdoms.	Importance of classification of living organism. General characteristics of kingdoms i) Monera/ Prokaryotae ii) Protoctista iii) Fungi iv) Plantae v) Animalia Using the observable characteristics of organisms to place them in appropriate kingdoms.	Let students: discuss the importance of classification. Review the topic on the general characteristics of the five kingdoms from the SHS integrated science syllabus, p4. Go out of the classroom, Identify, list and collect as many organisms as possible, and then place them in their kingdoms based on their characteristics.	List any two general characteristics for each of the following kingdoms, i) Monera/ Prokaryotae ii) Protoctista iii) Fungi vi) Plantae v) Animalia State the kingdoms of the following organisms and give two reasons to support your answer in each case. I) <i>Tilapia</i> II) Dove III) <i>Hibiscus</i> IV) Cat V) Bread mould VI) Cassava plant
	1.2.1 list the major Phyla of Kingdoms Protoctista and Fungi and describe their major characteristics.	Major Phyla of Kingdom Protoctista. Major Phyla of kingdom Fungi. Characteristics of the major Phyla of Kingdom Ptotoctista and Fungi	Examine, identify and draw members or representatives of the major phyla of Kingdom Protoctista and Fungi Include; Rhizopoda, Zoomastigina, Apicomplexa, Ciliophora, Euglenophyta, Oomycota, Chlorophyta, Rhodophyta and Phaeophyta Discuss the characteristics of each phyla of Kingdom Protoctista. and Fungi	Give an example. each of fungi belonging to the following divisions. a) Ascomycota b) Basidiomycota c) Zygomycota Give one reason in each case for your choice of example.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 DIVISIONS AND CLASSES OF KINGDOM PLANTAE	The student will be able to: 1.3.1 outline the major divisions and classes of Kingdom Plantae.	Major divisions and classes of Kingdom Plantae.	Let students: Examine and draw representatives of the major divisions and classes of Kingdom Plantae: Bryophyta (Hepaticae, Musci), Lycopodophyta, Filicinophyta, Coniferophyta, Cycadophyta, Angiospermophyta – (Monocotyledoneae and Dicotyledoneae)	Identify with reasons a moss plant and a fern plant.
	1.3.2 describe the characteristics of the major divisions and classes of Kingdom Plantae.	Characteristics of the major divisions and classes of Kingdom Plantae.	Outline the major divisions and classes of the Kingdom Plantae. Identify and discuss the characteristics of the major divisions and classes of Kingdom Plantae	Distinguish between monocotyledonous and dicotyledonous plants. Discuss any two characteristics which adapt mosses to their habitat.
UNIT 4 PHYLA, CLASSES AND ORDERS OF KINGDOM ANIMALIA	1.4.1 outline the major phyla and classes of Kingdom Animalia.	Major phyla and classes of Kingdom Animalia:.	Examine and draw representatives of the major phyla and classes of Kingdom Animalia.	Compare the five classes of Phylum Arthropoda under the following headings:
	1.4.2 identify and describe the characteristics of the major phyla and classes of Kingdom Animalia.	Characteristics of the major phyla and classes of Kingdom Animalia. Major phyla; Cnidaria, Platheminthes, Nematode, Annelida, Mollusca, Arthropoda, Echinodermata and Chordata	List the major phyla and classes of the Kingdom Animalia. Discuss the characteristics of the major phyla and classes of Kingdom Animalia	i. antennae ii. appendages iii. body divisions. List the characteristic features of mammals.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
<p>UNIT 5</p> <p>CHARACTERISTICS OF SOME OF THE ORDERS OF CLASS INSECTA</p> <p>UNIT 6</p> <p>IDENTIFYING ORGANISMS USING BIOLOGICAL KEYS</p> <p>UNIT 7</p> <p>SCIENTIFIC INQUIRY SKILLS</p>	<p>The student will be able to</p> <p>1.5.1. name the major orders of Class Insecta.</p> <p>1.5.2. describe the characteristics of the major orders of Class Insecta.</p> <p>1.6.1 identify the types of keys used in biological classification.</p> <p>1.6.2. construct identification keys using characteristics of organisms.</p> <p>1.7.1 use keys to identify organisms.</p> <p>1.7.2 classify organisms.</p>	<p>Orders of Class Insecta (Odonata, Orthoptera, Coleoptera, Hymenoptera, Hemiptera, Diptera, Isoptera, Dictyoptera Lepidoptera .</p> <p>Characteristics of orders of Class Insecta.</p> <p>Identification of organisms using keys (Numbered keys and Dichotomous keys)</p> <p>Construction of identification keys.</p> <p>Identifying organisms using keys.</p> <p>Classification of organisms.</p>	<p>Let students:</p> <p>Examine, draw and label representatives of the orders of Class Insecta.</p> <p>List the major orders of the Class Insecta.</p> <p>Use specimens of insects to identify the characteristics of the major orders of class Insecta.</p> <p>Discuss the characteristics of each order.</p> <p>Discuss the characteristics of the two types of identification keys. Note: Provide a wide range of arthropods or any appropriate organisms for the lesson.</p> <p>Examine organisms provided and use their characteristics to construct numbered keys and dichotomous keys.</p> <p>Use dichotomous and numbered keys to identify organisms.</p> <p>Collect a lot of different plants and animals (organisms) from different habitats.</p> <p>Put the organisms in major groups and sub groups as much as possible.</p> <p>Discuss their reasons for the groupings.</p>	<p>Place the underlisted insects into their correct orders and give at least two reasons for your choice</p> <ol style="list-style-type: none"> i. cockroach ii. housefly iii. cricket iv. dragon fly v. honey bee vi. cotton stainer vii. grain weevil viii. butterfly ix. termite <p>Use the organisms provided by the teacher to construct a named identification key. Note: Teacher provides a wide range of arthropods or any appropriate group of organisms for the evaluation question.</p>

SENIOR HIGH SCHOOL - YEAR 2

SECTION 2: INTERACTIONS IN NATURE

General objectives: The student will:

1. identify the significance of biological associations in ecosystems
2. appreciate the importance of maintaining soil fertility
3. use some instruments for sampling populations of different organisms

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 BASIC CONCEPTS IN ECOLOGY	The students will be able to:		Let students:	
	2.1.1 discuss basic concepts in ecology.	Basic concepts in ecology	Revise basic concepts in ecology from SHS Integrated Science Syllabus. Note; ecological niche and biomes should be treated	Name one ecosystem in your locality that you might study and list three abiotic factors affecting living things in that ecosystem.
UNIT 2 STUDY OF SPECIFIC HABITATS	2.2.1 outline the general characteristics of aquatic and terrestrial habitats	General characteristics of aquatic and terrestrial habitat	Visit an aquatic and terrestrial habitat and observe the characteristics of each habitat. List the characteristics of the various habitats using the following headings: i. Physical environment ii. Chemical environment iii. Geologic features iv. Photosynthetic organisms v. Animals.	Compare the features of aquatic and terrestrial habitats under the following headings; i. Physical environment ii. Chemical environment iii. Geologic features iv. Photosynthetic organisms
	2.2.2 explain the effects of abiotic and biotic factors on life in aquatic and terrestrial habitats	Biotic and abiotic factors in the terrestrial and aquatic habitats.	Discuss the aquatic and terrestrial habitats observed. Observe the interactions in an aquatic and terrestrial habitat and identify some biotic and abiotic factors	Identify any two biotic and abiotic factors in aquatic habitats and explain their effects on a named aquatic organism.
	2.2.3 explain how organisms in aquatic and terrestrial habitats are adapted to their habitats	Adaptations of organisms in aquatic and terrestrial habitats	Observe and discuss the effects of biotic and abiotic factors in selected aquatic and terrestrial habitats Observe and discuss the adaptive features or structures on each organism.	

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 STUDY OF SPECIFIC HABITATS UNT 3 BIOLOGICAL ASSOCIATIONS UNIT 4 POPULATION DYNAMICS	The students will be able to:		Let students:	
	2.2.4 identify the components of a food chain, food web and ecological pyramids.	Food chains, food webs and pyramids of numbers, biomass and energy.	Revise food chains and food webs from SHS Integrated Science syllabus pg.21 Discuss productivity and decomposition in nature.	Discuss the components of the pyramids of numbers, biomass and energy.
	2.2.5 explain how food chains and food webs can be determined.	Methods of determining food chains and webs: Direct observation, Dissection and use of radioactive substances.	Discuss the methods of determining food chains and food webs. Dissect a small mammal, examine the content of its gut and determine the feeding level of the organism.	State the methods by which food chains can be determined.
	2.3.1 explain the concept of symbiosis.	Concept of symbiosis: Symbiotic relationships:	Brainstorm to give an explanation of the concept symbiosis.	
	2.3.2 identify the different symbiotic relationships	Mutualism , Parasitism Saprophytism, and Epiphytism	Observe ecological associations between different organisms in their school garden or field and record their observations. Distinguish between mutualism and parasitism. Giving one example in each case. NOTE: let groups of students look for more examples of the various symbiotic relationships and report to the class, using charts, drawings or photographs.	What do you understand by the term symbiosis? Distinguish between mutualism and parasitism giving ne example in each case
	2.4.1 explain the terms, population density, population growth, immigration, emigration, birth rate and death rate.	Population density, Population growth, Immigration, Emigration, Birth rate and Death rate	Brainstorm to explain the terms mentioned under content.	Explain the following terms: i. Population density ii. Immigration iii. Emigration iv. Birth Rate v. Death Rate
2.4.2 outline the population sampling techniques.	Methods of determining population size, density, etc. Direct counting, Capture-mark-release-recapture, Removal method.	Discuss the methods of determining the population size, density and growth. Note: Quadrats, traps, nets, etc. are sampling tools and are used together with the sampling techniques or methods.		

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 (Cont).	<p>The students will be able to:</p> <p>2.4.3 apply the techniques in determining population density, population size and population growth.</p> <p>2.4.4 identify the factors which affect population size.</p> <p>2.4.5 distinguish between density dependent and density independent factors that affect population size.</p> <p>2.4.6 describe the exponential growth curve and the sigmoid or logistic growth curve.</p>	<p>Application of techniques for determining population density, size and growth.</p> <p>Main factors which affect the size of population (Immigration, Emigration, Death rate, Birth rate).</p> <p>Density dependent and density independent factors that affect population size.</p> <p>Growth curves: sigmoid and exponential growth curves. Note: Teachers should use appropriate graphs or curves to explain the characteristics of the two curves.</p>	<p>Let students:</p> <p>Use quadrats and traps to estimate population size and population density flora and fauna respectively in the field.</p> <p>Discuss the factors which affect population size.</p> <p>Brainstorm to distinguish between density dependent and density independent factors that affect population size.</p> <p>Discuss and give examples of populations whose growth can be represented by the sigmoid growth curve or the exponential growth curve</p>	<p>Four hundred and twenty-eight insects were trapped, marked and released into the field. A few days later 639 insects were trapped from the same field, but 89 of these had been marked:</p> <ol style="list-style-type: none"> i. Estimate the population of insects in the field ii. Explain why the second trapping was done some days after the first trapping <p>Carry out a project to estimate the population of butterflies or common insects found on your school compound. Carry out a similar project to estimate the population of weeds found on your school compound or environment. Explain all the steps you took in both projects.</p>
UNIT 5 BIOLOGICAL PEST CONTROL	<p>2.5.1 explain the concept of biological pest control.</p> <p>2.5.2 outline the advantages and disadvantages of biological pest control.</p>	<p>Biological pest control: - Using organisms to control population of other organisms.</p> <p>Advantages and disadvantages of biological pest control</p>	<p>Discuss what biological pest control is and come out with an explanation of the concept. Note: Chemical substances known as pheromones produced by living things are used as baits to attract pests to traps that are laced with pesticides come under biological control.</p> <p>Discuss the advantages and disadvantages of biological pest control.</p>	<p>Teacher provides data on growth patterns which the students will represent graphically and describe the shape of the graphs.</p> <p>What advantages do the biological pest control have over the use of chemicals in controlling population of pest?</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 6 ECOLOGICAL SUCCESSION	The student will be able to:		Let students:	
	2.6.1 explain the concept ecological succession.	Concept of ecological succession	Discuss the meaning of ecological succession.	Explain ecological succession.
	2.6.2 outline the process of ecological succession in a field.	Process of ecological succession	Discuss the types of ecological succession. Locate a patch of bare piece of land or place a concrete block in a shaded place, observe between 6 to 12 months and record findings.	
UNIT 7 SOIL	2.7.1 identify the components of a soil sample.	Components of soil; 1. Organic components:- (i) Living things (ii) Humus 2. Inorganic components:- (i) soil particles (ii) Mineral salts (iii) Soil water (iv) Air	Carry out sedimentation experiments. Identify different layers of soil particles and draw the different layers.	Differentiate between organic and inorganic components of soil.
	2.7.2 identify different soil types.	Types of soil: - Sand, Loam and Clay.	Collect the three types of soils and carry out experiments to determine their properties. The properties should include, pH, permeability, capillarity and water retention capacity.	
	2.7.3 determine the presence of living things in soil.	Living things in the soil. NOTE: Living things should include macro and micro organisms.	Collect soil samples from different locations and carry out experiments to find out presence of living things. Record and discuss findings.	Compare the properties of sand loam and clay.
	2.7.4 identify some mineral salts in soil	Mineral salts exist as anions and cations in the soil. Cations: - Ca^{2+} , Fe^{2+} , Fe^{3+} , Mg^{2+} , K^+ Anions: - SO_4^{2-} , NO_3^- , PO_4^{3-} in soil sample	Carry out tests for; the presence of Ca^{2+} , Fe^{2+} , Fe^{3+} , Mg^{2+} , K^+ And SO_4^{2-} , NO_3^- , PO_4^{3-} 2- NOTE: - No quantitative analysis of these ions required.	Explain why clay has higher water-holding capacity than sand
	2.7.5 determine the percentage organic matter , soil water and soil air content in soil samples	Organic matter(humus), inorganic matter, soil water and soil air content in soil samples	Perform experiments to determine the percentage of organic matter , soil water and soil air content in soil sample Compare the results of different soil samples.	Describe an experiment to determine the presence of Ca^{2+} , K^+ , SO_4^{2-} , and NO_3^- , in soil sample.

