

MINISTRY OF EDUCATION



REPUBLIC OF GHANA

TEACHING SYLLABUS FOR INTEGRATED SCIENCE (SENIOR HIGH SCHOOL)

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TEACHING SYLLABUS FOR INTEGRATED SCIENCE (SHS)

RATIONALE FOR TEACHING INTEGRATED SCIENCE

We are confronted daily with situations that require us to use scientific information to make informed choices and decisions at every turn. Modern life also requires general scientific literacy for every Ghanaian citizen. This is the only way by which the country can create a scientific culture toward achieving the country's strategic programme of scientific and technological literacy in the shortest possible time. Every citizen of the country needs training in science to be able to develop a scientific mind and a scientific culture. This is the only way by which people of the country could deal objectively with phenomena and other practical issues; prevent reliance on superstition for explaining the nature of things and help us to construct and build the present and the future on pragmatic scientific basis. Our humanistic past has been valuable, but cannot help much to usher the country into the age of science, invention and rapid economic development. The study of Science helps us to understand the natural world and secondly helps us to approach challenges in life and in the workplace in a systematic and logical manner. Development in the current world is knowledge based on science and technology. We gain knowledge faster through the use of science and technology. More knowledge helps nations to advance faster on the road to increased development and progress. For the country to develop faster, it is important for students to be trained in the processes of seeking answers to problems through scientific investigations and experimentation. The integrated science syllabus is a conscious effort to raise the level of scientific literacy of all students and equip them with the relevant basic scientific knowledge needed for their own living and secondly, needed for making valuable contributions to production in the country. Education in science also provides excellent opportunities for the development of positive attitudes and values in our youth. These include:

- Curiosity to explore their environment and question what they find
- Keenness to identify and answer questions through scientific investigations
- Creativity in suggesting new and relevant ways to solve problems
- Open-mindedness to accept all knowledge as tentative and to change their view if the evidence is convincing
- Perseverance and patience in pursuing a problem until a satisfying solution is found
- Concern for living things and awareness of their responsibility toward maintaining the quality of the environment
- Honesty, truthfulness and accuracy in recording and reporting scientific information
- Love, respect and appreciation for nature and desire to conserve natural balance.

GENERAL AIMS

The syllabus is designed to help the student to:

1. solve basic problems within his/her immediate environment through analysis and experimentation
2. keep a proper balance of the diversity of the living and non-living things based on their interconnectedness and repeated patterns of change.
3. adopt sustainable habits for managing the natural environment for humankind and society
4. use appliances and gadgets effectively with clear understanding of their basic principles and underlying operations
5. explore, conserve and optimize the use of energy as an important resource for the living world
6. adopt a scientific way of life based on pragmatic observation and investigation of phenomena.
7. search for solutions to the problems of life recognizing the interaction of science, technology and other disciplines.

SCOPE OF CONTENT

The content of the Senior High School Integrated Science syllabus covers the basic sciences and includes topics in Health, Agriculture and Industry. The course has been designed to offer a body of knowledge and skills to meet the requirements of everyday living and also provide adequate foundation for the study of other subjects and for those who wish to pursue further education and training in science related vocations.

Specific issues covered are the following:

1. Science for all students
2. Science as an active inquiry process
3. Science and the satisfaction of individual needs
4. Science as a profession
5. Science and culture.

The approach in this revised syllabus is based on themes that students can relate to in their everyday experiences, and to commonly observed phenomena in nature. The basic aim is to enable students to appreciate the links between seemingly different scientific topics and hence help them to be able to integrate ideas from various scientific sources. The five themes chosen for this subject are: Diversity of matter, Cycles, Systems, Energy and Interactions. These themes encompass a core body of concepts in both the life and physical sciences. This body of concepts has been chosen because it provides a broad based understanding of the environment, and will help build a foundation upon which students can rely for further study. In particular, the relationships between Science and Technology and the environment are explored under the theme of Interactions.

Although the content of the syllabus is organized into five themes, the topics under each theme should not be viewed as separate blocks of knowledge. In general, there are no clear boundaries between these themes. There may be topics common to different themes. Hence, the teacher should make a conscious effort to demonstrate the relationship between themes whenever possible for students to understand such relationship. It should be noted in particular that Systems, Energy and Interactions are closely related.

Another feature of the syllabus is the **spiral approach**. This is characterized by revisiting concepts and skills at different levels with increasing degrees of depth. The spiral approach allows the learning of scientific concepts and skills to be matched to students' cognitive development to facilitate gradual mastery of skills.