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 8 SCIENTIFIC INQUIRY SKILLS	The students will be able to:		Let students:	
	2.7.6 explain how soil loses its fertility	Loss of soil fertility: Erosion, overgrazing, burning, over-cropping, leaching and surface compacting	Select a site of land in the locality and explore the factors that contribute to loss of soil fertility in the field.	Describe an experiment to determine the percentage water content of a soil sample.
	2.7.7 explain conservation, maintenance, renewal of soil fertility and soil reclamation.	Explanation of soil conservation, soil maintenance, renewal of soil fertility and soil reclamation.	Brainstorm to bring out the meaning of soil conservation, soil maintenance, renewal of soil fertility and soil reclamation.	Discuss four different ways by which soil loses its fertility.
	2.7.8 identify the methods of soil conservation, soil maintenance, renewal of soil fertility and soil reclamation.	Methods of soil conservation, maintenance, fertility renewal and reclamation.	Visit different land sites like farms, fields, plantations, etc and identify ways by which the soil can be conserved, maintained, renewed and reclaimed as the case may be.	Discuss four methods of maintaining soil fertility
	2.8.1 weigh soil samples on an electronic or chemical balance.	Measuring weight of different soil samples.	Weigh soil samples using electronic or chemical balance. Discuss their findings	
	2.8.2 Determining water content in soil samples.	Comparing the permeability and water – retaining abilities of clay, sand and loam.	Perform an experiment to compare the permeability and water-retaining abilities of types of soil in dried form. Read the volumes of water in the measuring cylinders and record the volumes. Discuss their observation.	
2.8.3 identify plants and animals by their adaptive features.	Adaptations of plants and animals to their habitat.	Collect different flora and fauna from different environments. Examine closely their observable features.		

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
<p>UNIT 8 (CONT'D)</p> <p>SCIENTIFIC INQUIRY SKILLS</p>	<p>The student will be able to:</p> <p>2.8.4 use dissecting instruments to cut open the gut of a small mammal for observation of its content.</p> <p>2.8.5 identify biological associations in an ecosystem.</p> <p>2.8.6 interpret biological data.</p> <p>2.8.7 present biological data in graphical form.</p> <p>2.8.8 report on succession of organisms on a plot of land or a concrete block.</p>	<p>Dissection of a small mammal. For example, rat, guinea pig, rabbit, mouse.</p> <p>Biological associations observable in an ecosystem.</p> <p>Interpreting biological data using studies from a terrestrial habitat.</p> <p>Presentation of biological data in graphical form.</p> <p>Studying succession on a plot of land or a concrete block.</p>	<p>Let Students</p> <p>Discuss their features and how they are used (plants and animals) to live successfully. Dissect the abdominal section of a small mammal. Draw in situ the structures observed and label fully.</p> <p>Empty the gut and examine it critically. and use what they observe to determine the trophic level.</p> <p>Go on a field trip to an abandoned farm land or forest.</p> <p>Name biological associations they observe. Discuss their observation.</p> <p>Select a habitat near the school. Use quadrats and other techniques to collect different organisms in the habitat. Record the names or assign labels to the organisms for identification. Interpret their observation of the numbers of organisms collected.</p> <p>Draw graphs from biological data</p> <p>Note: Teacher should provide enough data for students to handle.</p> <p>Observe a concrete block or a plot of land on an exposed wall for a period of time (6-12 months).</p> <p>Make recordings of the observation and report to the class. Discuss their findings</p>	

SENIOR HIGH SCHOOL - YEAR 2

SECTION 3: HUMANS AND THEIR ENVIRONMENT

General Objectives: The student will:

1. appreciate the values of natural resources for sustainable development.
2. appreciate the fact that not all natural resources are renewable, thus the need to conserve them.
3. understand the consequences of human interference in nature.
4. understand the fact that there are both harmful and useful microbes in the environment and that harmful microbes breed in unclean environment causing diseases, thus our surrounding must be kept clean constantly.
5. appreciate the need for proper planning of our communities for quality life
6. apply the basic first aid methods to save life
7. understand dangers posed by the abuse of drugs .

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 NATURAL RESOURCES	The student will be able to: 3.1.1 explain what Natural Resources are and give some examples of Natural Resources. 3.1.2 distinguish between renewable and Non-renewal Natural Resources. 3.1.3 explain the need for conserving Natural resources and identify the methods of their conservation.	Natural Resources: Note: Genetic resources should be included Renewable and Non-renewable Natural Resources. Importance of Natural resources. Methods of conserving Natural Resources	Let students Brainstorm to bring out the meaning and examples of natural resources. Visit forest reserves, games and wildlife parks, mines and water bodies. Classify all natural resources as renewable or non-renewable. Brainstorm to bring out the importance of named Natural Resources and suggest ways of conserving them. Note cultural practices like sacred groves, specific days for fishing, farming and hunting also contribute to conserving Natural Resources.	1. Explain the term Natural Resources and give Examples. . List the importance of any two natural resources and explain how such resources can be conserved.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 CONSEQUENCES OF HUMAN INTERFERENCE IN NATURE	The student will be able to:		Let students.	
	3.1.4 explain the ecosystem approach to Natural Resource Management.	Functional relationship and processes within ecosystems Enhanced benefit sharing for all stakeholders Adaptive management practices Management actions at the appropriate scale Inter-sectoral cooperation	Identify a degraded area close to the school, list the key stakeholders and suggest interventions that would reverse the degradation.	Explain the term Ecosystem approach
	3.2.1 identify human activities that bring about undesirable change in the natural environment.	Human activities and the environment	Brainstorm and cite examples of human activities that cause harm to the stable nature of their environment.	What four activities of humans could result in i) Air pollution ii) Water pollution
	3.2.2 explain the term pollution, causes and its effects on the environment.	Pollution: Causes and effects of pollution on the environment	Brainstorm to bring out the meaning of the term pollution. Note: In the definition words such as substances, energy, quantities released should be stressed.	
	3.2.3 discuss ways and means of controlling pollution.	Controlling pollution.	Note: Greenhouse effect and depletion of the ozone layer must be stressed. Visit the field to observe and discuss causes and effects of air, water, land, noise and thermal pollution.	Discuss any two means by which the following can be controlled. i) Eutrophication ii) Greenhouse effect
3.2.4 describe the Integrated Water Resources Management and explain how it can reduce undesirable change in the natural environment.	Integrated Water Resources Management(IWRM)	Identify the pollutants responsible for air, water, land and noise pollution, then discuss ways and means of controlling pollution. Discuss the IWRM approach to manage available water and prevent further contamination of water sources Note: water is a commodity with social, biological and economic dimensions. Discuss the various uses of water by different users and the consequent environmental impacts.	Describe two ways in which potable water can be contaminated. How can IWRM reduce the cost of water treatment?	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 HUMANS AND HARMFUL MICROBES	<p>The student will be able to:</p> <p>3.3.1 explain the term microbes and classify them.</p> <p>3.3.2 name some diseases caused by microbes.</p> <p>3.3.3. describe the mode of transmission, symptoms, control and prevention of some diseases caused by microbes.</p> <p>3.3.4 explain the terms immunization, vaccination and inoculation, and show how they are related.</p> <p>3.3.5 classify immunity.</p> <p>3.3.6 state the importance of immunization.</p>	<p>Microbes</p> <p>Classification of Microbes (useful and harmful).</p> <p>Diseases caused by microbes in plants and animals.</p> <p>Mode of transmission, symptoms, control and prevention of some diseases of people and other organism caused by bacteria, viruses, fungi.</p> <p>Immunization, vaccination Inoculation.</p> <p>Classification of immunity.</p> <p>Importance of immunization</p>	<p>Let students:</p> <p>Observe pictures of bacteria, viruses etc. from textbooks, internet, scientific magazines and journals.</p> <p>Observe permanent slides of microbes such as <i>Amoeba</i>, <i>Plasmodium</i> <i>Paramecium</i> and yeast cells</p> <p>Draw and label the organisms they observe.</p> <p>Invite resource persons e.g. health personnel to interact with students on diseases caused by microbes.</p> <p>Visit crop and livestock farms to identify diseases based on symptoms observed.</p> <p>Discuss their observations.</p> <p>Discuss mode of transmission, symptoms, control and prevention of the diseases mentioned under content. Note: In the control of malaria knowledge of the life cycle of vector (<i>Anopheles</i> mosquito) is required. Note. Examples should include, avian flu, CSM, the six childhood killer diseases, and potato blight .</p> <p>Brainstorm to bring out the meaning of Immunization, vaccination inoculation and show how they relate.</p> <p>Visit immunization centres and observe how immunization is carried out.</p> <p>Brainstorm to bring out the classes of immunity.</p> <p>Discuss the importance of immunization in the control and prevention of diseases</p>	<p>List five microbes and the diseases they cause in each of the following</p> <ul style="list-style-type: none"> i) humans ii) plants iii) Livestock <p>Describe how you would control malaria in your community.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 HEALTH AND HYGIENE.	<p>The students will be able to</p> <p>3.4.1 define the terms health, hygiene and sanitation.</p> <p>3.4.2 explain the need for observing personal hygiene.</p> <p>3.4.3 explain the term drug abuse and name the classes of drugs that are usually abused.</p> <p>3.4.4 state the dangers posed by drug abuse.</p> <p>3.4.5 explain the term First Aid.</p> <p>3.4.6 describe different methods of administering First Aid.</p>	<p>Health, hygiene and sanitation.</p> <p>Means of achieving personal cleanliness</p> <p>Drug abuse</p> <p>Consequences of drug abuse</p> <p>Note: The effect of alcoholism on pregnant mothers and the unborn child should be stressed.</p> <p>First Aid</p> <p>First Aid administration.</p>	<p>Let students:</p> <p>Brainstorm to bring put the meaning of Health, hygiene and sanitation.</p> <p>Brainstorm to bring out the meaning of personal hygiene.</p> <p>Discuss the need for proper care of the body and clothing.</p> <p>Discuss the meaning of drug abuse and brainstorm to bring out the classes of drugs that are usually abused.</p> <p>Invite a psychiatric to give a talk or visit a psychiatric hospital to observe the behaviour of patients and discuss some of the causes of the observed behaviour. Or observe pictures or charts showing effects of drugs abused by humans.</p> <p>Brainstorm to bring out some dangers associated with the use of hard drugs, smoking and alcoholism.</p> <p>Brainstorm to bring out the meaning of First Aid.</p> <p>Invite Red Cross personnel to demonstrate how First Aid is administered.</p> <p>Discuss their observations.</p> <p>Practise how to administer First Aid.</p>	<p>Distinguish between active and passive immunization?</p> <p>What do you understand by drug abuse? List the classes of drugs abused.</p> <p>What is the effect of drug abuse on humans?</p>
UNIT 5 SCIENTIFIC INQUIRY SKILLS	<p>3.5.1 communicate biological observation verbally with peers and other people.</p>	<p>Reporting on biological observations</p>	<p>Go on field trips to observe natural resources.</p> <p>Note: use natural settings such as: forest reserves, game reserves, mines, water bodies.</p> <p>Discuss in groups the importance of the natural resources they observed.</p> <p>Make group presentations to the class on their observations and the importance of the resources.</p>	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 5 SCIENTIFIC INQUIRY SKILLS (CONT'D)	<p>The students will be able to:</p> <p>3.5.2 demonstrate the skill of observing the causes and effects of pollution.</p> <p>3.5.3 draw a diagram of stages of production in a local industry.</p> <p>3.5.4 follow laboratory instruction to estimate the alcohol content of different alcoholic drinks.</p> <p>3.5.5 carry out biological investigation of the contents of cigarette smoke.</p>	<p>Types of pollution in the environment.</p> <p>Stages of local brewery production.</p> <p>Designing experiments</p> <p>Investigating contents of cigarette smoke Note . Each student should be encouraged to design his or her own investigation so no one investigation is correct provided the design works.</p>	<p>Let students:</p> <p>Visit different areas in their environment, observe and document the kinds of pollution in the area. Present a report on your visit.</p> <p>Discuss the effects of the kind of pollution they observed.</p> <p>Visit a local brewery. Document the processes of production. Draw a flow chat to show the stages of production.</p> <p>Use written out steps to design an experiment to estimate the alcohol content of drinks.</p> <p>Carry out the experiment to estimate the alcohol content of different drinks.</p> <p>Design packs of instructions that they will want to be used to carry out an experiment of their choice.</p> <p>Carry out biological investigation of the contents of cigarette smoke in groups Note: Materials suggested to be used: U-tube with vents on each stem of the tube, rubber tubing, glass tubes, rubber bungs (one big one with two holes, and two smaller ones without holes in them), water, cotton wool, six untipped sticks or cigarette, matches.</p> <p>Examine the cotton wool and the water and note their colour and smell.</p> <p>Discuss their observation.</p>	