ORGANIZATION OF THE SYLLABUS

The syllabus covers three year period of Senior High School Education. Each year's work embraces the five themes which are: ***Diversity of Matter, Cycles, Systems, Energy and Interaction of Matter***. The five themes form the five sections of the syllabus for each of the three years' work. Details of the coverage of the themes are as follows:

Section 1 - Diversity of Matter

Our world has great biological, physical and geological diversity. The study of diversity should enable students to appreciate that there is a great variety of living and non-living things around us and in the world in which we live. They will also recognize that there are common threads that connect all living things and there are unifying factors in the diversity of non-living things that help to classify them. The study of diversity will allow students to appreciate importance of diversity and the necessity of maintaining it. They will also come to realize that interconnectedness among living and non living things are necessary to create harmony in nature.

Section 2 – Cycles

The study of cycles should enable students to recognize that there are repeated patterns of change in nature and understand how these patterns arise. Examples of these cycles include the day and night cycle, life cycles of living things and the recycling of resources. Studying these cycles helps humans to predict events and processes and to understand the Earth as a self-sustaining system.

Section 3 - Systems

The study of systems should enable students to recognize that a system is a whole consisting of parts that work together to perform a function. There are natural and artificial systems. Examples of systems in nature are the digestive and respiratory systems. Examples of artificial systems are electrical systems. A study of these systems allows humans to understand how they operate and how different parts influence and interact with one another to perform a function vital for life.

Section 4 – Energy

The study of energy should enable students to appreciate that energy affects both living and non-living things. It makes change and movement possible in everyday life. There are many forms of energy and one form can be converted to another. Humans use energy in many ways and for many different purposes. Humans are not the only living things that use energy. All living things obtain energy and use it to carry out life processes. The study of this theme will allow students to appreciate the importance and uses of energy and the need to explore and conserve it.

Section 5 – Interactions of Matter

The study of interactions should enable students to appreciate that the interactions between and within systems helps humans to better understand the environment and their role in it. There are many types of interactions. There are interactions between the living world and the environment at various levels; i.e. interactions which occur within an organism, between organisms as well as between organisms and the environment. There are also interactions between forces and objects. At the societal level, the interaction of humans with the environment drives the development of Science and Technology. At the same time, Science and Technology influences the way humans interact with their environment. By studying the interactions between humans and the environment, students can better appreciate the consequences of their actions.

The structure and organization of the syllabus for the three year Senior High School is presented on the next page.

STRUCTURE AND ORGANISATION OF THE SYLLABUS

SECTIONS	SHS1	SHS2	SHS3
DIVERSITY OF MATTER	Unit 1: Introduction to Integrated Science. (p. 1-2) Unit 2: Measurement (p. 2-3) Unit 3: Diversity of living and non-living things. (p. 3-4) Unit 4: Matter (p. 4-5) Unit 5: Cells and cell division (p.6) Unit 6: Rocks (p.6)	Unit 1: Acids, Bases and Salts (p. 21-22) Unit 2: Soil conservation (p. 22-23) Unit 3: Water (p. 24)	Unit1: Metals and Non Metals (p. 41) Unit 2: Exploitation of minerals (p. 41) Unit 3: Rusting (p. 42) Unit 4: Organic And Inorganic Compounds(pg.43)
CYCLES	Unit 1: Air movement (p.7) Unit 2: Nitrogen cycle (p.8)	Unit 1: Hydrological Cycle (p.25-26) Unit 2: General principles of farm animal production (pg. 26).	Unit 1: Life Cycles of Pests and parasites (p. 44) Unit 2: Crop Production (p.45)
SYSTEMS	Unit 1: Skeletal System (p.9) Unit 2: Reproduction and growth in Plants (p. 9-11) Unit 3: Respiratory System (p.11-12) Unit 4: Food and Nutrition (p.13) Unit 5: Dentition, Feeding and Digestion in mammals (p.13) Unit 6: Transport-Diffusion, Osmosis and Plasmolysis (p.14)	Unit 1: Excretory system (p.27) Unit 2: Reproductive Systems and growth in mammals (p.27-29) Unit 3: Circulatory System (p.29)	Unit 1: The Nervous System (p.46)
ENERGY	Unit 1: Forms of Energy and Energy Transformation (p.15) Unit 2: Solar Energy (p.16) Unit 3: Photosynthesis (17) Unit 4: Electronics (p.17)	Unit 1: Electrical Energy(p.30-31) Unit 2: Electronics.(p.32) Unit 3: Sound Energy(32-33) Unit 4: Nuclear Energy(pg.33)	Unit 1: Light Energy (p.48) Unit 2: Heat Energy (p.49) Unit 3: Electronics (p.50)
INTERACTIONS OF MATTER	Unit 1: Ecosystem (p.18-19) Unit 2: Atmosphere and Climate Change (p.19-20) Unit 3: Infections and diseases (p.20)	Unit 1: Magnetism (p.34) Unit 2: Forces, Motion and pressure (p.35-36) Unit 3: Safety in the Community (p.37-38) Unit 4: Endogenous Technology (pg.38-39) Unit 5: Biotechnology (pg.39-40) Unit 6: Work and Machines(pg. 40)	Unit 1: Variation and inheritance (p.51)

PRE-REQUISITE SKILLS AND ALLIED SUBJECTS

Average performance in Science and Mathematics at Basic Stages 1 – 9 is necessary for success in this course. Students offering this course should also be concurrently studying Senior High School Core Mathematics and English language

SUGGESTED TIME ALLOCATION

A total of five periods a week, each period consisting of forty minutes, is allocated to the teaching of Integrated Science. The time allocation and the recommended structure for theory and practical are as follows:

Year 1: 5 periods a week: Theory - 3 periods per week; Practical - Two continuous periods per week

Year 2: 5 periods a week: Theory –3 periods per week; Practical - Two continuous periods per week

Year 3: 5 periods a week: Theory –3 periods per week; Practical - Two continuous periods per week

SUGGESTIONS FOR TEACHING THE SYLLABUS

For effective teaching and learning in this course, it is recommended that schools should keep farms for growing crops. It is also recommended that farm animals in at least one of each of the following groups must be reared.

1. Chickens/ducks/turkeys
2. Goats/sheep/cattle
3. Rabbits and Guinea Pigs

Plans must be made for visiting well established experimental and commercial farms, research institutes, and other institutions/organizations related to Science, Health and Agriculture. Visits must also be planned to scientific and manufacturing industries where students will observe scientific work and the application of science and technology in manufacturing. Video clips, digitized content or CD ROM on processes and systems could also be shown where these are available.

Schools must adopt a team teaching approach for this course since many science teachers of the moment are trained as physicists, biologists, chemists, agriculturists etc. This deficiency will be remedied in the future if the universities start programmes in integrated science from where a new crop of integrated science teachers will be drawn. In the meantime, teachers are encouraged to tap the abilities of their colleagues in agriculture and in other science fields for the effective teaching of this course.

General Objectives

General Objectives have been listed at the beginning of each section of the syllabus, that is, just below the theme of the section. The general objectives are linked the general aims for teaching natural science listed on page (ii) of this syllabus. The general objectives specify the skills and behaviours the student should acquire after learning the units of a section and they form the basis for the selection and organization of the themes and their unit topics. Read the general objectives very carefully before you start teaching. After teaching all the units, go back and read the general aims and general objectives again to be sure you have covered both of them adequately in the course of your teaching.

Years and Units

The syllabus has been planned on the basis of Years and Units. Each year's work is covered in a number of units sequentially arranged and in a meaningful manner such that each unit's work will provide the necessary and enabling skills for the next unit. A description of the contents of each column is as follows:

Syllabus Structure

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 the major topics of the year. 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 Objectives: Column 2 shows the Specific Objectives for each unit. The specific objectives begin with numbers such as 1.2.5 or 3.4.1. 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 refer to the rank order of the specific objective. For instance 1.2.5 means section 1, Unit 2 and Specific Objective 5. In other words 1.2.5 refers to Specific Objective 5 of Unit 2 of section 1. Similarly, the syllabus reference number 3.4.1 simply means Syllabus Objective number 1 of Unit 4 of section 3. Using syllabus reference numbers provide an easy way for communication among teachers and educators. It further provides an easy way for selecting objectives for test construction. For instance, if Unit 4 of section 3 has seven specific objectives 3.4.1 - 3.4.7, a teacher may want to base his/her test items/questions on objectives 3.4.4 to 3.4.7 and not use the other first three objectives. In this way, a teacher would sample the objectives within units to be able to develop a test that accurately reflects the importance of the various specific objectives and skills taught in class.

You will note also that specific objectives have been stated in terms of the student i.e. what the pupil will be able to do during and 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 individualizing 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. The teaching of Natural Science should be activity-oriented for two important reasons. The activity approach challenges the children to develop their own ideas, and secondly makes the subject more meaningful and relevant to them.