SENIOR HIGH SCHOOL - YEAR 2

SECTION 4: MAMMALIAN ANATOMY AND PHYSIOLOGY

General Objectives: The student will:

1. appreciate the complex nature of mammalian life
2. understand the process by which mammals obtain and utilize materials for growth and survival.
3. understand how each organ relates to other organs for the normal functioning of the organism.
4. appreciate the need to take proper care of the parts of the body.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 DISSECTION OF A SMALL MAMMAL (NECK, CHEST AND ABDOMINAL REGIONS)	The student will be able to: 4.1.1 dissect a small mammal. 4.1.2 relate the structure of the internal organs to their functions.	The arrangement of internal organs of mammals. Functions of the internal organs.	Let students: Dissect a small mammal and display the internal organs in the neck, chest and abdominal regions. Identify by name and their location internal organs of a dissected mammal. Draw and label the internal organs both in situ and when displayed. Describe the structure of the internal organs and list their various functions.	List the abdominal organs viewed in situ when a small mammal (guinea pig) is dissected. Describe any five abdominal organs of a mammal and state their functions.
UNIT 2 NUTRITION	4.2.1 explain the concept <i>Nutrition</i> . 4.2.2 explain why living things need energy.	Nutrition. Why living things need energy.	Brainstorm to bring out the meaning of Nutrition, and types of nutrition (autotrophic and heterotrophic). Discuss some common examples of the use of energy in organisms. For example, synthesis of substances Active transport. Electrical transmission of nerve impulses, contraction of muscle. Maintenance of body temperature Bioluminescence, etc.	Distinguish between the different types of heterotrophic nutrition. Give reasons why organisms need energy.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) NUTRITION	<p>The student will be able to:</p> <p>4.2.3 outline the types of nutrients found in food.</p> <p>4.2.4 classify nutrients found in food.</p> <p>4.2.5 write the structural formulae of carbohydrates, proteins and lipids.</p> <p>4.2.6 state the importance of nutrients found in food.</p> <p>4.2.7 demonstrate the presence of various nutrients found in food.</p> <p>4.2.8 determine the dental formula of a Mammal.</p>	<p>Types of nutrients found in food: carbohydrates, proteins, lipids, vitamins and minerals.</p> <p>Classes of nutrients.</p> <p>Structural formulae of carbohydrates proteins and lipids.</p> <p>Importance of nutrients in food.</p> <p>Food test.</p> <p>Dental formula.</p>	<p>Let students:</p> <p>Discuss types of nutrients found in food.</p> <p>Discuss and classify nutrients found in food giving examples in each case.</p> <p>Draw the structural formulae of carbohydrates, proteins and lipids.</p> <p>Discuss the functions of each nutrient found in food.</p> <p>Note: Refer to Regenerative Health and Nutrition Training Manual pgs 17-20 for examples of common local foods and their nutritional values</p> <p>Carry out experiments to test for starch, sugars, lipids, proteins and vitamin C.</p> <p>Brainstorm to bring out the meaning of dental formula.</p> <p>Observe the skull and jaw bones of herbivores, carnivores and of humans and note the arrangements of teeth.</p> <p>Draw and label the various kinds of jaw bones and state their dental formulae.</p>	<p>State two characteristics each of:</p> <ul style="list-style-type: none"> • monosaccharides • disaccharides • polysaccharides • amino acids <p>How would you test for a reducing sugar in fruit juice?</p> <p>How is the structure of a named tooth related to its function?</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) NUTRITION	<p>The student will be able to:</p> <p>4.2.9 explain the importance of dental care in humans.</p> <p>4.2.10. explain the concept of balanced diet.</p> <p>4.2.11 explain the concept malnutrition.</p> <p>4.2.12 explain the concept enzymes.</p> <p>4.2.13 outline the characteristics of Enzymes and enzyme action.</p> <p>4.2.14 explain the factors that affect the rate of enzyme reaction</p>	<p>Dental care in humans.</p> <p>Balanced diet. Note: should include water</p> <p>Malnutrition.</p> <p>Enzymes.</p> <p>Mechanisms of enzyme action.</p> <p>Rate of Enzyme reactions.</p>	<p>Let students:</p> <p>Review dental care from SHS Integrated science. Syllabus page 14</p> <p>Discuss methods by which dental decay may be prevented or controlled.</p> <p>Discuss what makes a diet balanced and what factors make it vary from individual to individual.</p> <p>Brainstorm to bring out the meaning of malnutrition.</p> <p>Discuss the various forms of malnutrition and their effects on humans.</p> <p>Brainstorm to bring out the meaning of enzymes and how enzymes work.</p> <p>Carry out experiments to show enzyme action. Record and discuss the observation.</p> <p>Perform and discuss experiments on rate of enzymatic reactions.</p>	<p>Discuss three different ways by which dental health is maintained.</p> <p>Children of both affluent and poor parents may be obese. What are the likely reasons in each case.</p> <p>Describe the process of digestion in humans after taking a meal of boiled rice and meat stew and fresh orange as desert.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
<p>UNIT 2 (CONT'D)</p> <p>NUTRITION</p>	<p>The student will be able to:</p> <p>4.2.15 describe the process of digestion.</p> <p>4.2.16 explain how the structure of the villus facilitates the absorption of digested food.</p> <p>4.2.17 describe the structure of the Liver.</p> <p>4.2.18 state the functions of the liver.</p>	<p>Digestion of food.</p> <p>Note: Mention should be made of hormones that affect enzymes.</p> <p>Structure of the villus.</p> <p>Structure of the liver of a mammal.</p> <p>Functions of the liver.</p>	<p>Let students:</p> <p>Review structure of parts of the alimentary canal and its associated glands and organs from SHS 1 Integrated Science syllabus S.R.N 3.5.3</p> <p>Review structure in relation to function.</p> <p>Examine the T.S of different parts of the alimentary canal of a mammal. Draw and label.</p> <p>Observe permanent slides of the generalized plan of the gut structure as seen in transverse section. Draw and label. Relate the structure of each part to its function.</p> <p>Discuss enzymatic reactions taking place in each part of the alimentary canal.</p> <p>Observe the internal structure of the villus on prepared slides. Draw and label.</p> <p>Discuss how the villus is adapted to the absorption of food.</p> <p>Observe the structure of the liver of a mammal</p> <p>Observe prepared slides of T.S. of the internal structure of the liver. Draw and label</p> <p>Describe structure of the liver in relation to its functions</p>	<p>Describe the peristaltic movement of the gut.</p> <p>What would happen to the activity of the intestinal enzyme if the pH in the small intestine is 2?</p> <p>Describe how the small intestine is adapted for absorption of nutrients in food?</p> <p>Identify FOUR functions of the liver that involves protein metabolism.</p> <p>What is the role of phagocytic cells in the liver?</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 TRANSPORT	<p>The student will be able to:</p> <p>4.3.1 explain the concept “Transport” and its need in mammals.</p> <p>4.3.2 describe the structure of the mammalian heart.</p> <p>4.3.3 explain the mechanism of heart excitation and contractions.</p> <p>4.3.4 describe the structure of blood vessels.</p> <p>4.3.5 describe the composition of blood</p>	<p>Transport in mammals</p> <ul style="list-style-type: none"> - surface area/volume ratio - substances have to move greater distances. <p>Structure of the mammalian heart.</p> <p>Mechanism of heart beat: myogenic stimulation of the heart include (SAN), (AVN), Purkinje tissue.</p> <p>Structure of blood vessels.</p> <p>Composition of blood.</p>	<p>Let students:</p> <p>Discuss the need for transport in mammals.</p> <p>Examine, draw and label the mammalian heart showing its internal and external features and its associated blood vessels.</p> <p>Discuss the structure in relation to its functions.</p> <p>Discuss the generation and transmission of heart-beat.</p> <p>Examine, draw and label the T.S. of artery, vein and capillary.</p> <p>Discuss the structure of each type of blood vessel in relation to its functions.</p> <p>Carry out activities to find out the composition of blood</p> <p>Discuss their findings</p> <p>Discuss the role played by each component of blood.</p> <p>Examine a mammalian blood smear under the microscope.</p> <p>Identify and draw the different types of blood cells.</p> <p>Discuss the structure of each type of blood cell in relation to its function.</p>	<p>Give two reasons for which blood transport system is necessary in mammals.</p> <p>Describe how the structure of the mammalian heart is related to its functions.</p> <p>Compare the structure of an artery, vein and capillary.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 (CONT'D) TRANSPORT	The student will be able to: 4.3.6 state the functions of blood. 4.3.7 describe circulation of blood of a mammal 4.3.8 explain the formation of lymph. 4.3.9 outline the functions of lymph.	Functions of blood. Circulatory system Formation of lymph. NOTE: discussion should show the relationship between blood, tissue fluid(intercellular fluid) and lymph Functions of lymph.	Let students: Discuss the functions of blood. Examine the circulatory system of a dissected mammal. Draw and label the circulatory system Observe capillary circulation in the tail of a live tadpole Discuss how blood circulates in the body of a mammal. Discuss how lymph is formed in the body of humans. Discuss the functions of lymph.	What is the significance of double circulation in mammals? Tabulate five differences between blood and lymph.
UNIT 4 RESPIRATION	4.4.1 explain the concept respiration. 4.4.2 explain the concept of gaseous exchange. 4.4.3 describe the respiratory system of mammals (humans) 4.4.4 outline the breathing mechanism in humans.	Respiration. Gaseous exchange. Note: "Gaseous exchange" is also known as breathing in mammals. The mammalian respiratory system. Mechanism of breathing.	Brainstorm to bring out the meaning of respiration. Brainstorm to bring out the meaning of gaseous exchange. Observe a dissected mammal, draw and label the respiratory system. Discuss how the structure relates to the functions of the various parts. Use models or charts to discuss the mechanism of breathing. Carry out activities to demonstrate the mechanism of breathing.	Trace the path of air from the atmosphere to the alveolus. In what ways does lung structure facilitate gaseous exchange? Write a chemical equation for the reaction between pyruvic acid and NADH ₂

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 (CONT'D) RESPIRATION	<p>The student will be able to:</p> <p>4.4.5 cellular respiration.</p> <p>4.3.6 state the functions of blood.</p> <p>4.3.7 describe circulation of blood of a mammal</p> <p>4.3.8 explain the formation of lymph.</p> <p>4.3.9 outline the functions of lymph.</p>	<p>Cellular or tissue respiration</p> <p>Glycolysis: Note: The fate of Pyruvic acid in the presence or absence of oxygen must be discussed. Cellular or tissue respiration.</p> <p>Kreb's cycle: Note: Discussion should include the generation of energy in the form of ATP.</p> <p>Respiratory quotient $RQ = \frac{\text{Moles of } CO_2 \text{ Produced}}{\text{Moles of } O_2 \text{ Absorbed}}$</p>	<p>Discuss the process of respiration and write the chemical equation for respiration. Discuss the breakdown of glucose to pyruvic acid or pyruvate.</p> <p>Discuss the chemical process of the Kreb's cycle</p> <p>Calculate RQ values for different substrates.</p>	<p>Summarize the chemical process that occurs in the Kreb's Cycle.</p> <p>What is the significance of the knowledge of RQ?</p> <p>Explain why the usual RQ of humans is between 0.7 and 1.0</p> <p>What is the RQ when glucose is respired anaerobically to ethanol and Carbon (IV) Oxide</p> <p>Write a chemical equation for the reaction between pyruvic acid and NADH₂</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
<p>UNIT 5</p> <p>EXCRETION</p>	<p>The student will be able to:</p> <p>4.5.1 explain excretion and identify organs of the mammalian excretory system.</p> <p>4.5.2 describe the structure of mammalian kidney, skin and lungs.</p> <p>4.5.3 describe the formation and elimination of excretory products by kidney, skin, lungs and liver</p> <p>4.5.4 explain the term homeostasis and outline the role of lungs, skin, liver and the kidney in homeostasis.</p>	<p>Excretory system</p> <p>The structure of mammalian kidney, skin and lungs.</p> <p>Formation and elimination of excretory products.</p> <p>Homeostasis.</p>	<p>Let students:</p> <p>Revise the meaning of excretion and organs of the mammalian excretory system from the SHS 1 UNIT 5 integrated science syllabus S.R.N. NOTE: mention should be made of the liver as an excretory organ</p> <p>Examine models and drawings or charts of kidney, skin and lung of a mammal</p> <p>Draw models or charts showing sections of the excretory organs.</p> <p>Observe slides of the kidney, skin and lungs and discuss their structure in relation to their functions.</p> <p>Discuss the formation and elimination of excretory products by the excretory organs.</p> <p>Brainstorm to bring out the meaning of homeostasis.</p> <p>Discuss the role of the skin, kidney and liver in homeostasis.</p>	<p>List the component parts of.</p> <ol style="list-style-type: none"> i. Mammalian kidney ii. Mammalian Lungs and iii. Mammalian skin <p>How is urine formed?</p> <p>Enumerate the functions of</p> <ol style="list-style-type: none"> i. Mammalian kidney ii. Mammalian skin iii. Mammalian lungs <p>Describe the role of the kidney, skin and liver in homeostasis.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 6 MOVEMENT	<p>The student will be able to:</p> <p>4.6.1 explain the concept skeleton and mention the types of skeleton.</p> <p>4.6.2 describe the general plan of the mammalian skeleton.</p> <p>4.6.3 describe the structure of skeletal tissues.</p>	<p>Concept of skeleton: Types of skeleton (Endoskeleton, Exoskeleton and Hydrostatic skeleton).</p> <p>General plan of the mammalian Skeleton. (Axial Skeleton and Appendicular Skeleton).</p> <p>Skeletal tissues (Bone and cartilage).</p>	<p>Let students:</p> <p>Brainstorm to bring out the meaning of skeleton.</p> <p>Discuss the types of skeleton in animals.</p> <p>Examine a model of the skeleton of a mammal (human, rabbit etc).</p> <p>Identify the components of the axial and appendicular skeletons.</p> <p>Discuss the general plan of the mammalian skeleton.</p> <p>Describe the structure of bone and cartilage.</p> <p>Examine a T.S of a compact bone under a microscope and discuss the structure.</p> <p>Draw the internal structure (T.S) of the bone.</p>	<p>Distinguish among the three types of skeleton.</p> <p>Name the bones that constitute the</p> <ol style="list-style-type: none"> i. axial skeleton and ii. Appendicular skeleton <p>Explain any three advantages the endoskeleton has over the exoskeleton.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 6 (CONT'D) MOVEMENT	<p>The student will be able to:</p> <p>4.6.4 identify the different vertebrae in the vertebral column</p> <p>4.6.5 describe the structure of the rib cage</p> <p>4.6.6 identify the limb bones and their girdles</p> <p>4.6.7 outline the functions of the mammalian skeleton</p> <p>4.6.8 define the term joint and identify the different types of joints</p>	<p>Structure and function of the vertebral column:</p> <p>Structure of the rib cage</p> <p>Limb bones and their girdles</p> <p>Functions of the mammalian skeleton</p> <p>Types of joints: (Movable, slightly movable and immovable)</p>	<p>Let students:</p> <p>Examine the vertebral column of a mammal</p> <p>Identify the various vertebrae by virtue of their location i.e. Neck region = cervical, Chest region = thoracic, etc.</p> <p>Discuss the structure of the various vertebrae, in relation to their functions</p> <p>Draw and label the different vertebrae</p> <p>Examine the rib cage of a mammal. Identify the various bones that form the rib cage</p> <p>Examine the bones of the limbs and their girdles.</p> <p>Discuss the structure of the bones of the limbs and their girdles, in relation to their function.</p> <p>Draw and label the long bones of the limbs and their girdles</p> <p>Discuss the functions of the mammalian skeleton</p> <p>Brainstorm to bring out the definition of joint</p> <p>Examine the different types of joints Discuss the structure of the different types of joints in relation to their functions</p> <p>Draw and label the different types of joints.</p>	<p>How will you distinguish among the various types of vertebrae?</p> <p>Name the parts of the rib cage that are made of cartilage</p> <p>What advantage do mammals have in possessing a flexible connection between the pectoral girdle and the vertebral column</p> <p>State four major functions of the skeleton</p> <p>Describe the characteristic features of a moveable joint</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 6 (CONT'D) MOVEMENT	<p>The student will be able to:</p> <p>4.6.9 identify the types of muscles.</p> <p>4.6.10 explain the sliding-filament model of muscle contraction.</p> <p>4.6.11 describe how muscles bring about movement.</p>	<p>Types of muscles (Smooth, striated and cardiac muscles).</p> <p>The sliding-filament model of muscle contraction.</p> <p>Movement of muscles.</p>	<p>Let students:</p> <p>Examine slides of muscles under a microscope.</p> <p>Identify the different types of muscles under the microscope and draw them.</p> <p>Examine the structure of skeletal muscle (Model or diagram).</p> <p>Discuss the sliding-filament model of muscle contraction.</p> <p>Carry out activities to demonstrate how muscles act on bones to bring about movement.e.g. bending and straightening of the arm.</p>	<p>What happens to the length of the A-band as the sarcomere contracts?</p> <p>Describe the action of any two antagonistic muscles.</p>
UNIT 7 REPRODUCTION	<p>4.7.1 explain the term reproduction.</p> <p>4.7.2 describe the mammalian reproductive system.</p>	<p>Reproduction in mammals.</p> <p>Reproductive system of the male and female mammal.</p>	<p>Brainstorm to bring out the meaning of the term reproduction.</p> <p>Use charts, diagrams, pictures or models to identify the parts of the male and female reproductive systems.</p> <p>Dissect a small male and female mammal to show the urino-genital system.</p> <p>Describe the structure of the male and female reproductive systems, in relation to their functions.</p> <p>Compare the male and female reproductive systems.</p>	<p>In what ways are the male and female reproductive systems similar to and different from each other?</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 7 (CONT'D) REPRODUCTION	<p>The student will be able to:</p> <p>4.7.3 describe the internal structure of the testis and ovary.</p> <p>4.7.4 outline the process of gamete formation.</p> <p>4.7.5 describe fertilization, development of the embryo and birth.</p> <p>4.7.6 outline the secondary sexual characteristics in male and female human beings.</p> <p>4.7.7 explain the different birth control methods.</p> <p>4.7.8 explain prenatal(antenatal) care</p>	<p>Internal structure of the testis and ovary.</p> <p>Gametogenesis.</p> <p>Fertilization, development of the embryo and birth.</p> <p>Secondary sexual characteristics.</p> <p>Birth control.</p> <p>Meaning of antenatal care. Antenatal visits requirements Nutrition and diet Exercise during pregnancy Benefits for the use of natural products by the mother and child</p>	<p>Let students:</p> <p>Examine slides of sections of testis and ovary under a microscope.</p> <p>Compare the slides to diagrams or pictures of sections of the testis and ovary.</p> <p>Discuss the internal structure of testis and ovary in relation to their function.</p> <p>Draw and label the sections of the testis and ovary.</p> <p>Discuss the processes of spermatogenesis and oogenesis.</p> <p>Examine slides of sperm and ovum under a microscope and discuss their function in relation to their structure.</p> <p>Discuss the processes involved in fertilization, development of the embryo and birth.</p> <p>Discuss the changes (physical) that occur in males and females during puberty. Discuss the role of hormones in the development of secondary sexual characteristics.</p> <p>Explain what birth control is and discuss the methods of birth control in humans.</p> <p>Discuss the different birth control methods. Invite a midwife to give a talk on the role of antenatal care during pregnancy and stress the importance of using natural products. Reference: regenerative health Training Manual pg.34, 101</p>	<p>In what important way is the structure of the ovum similar to that of the sperm?</p> <p>Summarize the important differences between the sperm and the ovum.</p> <p>Compare spermatogenesis and oogenesis.</p> <p>Describe the processes involved when a potent sperm meets a potent ovum until a baby is born.</p> <p>Distinguish between primary and secondary sexual characteristics.</p> <p>Compare secondary sexual characteristics of males and females.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 8 CONTROL AND CO-ORDINATION	<p>The student will be able to:</p> <p>4.8.1 explain control and co-ordination of body activities.</p> <p>4.8.2 describe the general plan of the nervous system.</p> <p>4.8.3 identify the parts of the brain and state their functions.</p> <p>4.8.4 identify the spinal cord and its parts.</p> <p>4.8.5 describe the structure of the neurone.</p>	<p>Control and co-ordination.</p> <p>The nervous system (Central nervous system and peripheral nervous system). NOTE: peripheral nervous system should include spinal nerves and cranial nerves</p> <p>Parts of the brain and their functions:</p> <p>Parts of the spinal cord</p> <p>Structure of neurone. NOTE: sensory neurone, relay neurone and motor neurone</p>	<p>Let students:</p> <p>Brainstorm to bring out the meaning of control and co-ordination.</p> <p>Observe and discuss models or charts of the nervous system.</p> <p>Identify the various parts of the nervous system.</p> <p>Use a model or chart to locate the position of the brain and how it is protected.</p> <p>Identify the various parts of the brain and discuss their functions.</p> <p>Draw the brain and label the various parts.</p> <p>Examine slides of the spinal cord under a microscope.</p> <p>Identify the various regions and draw and label.</p> <p>Describe the functions of the spinal cord.</p> <p>Examine slides, charts or diagrams of neurones. Draw and label a neurone.</p> <p>Discuss the structure of a neurone in relation to its function.</p>	<p>What is the basic unit of the nervous system?</p> <p>State two different functions each of the cerebrum, cerebellum and the medulla oblongata.</p> <p>Draw T.S. of the spinal cord to show the parts.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 8 (CONT'D) CONTROL AND CO-ORDINATION	<p>The student will be able to:</p> <p>4.8.6 classify neurones.</p> <p>4.8.7 describe the generation and transmission of nerve impulses.</p> <p>4.8.8 distinguish between voluntary and involuntary actions.</p> <p>4.8.9 describe the reflex arc and reflex action.</p> <p>4.8.10 explain the organization of the autonomic nervous system and its function.</p>	<p>Classification of neurones.</p> <p>Generation and transmission of nerve impulses:</p> <p>Voluntary and Involuntary actions.</p> <p>Reflex arc and reflex action.</p> <p>Autonomic nervous system:</p>	<p>Let students:</p> <p>Use charts/drawings to identify different types of neurones.</p> <p>Draw the types of neurones and discuss their functions.</p> <p>Discuss the generation and transmission of impulses. Note: The study should include generator region, generator potential, threshold value, action potential and resting potential. Carry out activities to demonstrate the reception of stimulus. Discuss their findings.</p> <p>Brainstorm to bring out the meaning of voluntary and involuntary actions. Carry out experiments to demonstrate voluntary and involuntary actions. Discuss their findings and distinguish between voluntary and involuntary actions.</p> <p>Examine, discuss and draw charts or pictures of reflex arc. Discuss the process of a reflex action.</p> <p>Discuss the organization of the autonomic nervous system.</p> <p>Discuss the functions of the autonomic nervous system.</p> <p>Brainstorm to bring out the importance of the autonomic nervous system.</p>	<p>Differentiate among the three types of neurons.</p> <p>What role does the Golgi Apparatus and Mitochondria play in the synaptic knobs of neurones?</p> <p>Describe the various steps involved in the transmission of impulses.</p> <p>Describe the reflex arc and give three different examples of reflex action.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
<p>UNIT 8 (CONT'D)</p> <p>CONTROL AND CO-ORDINATION</p>	<p>The student will be able to:</p> <p>4.8.11 describe the structure and the functions of the ear and the eye of a mammal.</p> <p>4.8.12 describe the eye defects and their corrections.</p> <p>4.8.13 describe the endocrine system.</p> <p>4.8.14 explain the effects of over-secretion or under-secretion of hormones by the endocrine glands.</p>	<p>Structure and functions of the ear and the eye of a mammal.</p> <p>Common eye defects and their correction.</p> <p>The endocrine system.</p> <p>Effects of over-secretion or under-secretion of hormones by the endocrine glands.</p>	<p>Let students:</p> <p>Observe models or diagrams/charts of the ear and the eye.</p> <p>Identify the various parts.</p> <p>Discuss the structure of the eye and ear, in relation to their functions.</p> <p>Draw and label the eye and the ear of a mammal.</p> <p>Discuss the eye defects and their corrections NOTE: myopia, hypermetropia, presbyopia and astigmatism.</p> <p>Identify the organs that constitute the endocrine system.</p> <p>Name the hormones produced by each endocrine organ.</p> <p>Discuss the target organs and the effects of the hormones.</p> <p>Discuss the effects of over-secretion or under-secretion of each of the hormones.</p>	<p>What is the principal function of the lens of the eye?</p> <p>Where does the greatest degree of refraction of light occur in the eye and why?</p> <p>What is the difference between the pitch and intensity of sound? How does the cochlea differentiate between the pitch and intensity of sound?</p> <p>Explain how convex and concave lenses correct eye defects.</p>
<p>UNIT 9</p> <p>SCIENTIFIC INQUIRY SKILLS</p>	<p>4.9.1 dissect a small mammal (neck and chest regions) and draw the internal organs seen.</p>	<p>Dissection of a small mammal</p>	<p>Cut open a chloroformed mammal (guinea pig, rat, mouse or rabbit) Draw the internal organs as they are arranged naturally.</p>	<p>What is the difference between an endocrine and exocrine gland? Give two examples each of endocrine and exocrine glands.</p> <p>In what ways is the pancreas an exocrine gland as well as endocrine gland?</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
<p>UNIT 9 (CONT'D)</p> <p>SCIENTIFIC INQUIRY SKILLS</p>	<p>The student will be able to:</p> <p>4.9.2 plan and design experiment to determine the nutrients in a meal.</p> <p>4.9.3 plan physiological experiment.</p> <p>4.9.4 observe the movement of blood in blood vessels.</p>	<p>Food Test.</p> <p>Planning physiological experiment Note: use starch and the enzyme amylase.</p> <p>Movement of blood in blood vessels of a tadpole of toad or frog.</p>	<p>Let students:</p> <p>Plan how they will identify the food nutrients in a given meal.</p> <p>Design how they will carry out the experiment.</p> <p>Carry out the experiment to test for food nutrients in a sample of meal served in their school dinning hall.</p> <p>Discuss the nutritional value of the meal they have used.</p> <p>Discuss the plan they will use to carry out experiment to show that amylase acts on starch.</p> <p>Carry out their plan to show how amylase acts on starch.</p> <p>Discuss their observation. Note: Time should be apportioned well and other things could be done while waiting for a time lapse for a reaction to proceed.</p> <p>Carry out experiment to observe the movement of blood in the blood vessels of a tadpole of toad or a frog. Note: Use audio visual to explain circulatory systems and other delicate experiments. Discuss their observation.</p>	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
<p>UNIT 9 (CONT'D)</p> <p>SCIENTIFIC INQUIRY SKILLS</p>	<p>The student will be able to:</p> <p>4.9.5 identify types of vertebrae.</p> <p>4.9.6 manipulate the microscope to view details of minute structures.</p> <p>4.9.7 draw conclusions from observations.</p>	<p>Vertebral column.</p> <p>Structure of the testis, ovary and sperm of a mammal</p> <p>Drawing of conclusions from data Note: use the experiment showing the effect of thyroxine on the development of tadpoles.</p>	<p>Let students:</p> <p>Observe vertebra from different regions of the vertebral column.</p> <p>Record the structures or features of each vertebra.</p> <p>Use the features to identify vertebrae from other mammals.</p> <p>Mount prepared slides of the testis, ovary and sperm.</p> <p>Observe the structure of the testis, ovary and sperm.</p> <p>Carry out the experiment showing the effect of thyroxine on the development of tadpoles.</p> <p>Note: this experiment will take at least 8 days.</p> <p>Record their observation of changes in development of the following structures Hind limbs fore limbs; eyes; and tails draw conclusions of their observations.</p>	