As has been said already, the order in which the topics appear should not necessarily be the teaching order. There should however, be a linkage in the order in which the units and specific objectives are treated. The teacher will have to study the syllabus carefully and plan ahead the activities the students will carry out during a particular period. Knowing the requirements of a particular lesson, the teacher should assemble the materials which will be required for the activities well in advance. The collection must be done by both the teacher and the students. Other materials like bottles, cans, match boxes, etc. may be continually collected and stored to be used when required. When materials are not available in the immediate environment, the teacher should try to contact resource persons or persons in higher institutions for help.

As students begin work on the activities of each lesson, the teacher should serve as a facilitator and motivate the students in various ways to sustain their interest. The teacher should pay particular attention to children's questions and should also ask questions that will guide them to other areas of useful investigation. During the last ten minutes of the class activity, all students should come together to discuss their observations. The teacher must involve all students in the discussion.

Column 3 - Content: The "content" in the third column of the syllabus presents a selected body of information that you will need to use in teaching the particular unit. In some cases, the content presented is quite exhaustive. In some other cases, you could add some more information based upon your own training and based also on current knowledge and information.

Column 4 - Teaching/Learning Activities (T/LA): T/LA that will ensure maximum student participation in the lessons is presented in Column 4. The General Aims of the subject can only be most effectively achieved when teachers create learning situations and provide guided opportunities for students to acquire as much knowledge and understanding of science as possible through their own activities. Students' questions are as important as teacher's questions. There are times when the teacher must show, demonstrate, and explain. But the major part of a student's learning experience should consist of opportunities to explore various scientific situations in their environment to enable them make their own observations and discoveries and record them. Teachers should help students to learn to compare, classify, analyze, look for patterns, spot relationships and come to their own conclusions/deductions. Avoid rote learning and drill-oriented methods and rather emphasize participatory teaching and learning in your lessons. You are encouraged to re-order the suggested teaching/learning activities and also add to them where necessary in order to achieve optimum student learning.

A suggestion that will help your students acquire the capacity for analytical thinking and the capacity for applying their knowledge to problems and issues is to begin each lesson with a practical problem. Select a practical problem for each lesson. The selection must be made such that pupils can use knowledge gained in the previous lesson and other types of information not specifically taught in class. The learning of any skill considered important must start early. Engage your students in analytical thinking and practical scientific problem solving techniques.

Column 5 - Evaluation: Suggestions and exercises for evaluating the lessons of each 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 has already been said, and that will engage them in developing solutions, and in developing observational and investigative skills as a result of having undergone instruction in this subject. The suggested evaluation tasks are 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, 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.

DEFINITION OF PROFILE DIMENSIONS

A 'dimension' is a psychological unit for describing a particular learning behaviour. More than one dimension constitutes a profile of dimensions. A specific objective may be stated with an action verb as follows: The pupil will be able to *describe* etc. Being able to "describe" something after the instruction has been completed means that the pupil has acquired "knowledge". Being able to explain, summarize, give examples, etc. means that the pupil has understood the lesson taught. Similarly, being able to develop, plan, solve problems, construct, etc. means that the student has learnt to create, innovate or synthesize knowledge. Each of the specific objectives in this syllabus contains an "action verb" that describes the behaviour the pupil will be able to demonstrate after the instruction. "Applying Knowledge", " ", etc. are dimensions that should be the prime focus of teaching and learning in schools. It has been realized unfortunately that schools still teach the low ability thinking skills of Remembering and understanding and ignore the higher ability thinking skills. Instruction in most cases has tended to stress knowledge acquisition to the detriment of the higher ability behaviours such as application, analysis, etc. The persistence of this situation in the school system means that pupils will only do well on recall items and questions and perform poorly on questions that require higher ability thinking skills such as application of mathematical principles and problem solving. For there to be any change in the quality of people who go through the school system, pupils should be encouraged 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 mathematical problems while still in school. 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.

The dimensions for teaching, learning and testing in Integrated Science at SHS and their respective weights are as follows:

Remembering and Understanding	20%
Applying Knowledge	40%
Practical and Experimental Skills	40%

Each of the dimensions has been given a percentage weight that should be reflected 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. You will notice that “Applying knowledge” and “Practical and Experimental Skills” have equal weight that is higher than the weight for “Knowledge and Comprehension”. This means that the second and third dimensions are considered more important and will therefore need more emphasis in the teaching and testing system.

The explanation and key words in each of the profile dimensions are indicated below.

Remembering and Understanding (RU)

Knowledge	The ability to: 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.

Applying 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.
Analyzing	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.

Evaluating

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.

The action verbs and the 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 the action verbs provided for your teaching, in evaluating learning before, during and after the instruction. Use the action verbs 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 integrated science 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.