SENIOR HIGH SCHOOL - YEAR 3

SECTION 1: PLANT STRUCTURE AND PHYSIOLOGY

General objectives: the student will:

1. relate the structure of plant parts to their functions
2. appreciate the interdependence of plants and animals.
3. recognize the ecological significance of plants, as oxygen producers and carbon dioxide 'sinks'
4. recognize that special structures of plants are linked to their functions.
5. understand how materials are transported in plants .
6. appreciate the need for gaseous exchange in plants.
7. recognize the need for the elimination of waste products of metabolism in plants.
8. appreciate how plants perpetuate their species.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 MORPHOLOGY OF MONOCOTYLEDONOUS AND DICOTYLEDONOUS PLANTS	<p>The student will be able to:</p> <p>1.1.1 describe the external features of monocotyledonous and dicotyledonous plants.</p> <p>1.1.2 outline the functions of roots, stems and leaves of plants.</p> <p>1.1.3 distinguish between monocotyledonous and dicotyledonous plants.</p> <p>1.1.4 identify modified roots, stems and leaves of plants and their functions.</p>	<p>External features of monocotyledonous and dicotyledonous plants.</p> <p>Functions of roots, stems and leaves of monocotyledonous and dicotyledonous plants.</p> <p>Differences between monocotyledonous and dicotyledonous plants.</p> <p>Modified roots, stems and leaves:</p>	<p>Let students:</p> <p>Collect samples of monocotyledonous and dicotyledonous plants.</p> <p>Examine and discuss the external features of a monocotyledonous and a dicotyledonous plant. Draw the plants, and label their external features.</p> <p>Brainstorm to bring out the functions of roots, stems and leaves of monocotyledonous and dicotyledonous plants.</p> <p>Relate the structure to functions of roots, stems and leaves of monocotyledonous and dicotyledonous plants.</p> <p>Discuss the differences between monocotyledonous and dicotyledonous plants.</p> <p>Collect and examine different plants showing different modifications of their roots, stems and leaves. Describe and draw the modified structures.</p> <p>Discuss the modified structures, in relation to their functions.</p>	<p>Using the external features only distinguish between monocotyledonous and dicotyledonous plants.</p> <p>Describe two each of modified roots, stems and leaves and discuss how the modification adapts the plant to its environment.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 INTERNAL STRUCTURE OF ROOTS, STEMS AND LEAVES.	<p>The student will be able to:</p> <p>1.2.1 describe the internal structure of root, stem and leaf.</p> <p>1.2.2 distinguish between the different types of tissues of the root, stem and leaf.</p> <p>1.2.3 relate the structure of the types of cells to their functions.</p> <p>1.2.4 compare T.S. of root and stem of monocotyledonous and dicotyledonous plants.</p>	<p>Internal structure of root, stem and leaf.</p> <p>Tissues of the root, stem and leaf. Note: Tissues as seen in T.S. and L. S. should be observed.</p> <p>Functions of cells in plant tissues.</p> <p>Comparison of the internal structure of stem and root of monocotyledonous and dicotyledonous plants.</p>	<p>Let students:</p> <p>Collect and cut T.S of root, stem and leaf of young monocotyledonous and dicotyledonous plants.</p> <p>Examine the sections under a microscope.</p> <p>Discuss the internal structure of the root, stem and leaf.</p> <p>Draw and label T.S of the root, stem and leaf.</p> <p>Identify the different tissues in both T.S. and L.S of roots, stems and leaves.</p> <p>Discuss the structure of the cells that make up the various tissues.</p> <p>Describe the types of cells as seen in the T.S. and L.S. of root, stem and leaf.</p> <p>Discuss the structure of each type of cell in relation to their functions.</p> <p>Examine the T.S of root and stem of monocotyledonous and dicotyledonous plants.</p> <p>Compare the T.S of the root and stem of a monocotyledonous and a dicotyledonous plant.</p>	<p>Draw tissue maps of T.S. of root, stem and leaf of young monocotyledonous and dicotyledonous plants</p> <p>Describe the composition or structure of the following tissues:</p> <ol style="list-style-type: none"> i. Cortex ii. Epidermis iii. Cambium <p>Compare the internal structure of the root, stem and leaf of monocotyledonous and dicotyledonous plants.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 GROWTH AND DEVELOPMENT OF PLANTS	<p>The student will be able to:</p> <p>1.3.1 explain the concept of growth and development.</p> <p>1.3.2 measure growth in seedlings.</p> <p>1.3.3 explain primary and secondary growth in plants.</p> <p>1.3.4 distinguish between primary and secondary growth.</p>	<p>Growth and development.</p> <p>Measurement of growth in plants Note: Indicators of growth in seedlings: length of shoot, length of root, length/breadth of leaf.</p> <p>Primary and secondary growth in plants.</p> <p>Comparing primary and secondary growth.</p>	<p>Let students:</p> <p>Brainstorm to bring out the explanation of the concept growth and development.</p> <p>Grow a number of seedlings and measure their growth over a period of time.</p> <p>Record and discuss the data collected.</p> <p>Plot the data collected on a graph.</p> <p>Discuss primary and secondary growth in plants.</p> <p>Examine slides of T.S. of shoots and roots showing primary and secondary growth.</p> <p>Discuss the processes that bring about or result in primary and secondary growth in plants.</p> <p>Examine sections of stems and roots showing different stages of primary and secondary growth.</p> <p>Brainstorm to bring out the differences between primary and secondary growth in plants.</p>	<p>Explain the concept of growth and development.</p> <p>Outline the processes that result in primary and secondary growth in plants.</p> <p>Compare primary and secondary growth in plants.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
<p>UNIT 3 (CONT'D)</p> <p>GROWTH AND DEVELOPMENT OF PLANTS</p>	<p>The student will be able to:</p> <p>1.3.5 explain what auxins are.</p> <p>1.3.6 describe the role of auxins in root and stem elongation.</p> <p>1.3.7 distinguish among tropic movements, nastic movements and tactic movements.</p>	<p>Auxins.</p> <p>Role of auxins in stem and root elongation.</p> <p>Tropic, nastic and tactic movements of plants.</p>	<p>Let students</p> <p>Brainstorm to bring out what auxins are.</p> <p>Examine slides or charts of L.S of root and shoot tips.</p> <p>Identify the various regions of the root and shoot tips.</p> <p>Draw and label the various regions.</p> <p>Carry out experiments to show the regions of fastest growth in roots and shoots of plants.</p> <p>Carry out experiments to demonstrate the effects of auxins on shoots and roots of plants.</p> <p>Brainstorm to bring out the meanings of tropic, nastic and tactic movements.</p> <p>Discuss the mechanisms involved in these plant movements.</p> <p>Identify tropic, nastic and tactic movements in plants.</p> <p>Discuss the differences between tropic, nastic and tactic movements Note: other movements such as stomatal movements should be mentioned.</p>	<p>Describe the role of auxins in roots and stem elongation</p> <p>Describe an experiment to demonstrate the effect of auxins on the elongation of shoot tips of a named seedling.</p> <p>Explain the significance of the tropic, nastic and tactic movements to plants.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 (CONT'D) GROWTH AND DEVELOPMENT	The student will be able to: 1.3.8 explain the mechanisms of the types of tropisms.	Mechanisms of tropic movements.	Let students: Discuss the different types of tropic movements. Discuss the role of IAA in the different tropic movements.	Explain the mechanism of geotropism and phototropism.
UNIT 4 PHOTOSYNTHESIS AND MINERAL NUTRITION	1.4.1 describe the process of photosynthesis. 1.4.2 describe the structural adaptation of the leaf for photosynthesis. 1.4.3 explain the conditions that affect the rate of photosynthesis. 1.4.4 explain the biochemical nature of photosynthesis.	The process of photosynthesis. Adaptations of the leaf for photosynthesis. Factors that affect the rate of photosynthesis: Note the following factors: Light intensity, temperature and carbon (IV) oxide concentration, chlorophyll. concentration, specific inhibitors, water and pollution. Biochemical nature of photosynthesis.	Revise the process of photosynthesis from the SHS integrated science syllabus p.19. Note: Revision should include definition and conditions necessary for photosynthesis as well as experiments on these conditions. Examine T.S of a leaf under a microscope. Examine a model or diagram showing the T.S of a leaf. Discuss the structural adaptations of the leaf for photosynthesis. Carry out experiments to show the effects of the factors that affect the rate of photosynthesis. Record and discuss the findings of the experiments. Discuss the light-dependent and light-independent stages of photosynthesis.	Explain the process of photosynthesis. Explain how a leaf is adapted to carrying out photosynthesis. Describe the biochemical nature of photosynthesis.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 (CONT'D) PHOTOSYNTHESIS AND MINERAL NUTRITION	<p>The student will be able to:</p> <p>1.4.5 explain the fate of the products of photosynthesis.</p> <p>1.4.6 state the effects of the macro-nutrients and micronutrients needed by plants.</p>	<p>Fate of the products of photosynthesis. Account should be given of the following:</p> <ol style="list-style-type: none"> (1) Transport of sugars and storage of starch (2) Respiration of sugar (3) Synthesis of lipids <p>Macronutrients: Nitrate (NO_3^-), sulphate (SO_4^{2-}), phosphate, (PO_4^{3-}), potassium ion(K^+), calcium ion (Ca^{2+}), iron (II) ion.(Fe^{2+}).</p> <p>Micronutrients: Manganese, (Mn^{2+}), zinc (Zn^{2+}), copper, (Cu^{2+}) molybdenum, (Mo^{3+}), Boron as Borate (BO_3^{3-} or $B_4O_7^{2-}$) chlorine (Cl^-).</p>	<p>Brainstorm to bring out what happens to the glucose produced during photosynthesis.</p> <p>Discuss how other substances are synthesized from glucose.</p> <p>Brainstorm to bring out the mineral elements needed by plants.</p> <p>Discuss macro and micronutrients.</p> <p>Investigate the effects of the minerals on plants by using water culture (hydroponics).</p> <p>Discuss the findings and list the ion or mineral deficiency symptoms of plants.</p>	<p>List the importance of the following macro and micronutrients in plants:</p> <ol style="list-style-type: none"> i. NO_3^- ii. SO_4^{2-} iii. Cu^{2+} iv. Cl^-

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
<p>UNIT 5</p> <p>GASEOUS EXCHANGE</p>	<p>The student will be able to:</p> <p>1.5.1 explain the term gaseous exchange in terms of concentration gradient.</p> <p>1.5.2 identify the structures of plants involved in gaseous exchange.</p> <p>1.5.3 demonstrate that plants respire.</p> <p>1.5.4 compare aerobic and anaerobic respiration .</p>	<p>Gaseous exchange.</p> <p>Structures of plants involved in gaseous exchange i.e. stomata, lenticels.</p> <p>Aerobic respiration: The equation for it should be explained $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + Heat$ Energy.</p> <p>Anaerobic respiration: The equation for it should be explained $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2 + Heat$ Energy.</p> <p>Comparing aerobic and anaerobic respiration in plants.</p>	<p>Let students:</p> <p>Brainstorm to bring out the meaning of gaseous exchange.</p> <p>Draw and label the structures involved in gaseous exchange.</p> <p>Discuss how the structures involved in gaseous exchange function.</p> <p>Carry out experiments to show that aerobic respiration releases carbon (IV) oxide/water vapour/heat energy.</p> <p>Record and discuss their findings.</p> <p>Carry out experiments to show that anaerobic respiration releases carbon (IV) oxide/alcohol/Heat Energy.</p> <ul style="list-style-type: none"> - Record and discuss their findings - Draw a table to compare aerobic and anaerobic respiration. 	<p>Using the idea of concentration gradient, explain how gases enter and leave plants.</p> <p>Explain how gaseous exchange occurs through:</p> <ol style="list-style-type: none"> i. the stomata ii. the lenticel <p>Describe an experiment to show that plants respire aerobically.</p> <p>Discuss the differences between aerobic and anaerobic respiration.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
<p>UNIT 6 TRANSPORT</p>	<p>The student will be able to:</p> <p>1.6.1 describe the process of uptake and movement of water and mineral salts in plants.</p> <p>1.6.2 explain the concept of translocation.</p> <p>1.6.3 demonstrate that transport of synthesized organic nutrients occurs through the phloem.</p>	<p>Water and mineral salts uptake from the soil into the plant.</p> <p>Movement of water and mineral salts through the plant.</p> <p>Movement of organic materials from sugar sources (leaves) to sugar stores (roots)</p> <p>Note: Mention should be made of the need for translocation of synthesized food to storage organs and actively growing regions.</p> <p>Translocation of synthesized organic nutrients.</p>	<p>Let student :</p> <p>Observe two potted plants one with moist soil and the other with dry soil.</p> <p>Note: Observation should begin one week before this lesson.</p> <p>Brainstorm on the causes of their observations.</p> <p>Discuss how the root hairs take up water and mineral salts from the soil into a plant.</p> <p>Carry out experiments using eosin solution to show water and mineral salts uptake.</p> <p>Record and discuss their findings.</p> <p>Discuss basic theories underlying translocation. i.e. pressure flow hypothesis and cytoplasmic streaming.</p> <p>Select a plant in the school garden/compound. Perform ringing or girdling experiment.</p> <p>Compare and discuss their observations.</p>	<p>Explain the mechanism of water and mineral uptake and movement through the plant.</p> <p>How will you design an experiment to show that organic nutrients are transported through the phloem tissue?</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 6 (CONT'D) TRANSPORT	<p>The student will be able to:</p> <p>1.6.4 explain the term transpiration.</p> <p>1.6.5 distinguish between the types of transpiration.</p> <p>1.6.6 explain how water is able to move to the apex of trees and herbs.</p> <p>1.6.7 determine the rate of transpiration.</p> <p>1.6.8 identify the environmental factors that affect transpiration.</p>	<p>Transpiration: advantages and disadvantages of transpiration to plants and humans.</p> <p>Types of transpiration. NOTE: mention them –stomata and cuticular</p> <p>Physiological factors affecting the rise of water in the xylem: Root pressure, Transpiration – Cohesion- Tension Mechanism, Water Potential Gradient.</p> <p>Rate of transpiration.</p> <p>Environmental factors affecting transpiration e.g. temperature light intensity, wind, relative humidity.</p> <p>Note: Control of excessive loss of water by transpiration should be emphasized.</p>	<p>Let student :</p> <p>Brainstorm on the definition of transpiration</p> <p>Discuss advantages and disadvantages of transpiration to plants and humans.</p> <p>Discuss types of transpiration</p> <p>Carry out experiments to demonstrate the physiological factors that affect the rise of water in the xylem.</p> <p>Record and discuss their observations.</p> <p>Carry out experiments to measure the rate of water uptake using the potometer.</p> <p>Record and discuss their observations.</p> <p>Carry out experiments to demonstrate the factors that affect transpiration.</p> <p>Discuss their observations</p> <p>Discuss the environmental factors that affect transpiration.</p>	<p>Describe an experiment to show that:</p> <ul style="list-style-type: none"> • transpiration occurs through the leaves of a plant. • root pressure could be responsible for the rise of water in the xylem of a plant. <p>What factors affect transpiration</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
<p>UNIT6 (CONT'D) TRANSPORT</p> <p>UNIT 7 EXCRETION</p>	<p>The student will be able to:</p> <p>1.6.9 explain the concept of guttation.</p> <p>1.7.1 explain the concept of excretion in plants.</p> <p>1.7.2 list the excretory products of plants.</p> <p>1.7.3 perform experiment to demonstrate excretion in plants</p>	<p>Biological principles underlying guttation.</p> <p>Excretion in plants.</p> <p>Excretory products of plants. e.g. water, carbon (IV) oxide, oxygen, alkaloids, tannins, gums, resins and acids.</p>	<p>Let student :</p> <p>Carry out experiments to measure the rate of transpiration under different conditions. Record and discuss their findings. Carry out experiments to demonstrate guttation.</p> <p>Brainstorm to bring out the meaning of excretion.</p> <p>List the excretory products plants and how they are produced</p> <p>Discuss how each of the excretory products are removed from the plant body.</p> <p>Carry out experiments to show that carbon (IV) oxide is produced as an excretory product from plants.</p>	<p>Distinguish between transpiration and guttation.</p> <p>Describe an experiment to show that plants produce carbon (IV) oxide.</p> <p>State three differences between excretion in plants and animals.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 8 REPRODUCTION	<p>The student will be able to:</p> <p>1.81 explain the concept of reproduction in plants.</p> <p>1.8.2 distinguish between asexual and sexual reproduction.</p> <p>1.8.3 describe the different methods of vegetative reproduction/propagation</p> <p>1.8.4 explain the advantages and disadvantages of vegetative reproduction/propagation in plants.</p> <p>1.8.5 describe how parts of plants are modified for vegetative reproduction/propagation.</p>	<p>Reproduction in plants.</p> <p>Types of reproduction: Asexual and sexual.</p> <p>Methods of vegetative reproduction/propagation.</p> <p>Importance of vegetative, reproduction/propagation in plants.</p> <p>Structure of perennating organs (bulbs, rhizomes, corms and suckers).</p>	<p>Let students:</p> <p>Brainstorm to bring out the meaning of reproduction in plants.</p> <p>Name the types of reproduction in plants.</p> <p>Discuss the different types of reproduction in plants.</p> <p>Discuss how each method is carried out.</p> <p>Visit agricultural gardens etc. where students can see how grafting and budding are done. NOTE: Marcoting should be treated.</p> <p>- discuss the importance of vegetative reproduction/propagation.</p> <p>Examine the structure/features on the perennating organs (bulbs, rhizomes, corms) - draw and label the common examples of perennating organs (bulb e.g. onion, rhizomes e.g. ginger, corms e.g. cocoyam, sucker e.g. plantain).</p> <p>Discuss the structure/features in relation to function.</p>	<p>How are the following adapted for vegetative Propagation?</p> <ol style="list-style-type: none"> i. Bulb ii. Rhizome iii. corm

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
<p>UNIT 8 (CONTD)</p> <p>REPRODUCTION</p>	<p>The students will be able to:</p> <p>1.8.6 identify the various parts of a flower.</p> <p>1.8.7 relate the structure of the floral parts to their functions.</p> <p>1.8.8 determine and write the floral formulae of named flowers.</p> <p>1.8.9 explain the concept Pollination.</p>	<p>Structure of flower parts.</p> <p>Structure and functions of parts of the flower.</p> <p>Floral formula.</p> <p>The concept of pollination. Types of pollination (cross and self pollination).</p>	<p>Let students:</p> <p>Collect and examine the following flowers: Flamboyant (<i>Delonix</i>), Pride of Barbados (<i>Caesalpinia</i>), Rattle box (<i>Crotalaria</i>).</p> <p>Draw and label the whole flower.</p> <p>Cut and draw a half flower of each of the named flowers.</p> <p>Pull out individual floral parts one after the other and count the number of each whorl and observe the relationship to each other (whether free or fused)</p> <p>Draw and label each part.</p> <p>Discuss the structure of parts of the flower in relation to their functions.</p> <p>Examine different types of flowers and write the floral formula of each flower.</p> <p>Note: Other terminologies used in describing flowers should be stressed e.g. bisexual or unisexual flowers (staminate, pistillate or (carpellate), complete and incomplete flower, , essential and non-essential parts, monoecious and dioecious plants, solitary and inflorescence flowers, Note: Floral diagrams are not required.</p> <p>Brainstorm to bring out the meaning of pollination.</p> <p>Discuss the types of pollination.</p>	<p>Explain the functions of the petals, sepals, anthers and sigma to the flower.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
<p>UNIT 8 (CONTD)</p> <p>REPRODUCTION</p>	<p>The students will be able to:</p> <p>1.8.10 explain how agents eg. animal agents (insects, birds, bats) and wind bring about pollination.</p> <p>1.8.11 describe the structural adaptations of flowers for pollination.</p> <p>1.8.12 outline the process of fertilization in a flower.</p> <p>1.8.13 describe how fruits and seeds are formed.</p> <p>1.8.14 explain the concept of seed/fruit dispersal.</p>	<p>Agents of pollination: Animals (insects, birds and bats) and wind.</p> <p>Adaptation of flowers for pollination. Should include: I for self pollination bisexual flowers, homogamy, cleistogamy and self compatibility li for cross pollination: unisexual flowers, dichogamy plants (protandry and protogyny) heterostyly, herkogamy and chasmogamy</p> <p>Fertilization in flowers.</p> <p>Fruit and seed formation.</p> <p>Dispersal of seeds and fruits.</p>	<p>Let student:</p> <p>Go out to observe animal agents pollinating flowers.</p> <p>List the agents they observed pollinating the flowers.</p> <p>Record their findings.</p> <p>Examine different types of flowers and indicate how each is adapted for pollination. record and discuss their findings.</p> <p>Discuss the process of fertilization in plants.</p> <p>Examine charts or drawings of a fertilized ovary at various stages. Draw and label the stages.</p> <p>Discuss what happens in a flower after fertilization until a fruit or seed is formed.</p> <p>Brainstorm to bring out the meaning of seed/fruit dispersal.</p>	<p>Tabulate the differences between named wind-pollinated and named insect-pollinated flowers.</p> <p>Describe how the honey bee brings about pollination in a named flowering plant.</p> <p>How does fertilization occur in flowering plants?</p> <p>Describe what happens to the petals, sepals, and ovary after fertilization.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 8 (CONTD) REPRODUCTION UNIT 9 SCIENTIFIC INQUIRY SKILLS	The student will be able to:		Let students:	
	1.8.15	Agents of seeds or fruit dispersal.	Discuss the agents of seed and fruit dispersal.	How are the following seeds or fruits adapted for dispersal:
	1.8.16	Adaptation of seeds or fruits for dispersal.	Visit plants with matured fruits and observe how the seeds/fruits are dispersed. Examine, draw and label various seeds and fruits. Discuss how each type of seed/fruit is dispersed. List the agents responsible for dispersal of seeds and fruits.	<ul style="list-style-type: none"> • <i>Tridax</i> fruit • Coconut fruit • <i>Desmodium</i> fruit • Mango fruit • <i>Tecoma</i> seed • <i>Balsam</i> seed • <i>Crotalaria</i> seed • <i>Boerhavia</i> fruit
	1.9.1	Cutting transverse sections of root and stem of a dicotyledonous plant. Note: use the root of a young bean seedling and the stem of <i>Talinum</i> or any herbaceous dicotyledonous plant.	Nurse bean seedlings for 8-10 days before the lesson. Collect bean seedling and a young <i>Talinum</i> plant. Cut thin sections of the root of bean seedling and the stem of a young <i>Talinum</i> plant. Mount the sections under the microscope. Draw what they see and label it.	
	1.9.2	Examining the internal structure of the root and stem of a monocotyledonous plant. NB: use the root and stem of a young maize plant.	Discuss any differences they observe. Nurse maize seedlings 8-10 days before the lesson. Collect young maize plants. Cut thin sections of the root and stem of a young maize plant.	
	1.9.3	Carrying out instructions to perform biological experiment. Note: Use the test for starch in a leaf. Any appropriate biological experiment that will require the carrying out of instruction could be used at the discretion of the teacher.	Mount the sections under the microscope. Draw what they see and label. Discuss any differences they observe.	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 9(CONTD) SCIENTIFIC INQUIRY SKILLS	<p>The student will be able to:</p> <p>1.9.4 organize biological data and draw a graph.</p> <p>1.9.5 demonstrate the skills of observing and recording.</p> <p>1.9.6 demonstrate the process skill of observing.</p> <p>1.9.7 demonstrate the process skill of recording.</p> <p>1.9.8 demonstrate the process skill of measuring</p>	<p>Organizing data and drawing of graph. Note: use the experiment on the effect of light intensity on the rate of photosynthesis using pond weeds such as <i>Elodea</i> or <i>Ceratophyllum</i>.</p> <p>Investigating the mineral elements maize plant needs for healthy growth. Note: Any biological experiment that will involve observing could be used at the discretion of the teacher.</p> <p>Observing the production of carbon (IV) oxide by anaerobically respiring yeast.</p> <p>Recording observations of differently treated transpiring leaves. Note: Use three leaves of the same plant: String the petioles such that they are equidistant from each other. Smear Vaseline on</p> <ol style="list-style-type: none"> 1. the abaxial surface 2. adaxial surface and on both surfaces. <p>1. Measuring the growth of pollen tubes</p>	<p>Carry out experiment to test for starch in a leaf based on instructions supplied by the teacher.</p> <p>Carry out an experiment to show the effect of light intensity on the rate of photosynthesis.</p> <p>Plot a graph of number of bubbles emerging per minute in relation to the distance of the plant from the light source.</p> <p>Form groups of not more than six members.</p> <p>Sow a number of maize grains let them germinate and grow into seven-day-old seedlings.</p> <p>Prepare a culture solution containing the following mineral elements: N, Ca, Fe, Mg, P, K and S.</p> <p>Carry out an experiment to show the effect of the various mineral elements on the maize seedlings.</p> <p>Observe the seedling every two days and record their observation for three weeks.</p> <p>Carry out experiment using yeast to show that in anaerobic respiration, carbon (IV) oxide is produced. Record their observation. Carry out experiment to show the surface of the leaf that transpires faster. Do periodic recording of their observation. Discuss their observations.</p> <p>Carry out experiment to show how the pollen tube grows in the style. Measure the growth rate of the pollen tube. Discuss their findings.</p>	

SENIOR HIGH SCHOOL - YEAR 3

SECTION 2: CELL BIOLOGY, GENETICS AND EVOLUTION

General objectives: The student will:

- 1 appreciate the roles of DNA and RNA in protein synthesis as well as the importance of protein synthesis
- 2 recognize cell division as being part of the cell cycle and that cell division is the basis for growth and reproduction in living organism
- 3 understand how proteins from external sources (dietary proteins) are used for the synthesis of essential proteins within the body

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 NUCLEIC ACIDS UNIT 2 DNA STRUCTURE AND REPLICATION, RNA TRANSCRIPTION	The student will be able to: 2.1.1 explain the term nucleic acid and name the types of nucleic acids.	Nucleic acids. Types of nucleic acids: DNA and RNA.	Let students: Brainstorm to bring out the meaning of nucleic acid. Discuss the types of nucleic acids and differentiate between DNA and RNA.	Name the types of nucleic acids.
	2.2.1 describe the double helix model of DNA structure.	Model of DNA structure by Watson and Crick.	Examine a model of DNA. Describe the DNA in terms of nucleotides. Draw the DNA structure with the correct pairing of complementary bases.	Describe the Watson and Crick model of DNA.
	2.2.2 outline the process of DNA replication.	DNA replication.	Brainstorm to bring out an explanation of DNA. Replication. Discuss the roles of the enzymes DNA polymerase, helicase and ligase in replication. Discuss the mechanism of replication using models or charts. View recorded visuals of DNA.	What is DNA replication? Outline the process of DNA replication.
	2.2.3 outline the process of RNA transcription.	RNA Transcription.	View recorded visuals of RNA transcription. Practice RNA Transcription on paper.	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 PROTEIN SYNTHESIS	<p>The student will be able to:</p> <p>2.3.1 outline the process of protein synthesis</p> <p>2.3.2 explain the importance of protein synthesis and give some examples of the proteins synthesized by humans.</p>	<p>Protein Synthesis The roles of m-RNA, t-RNA, and r-RNA and ribosomes should be mentioned.</p> <p>Importance of protein synthesis. Note: (Consider also the functions of the proteins synthesized).</p>	<p>Let students:</p> <p>Brainstorm to bring out the two steps involved in protein synthesis.</p> <p>Discuss each of the 2 steps in detail using charts, drawings or pictures. NOTE: Detail of the steps in each of the two stages are not required</p> <p>Discuss the sources of the amino acids used to synthesize proteins in the human body.</p> <p>Identify some of the proteins which are synthesized by humans.</p> <p>Discuss the importance of protein synthesis.</p>	<p>A man needs keratin to develop his hair that has been cut. Describe how he will be able to synthesis the keratin in his body?</p> <p>Name any two proteins synthesized by the human body and give their functions.</p>
UNIT 4 CELL CYCLE	<p>2.4.1 explain the term cell cycle.</p> <p>2.4.2 outline the phases of the cell cycle.</p> <p>2.4.3 describe the process of mitosis and its importance</p> <p>2.4.4 describe the process of meiosis and its importance</p>	<p>Cell cycle: Series of events that take place in eukaryotic cells leading to their replication or division.</p> <p>Phases of the cell cycle: [Interphase: G₁ S G₂ phases, Mitosis: M phase. (Karyokinesis and cytokinesis).</p> <p>The process of mitosis. Note: Mitosis is a part of the cell cycle i.e. the M phase.</p> <p>The process of meiosis</p>	<p>Brainstorm to bring out the meaning of cell cycle.</p> <p>Discuss the phases of the cell cycle using charts and diagrams.</p> <p>Make drawings to represent the cell cycle.</p> <p>Discuss the stages of mitosis</p> <p>Discuss the importance of mitosis.</p> <p>Discuss the stages of meiosis</p>	<p>What is the cell cycle?</p> <p>Make an annotated diagram to show the cell cycle.</p> <p>Describe the process of mitosis. What is the biological importance of mitosis?</p> <p>Tabulate the differences between mitosis and meiosis</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 5 HEREDITY	<p>The student will be able to:</p> <p>2.5.1 explain the term genetics.</p> <p>2.5.2 explain and define some terms used in genetics with examples.</p> <p>2.5.3 explain that chromosomes form the basis of heredity.</p> <p>2.5.3 explain the concept of inheritance.</p> <p>2.5.4 state and explain Mendel's first and second laws of inheritance.</p> <p>2.5.5 explain how hybrids are formed.</p> <p>2.5.6 explain the terms linkage, sex determination, sex linked characters.</p>	<p>Genetics</p> <p>Basic terms used in genetics e.g. gene, genotype, phenotype, dominant, recessive, allele, locus, test cross, back cross, etc.</p> <p>Structure of chromosomes</p> <p>Concept of inheritance Note. The study should include hereditary units – genes, traced to Gregor Mendel's experiments. Replication of DNA, gametes as vehicles of inheritance.</p> <p>Mendel's First and Second Laws</p> <p>Mendel's experiments on monohybrid and dihybrid inheritance.</p> <p>Sex determination and sex linked characters eg. Hemophilia, red-green colour blindness, baldness, hairy ear lobes.</p>	<p>Brainstorm to bring out the meaning of Genetics in relation to hereditary and variation.</p> <p>Brainstorm to bring out the meaning of basic terms in genetics.</p> <p>Discuss structure of chromosomes.</p> <p>Observe chromosomes on permanent slides of onion root tip cells.</p> <p>Discuss the concept of inheritance of characteristics.</p> <p>Brainstorm to bring out the clear understanding of Mendel's 1st and 2nd laws.</p> <p>Discuss the inheritance of a single pair and two pairs of contrasting characteristics up to the F₂ generation.</p> <p>Name the sex chromosomes.</p> <p>Discuss how sex is determined in humans.</p> <p>Mention some sex linked characters. Discuss the inheritance of se-linked characters.</p>	<p>What is the significance of a test cross?</p> <p>Draw and label a cell with chromosomes.</p> <p>How are the traits of parents (such as hair colour) transmitted to their offspring?</p> <p>Pea plants heterozygous for flower position and stem length (AaTt) are allowed to self pollinate and 400 of the resulting seeds were planted.</p> <p>How many offspring would be predicted to be dwarf with terminal flowers?</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 6 VARIATION	2.5.7 explain the term Gene interaction and list various forms of gene interactions.	Gene interactions: Co-dominance, multiple alleles (ABO blood group system, rhesus factor), polygenes (eg. Skin colour in humans)	Discuss and come out with the meaning of gene interactions. Brainstorm to bring out various types of gene interactions. Discuss each type of Gene interactions with examples.	A man of blood group B married a woman of blood group AB i. Write the possible genotypes of a. The man b. The woman c. The offspring
	2.6.1 explain what variation is	Variation	Carry out the following activities to bring out character differences among the students such as tongue rolling, figure prints, skin colour, height, hand clasping, sex, ability to taste PTC paper etc.	
	2.6.2 distinguish between continuous and discontinuous variation	Continuous and discontinuous variation	Classify different character traits into continuous(e.g. skin colour, height, intelligence etc.) and discontinuous (e.g. tongue rolling, hand clasping, A.B.O blood groups sickle cell disease and ability to taste PTC paper) variation.	Distinguish between continuous and discontinuous variation.
	2.6.3 distinguish between heritable and non-heritable variation.	Heritable and non-heritable variations	Explain that some variation is heritable (e.g. tongue rolling, skin colour, sickle cell disease etc.) while others are non-heritable (e.g. goiter river blindness scars etc).	Classify the following characteristics as heritable or non-heritable; i. Colour blindness ii. Scars iii. Intelligence iv. Goiter v. River blindness
	2.6.4 explain the causes of variation and state their source.	Causes of variation: Environmental and Genotypic (genetic) e.g.: <ul style="list-style-type: none"> • Crossing-over, • Independent assortment • Random fusion of gametes • Mutation 	Discuss the various causes of variation and show relationship to their sources. NOTE: Mutation should include chromosome abrasion and gene(point) mutation. Mention sickle cell disease as an example of gene mutation.	Explain how the sickle cell disease arose out of gene mutation.
	2.6.5 explain the consequences of variation.	Consequences of variation e.g. Natural selection and artificial selection.	Discuss natural selection and artificial selection as consequences of variation.	Explain inbreeding and outbreeding in artificial selection and state two advantages of each.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 7 EVOLUTION	<p>2.6.6 explain the term Recombinant DNA technology and state their applications.</p> <p>2.7.1 explain the term evolution.</p> <p>2.7.2 list evidence in support of evolution.</p> <p>2.7.3 describe the various theories of evolution.</p>	<p>Recombinant DNA technology</p> <p>Evolution.</p> <p>Evidence for evolution: Paleontology (fossil records), Comparative biochemistry, geographical distribution, Comparative anatomy & physiology, Comparative embryology, Systematics, evidence from computer simulation.</p> <p>Theories of evolution: Lamarckism and Darwinism Theories.</p>	<p>Use digitized videos/CDs/audiovisuals to explain genetic engineering.</p> <p>Discuss application of genetic engineering in GM organs and foods, gene therapy and the DNA test.</p> <p>Brainstorm to bring out the meaning of organic evolution.</p> <p>Discuss the evidence in support of evolution.</p> <p>Discuss the evolutionary trends in plants and animals(i.e. simple to complex forms and aquatic to terrestrial adaptations)</p> <p>NOTE: Mention divergent and convergent evolution under Comparative anatomy</p> <p>Discuss various theories with emphasis on that of Lamarck and Darwin.</p> <p>Read and make presentations on the theories of evolution.</p>	<p>Explain how DNA test is used to determine paternity?</p> <p>Show how comparative anatomy and embryology support the theory evolution.</p> <p>Explain how Darwin's theory of natural selection accounts for the long neck of giraffe.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 8 SCIENTIFIC INQUIRY SKILLS	<p>The student will be able to:</p> <p>2.8.1 prepare microscope slide of a squash of onion root tip.</p> <p>2.8.2 handle the microscope to view slides.</p> <p>2.8.3 observe detail of structures under the microscope.</p> <p>2.8.4 observe stages of meiosis in plant and animal cells.</p> <p>2.8.5. design a model of the structure of a nucleotide.</p>	<p>Preparation of squash of root tip of onion.</p> <p>Using the microscope.</p> <p>Observing slides under high power of a microscope.</p> <p>Observing stages of Meiosis in plant and animal cells.</p> <p>Model of the structure of a nucleotide.</p>	<p>Let students:</p> <p>Discuss stages of preparing microscope slide of a squash of root tip of onion.</p> <p>Carry out the preparation of a slide of onion root tip squash.</p> <p>Observe the slide under the microscope and look out for stages of mitosis.</p> <p>Draw stages of mitosis they can identify under the microscope.</p> <p>Examine prepared slides of a developing anther of a plant and a testis of a grasshopper or any available insect under the microscope.</p> <p>Draw and label cells to show many stages as possible of meiosis under high power.</p> <p>Use polystyrene spheres and broom sticks to make models of nucleotides with different nitrogenous bases purines: (adenine and guanine); pyrimidines: (cytosine and thymine/uracil).</p> <p>Pair nucleotides to show complementary base pairing of DNA strands.</p>	

SENIOR HIGH SCHOOL - YEAR 3

SECTION 3: BIOLOGY AND INDUSTRY

General objectives: The student will:

1. appreciate water as a very important commodity which must be handled with care.
2. appreciate that water is the only source of fish and other useful aquatic products. It is also a medium for transmission of some diseases.
3. understand that, water is the basic raw materials for industries.
4. appreciate the use of micro-organisms in industries.
5. be aware that fuel can be generated from biological sources.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 BIOLOGY AND WATER INDUSTRY	<p>The student will be able to:</p> <p>3.1.1 name some contaminants of water.</p> <p>3.1.2 identify polluted water by using the Biological Oxygen Demand (BOD).</p> <p>3.1.3 describe biological processes of purifying sewage.</p>	<p>Contamination of water.</p> <p>The use of BOD in the measurement of the level of organic pollution in water.</p> <p>Waste water treatment.</p>	<p>Let students:</p> <p>Carry out identification experiments to identify cations and anions in samples of water.</p> <p>Note: collect water from different locations i.e. factories, farm lands, polluted lagoons or ditches.</p> <p>Discuss their findings. Carry out experiments to test water samples for bacterial contamination.</p> <p>Discuss their findings.</p> <p>Brainstorm to get the meaning of BOD. Discuss how the BOD is determined.</p> <p>Discuss processes such as cesspit activated sludge.</p> <p>Visit any water treatment plant, document what goes on there and make a presentation in class.</p>	<p>Show how you will convince</p> <p>How would you use BOD to determine the level of pollution in a water body in your environment?</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 BIOLOGY AND FISHING INDUSTRY	<p>The student will be able to:</p> <p>3.2.1 explain why fish is an efficient converter of plankton into flesh.</p> <p>3.2.2 describe ways of conserving fish stocks in water bodies.</p> <p>3.2.3 explain the need for fish farming.</p> <p>3.2.4 list at least three each of advantages and disadvantages of fish farming.</p>	<p>Fish as an efficient converter of plankton into flesh.</p> <p>Note: fish is ectothermic and would not need energy to warm the body.</p> <p>Fish stock management.</p> <p>Fish Farming as a way of offsetting the depletion of fish stock in natural water bodies.</p> <p>Advantages and Disadvantages of fish farming.</p>	<p>Let students:</p> <p>Discuss the conversion of plankton into flesh by fish.</p> <p>Brainstorm on ways of conserving fish stocks in water bodies.</p> <p>Discuss the need for fish farming</p> <p>Brainstorm to bring out some advantages and disadvantages of fish farming.</p> <p>Visit any fish farms where possible observe and write a report for presentation in class.</p>	<p>Why is fish considered as an efficient converter of plankton into flesh?</p> <p>Suggest methods by which fish stocks can be conserved. What role might a marine biologist play in this?</p>
UNIT 3 BIOLOGY AND FOOD INDUSTRY	<p>3.3.1 describe various ways of preserving and storing foods.</p> <p>3.3.2 explain the biological bases of the methods of preserving and storing foods.</p> <p>3.3.3 explain what food additives are.</p>	<p>Preservation and storage of foods</p> <p>Note: The use of ionizing radiation (x-rays, etc) should be mentioned.</p> <p>Biological bases of preserving and storing foods.</p> <p>Note: Local ways of preserving food should be mentioned e.g. drying, salting, etc.</p> <p>Food additives.</p>	<p>Discuss various ways of preserving and storing foods.</p> <p>Discuss the biological bases of each method of food preservation and storage</p> <p>Brainstorm to bring out the meaning of food additives.</p>	<p>Food preservation depends on destroying micro-organisms in food or, at least, preventing their multiplication. Show how each of the following achieves either of these objectives: canning, refrigeration, dehydration.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 CONT'D BIOLOGY AND FOOD INDUSTRY	<p>The student will be able to:</p> <p>3.3.4 identify categories of food additives.</p> <p>3.3.5 explain the uses of some additives and their effect on health.</p>	<p>Principal categories of food additives.</p> <p>Note Naturally occurring and artificial food additives.</p> <p>Health implications in the use of food additives.</p>	<p>Let students:</p> <p>Brainstorm to bring out types of food additives they know.</p> <p>Discuss the use of food additives.</p> <p>Visit food vendors, confectionaries etc. to find out the types of additives they use and why.</p> <p>Discuss their findings.</p>	<p>Name two types of preserved food that you expect to contain antioxidant, two that may contain emulsifiers and two that may contain salt used as a preservative.</p>
UNIT 4 BIOLOGY AND AGRICULTURE	<p>3.4.1 explain the biological principles upon which successful agriculture depends.</p> <p>3.4.2 explain how fertilizer use increases productivity of a farm land.</p>	<p>Biological principles underlying successful agriculture.</p> <p>Effect of fertilizer use on productivity on a farmland.</p>	<p>Discuss the biological principle that optimum soil conditions supply essential minerals, water and air for successful farming.</p> <p>Discuss the biological principle that the quality of plants grown determines the level of success of farming.</p> <p>Discuss the biological principle that reduction of competition increases or determines the success of farming.</p> <p>Survey their environment to find out the kinds of fertilizer used in farming.</p> <p>Discuss the use of these fertilizers to enhance crop yield.</p>	<p>Explain the biological principles by which</p> <ol style="list-style-type: none"> fertilizer; pesticide; selective breeding, and irrigation <p>Can respectively increase the productivity of crops.</p>

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 (CONT'D) BIOLOGY AND AGRICULTURE	The student will be able to: 3.4.3 explain the biological importance of pesticides to boost agricultural productivity. 3.4.4 explain the biological principles underlying successful animal husbandry.	The use of pesticides to increase agricultural productivity. Biological principles of animal husbandry.	Let students: Discuss the biological importance of pesticides to increase agricultural productivity. Discuss the biological principle that selective breeding, fecundity and resistance to disease underlie successful animal breeding. Discuss the biological principle that optimizing food and diet promotes successful animal husbandry. Discuss the biological principle that reduction of losses due to diseases enhance successful animal husbandry. Discuss the biological principle that minimizing energy losses in movement and heat productions enhance successful animal husbandry.	
UNIT 5 BIOTECHNOLOGY	3.5.1 explain the concept of biotechnology. 3.5.2 name foods that are processed using micro-organisms. 3.5.3 explain the role of micro-organisms in the production of alcoholic drinks and organic acids. 3.5.4 explain the role of microbes in the pharmaceutical industry.	The concept of biotechnology. The use of micro-organisms in the manufacture of cheese, yoghurt, kenkey, bread, butter. Micro-organisms and liquor production. Micro-organisms in the pharmaceutical industry.	Brainstorm to bring out the meaning of biotechnology. Visit any food processing site that uses micro-organisms in food processing. Investigate how the processing is done and make a presentation in class. Visit any liquor production site that uses micro-organisms in liquor production. Investigate how the production is carried out and make a presentation in class. Discuss the effect of microbes in the production of some pharmaceutical products.	What do you understand by the term biotechnology? Describe the role played by named micro-organisms in the production of the following; a) yoghurt b) kenkey c) bread d) local gin brewed from palm wine

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 5 (CONT'D) BIOTECHNOLOGY	<p>The student will be able to:</p> <p>3.5.5 explain the role of microbes in the tanning industry.</p> <p>3.5.6 state other uses of microbes.</p>	<p>Microbes in the tanning industry.</p> <p>Microbes in mining.</p>	<p>Let students:</p> <p>Discuss the effect of microbes in the tanning industry.</p> <p>Read texts on microbial mining and make a presentation in class.</p>	
UNIT 6 BIOLOGICAL FUEL GENERATION	<p>3.6.1 explain the need for new sources of energy.</p>	<p>Fuel from Biomass Note: the use of biogas, use of green crops to produce ethanol, the generation of hydrogen gas from chloroplasts.</p>	<p>Discuss the need for the use of new sources of energy.</p>	

REFERENCES

1. Campbell N. A. & Reece (2005) *Biology* . San Francisco:Pearson Benjamin Cummings
2. Nyavor, C. B. & Seddoh, S. (2006). *Biology for Senior Secondary Schools*. Accra Unimax Macmillan
3. Clegg, C. J. & Mackean, D. G. *Advanced Biology: Principles and applications*
4. John Dollar & P.K. Acheampong, *Biology for Senior Secondary Schools*
5. D.J. Taylor , M.P.V. Green, L.W. Stout, *Biological Science*
6. *Ecological Biology 1*
7. *Ecological Biology 2*
8. Clegg & Clegg. *Biology of the Mammal*
9. Mordern Biology
10. *Functional Approach to Biology*