Experimental and Process Skills (EPS)

Experimental skills involve the enquiry/investigative process of planning and designing experiments, carrying out case studies and field studies to be able to compare phenomena or to observe phenomena closely to be able to identify causes and reasons for the occurrence of phenomena and develop practical solutions to problems and tasks.

Process skills involve demonstration of practical manipulative skills using tools, machines and equipment for problem solving in science. Process skills also involve the processes of observation, classification, drawing, measurement, interpretation, recording, reporting, and expected scientific conduct in the laboratory/field.

A summary of the skills required for effective practical and experimental work are the following:

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

A summary of the skills required for effective experimental and practical work are the following:

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7. Designing
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9. Interpretation
10. Recording
11. Reporting
12. Conduct in Laboratory/Field

i Equipment Handling:

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

ii. 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 conclusions.

Research evidence shows that when confronted with a problem, scientists who excel in their respective fields of work develop a number of hypotheses within a short time, review and criticize each hypothesis and then select the best one. Weaker scientists on the other hand, tend to focus on only one or two hypotheses. The implication of this for the teacher of integrated science is to lead students to learn to generate a number of hypotheses for every problem tackled in class; criticize each hypothesis generated before selecting the best one. Some of the critical characteristics to encourage in pupils are:

- Hypotheses generation,
- Ability to modify and change procedures when difficulties arise,
- Creativity,
- Persistence

iii. Observation:

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

iv. Manipulation:

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

v. Classification:

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

- vi. *Drawing:*
Draw clearly and label specimens, objects etc.
- vii. *Designing:*
Visualize and draw new objects or gargets from imagination, etc.
- viii. *Measuring:*
Refers to the accurate use of measuring instruments and equipment for measuring, reading and making observations.
- ix. *Interpretation:*
The ability to
 - (i) evaluate data in terms of its worth: good, bad, reliable, unreliable etc.
 - (ii) make inferences and predictions from written or graphical data
 - (iii) extrapolate
 - (iv) derive conclusions
- x. *Recording:*
Draw or make graphical representation boldly and clearly, well labelled and pertinent to the issue at hand.
- xi. *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.
- xii. *Generalizing*
Being able to use the conclusions arrived at in an experiment to what could happen in similar situations
- xiii. *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

FORM OF ASSESSMENT

It must be emphasized that both instruction and assessment be based on the profile dimensions of the subject. 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 mode you use i.e. class tests, homework, projects etc. must be developed in such a way that it will consist of a representative sample of the important objectives taught over a period.

End of Senior High School Examination

The Senior High School Examination consists of three papers, Paper 1, Paper 2, Paper 3 and the SBA. Paper 1 will usually be an objective – type test paper. Paper 2 will consist of structured questions or essay questions, essentially testing 'Application of Knowledge', but also consisting of some questions on 'Knowledge and Understanding'. Paper 3 will be the practical test paper. School Based Assessment (SBA) will be based on all three dimensions as indicated. The distribution of marks for the objectives test items, essay type questions and the practical questions in the three papers and in the SBA should be in line with the weight of the profile dimensions already indicated and as shown in the last column of the table 1.

The West African Examinations Council (WAEC) generally sets about 60 objective test items at the final examination. Emulate this by developing an objective test paper (Paper 1) that consists of 60 items. Paper 2 could consist of some structured questions and essay questions. In general, let students answer five essay questions from a list of 7-10 questions. Paper 3 will consist of 5-7 practical questions.

In the examination structure presented in the Table 1, Paper 1 is marked out of 60; Paper 2 is marked out of 90, Paper 3 marked out of 60, and School Based Assessment is marked out of 90, giving a total of 300 marks. The last row shows the weight of the marks allocated to each of the four test components. The three papers are weighted differently. Paper 2 is a more intellectually demanding paper and is therefore weighted more than Papers 1 and 3.

Distribution of Examination Paper Weights and Marks

DIMENSIONS	PAPER 1	PAPER 2	PAPER 3	SBA	TOTAL MARKS	% WEIGHT OF DIMENSION
Remembering and Understanding	30	20	-	10	60	20
Applying Knowledge	30	70	-	20	120	40
Experimental and Process Skills	-	-	60	60	120	40
Total Marks	60	90	60	90	300	
% Contribution of Papers	10	25	15	50		100

You will note that Paper 1 has a contribution of 10% to the total marks; Paper 2 has a contribution of 25% to the total marks; Paper 3 has a contribution of 15%, and SBA has a contribution of 50% to the total marks. The SBA marks should be appropriately scaled down to 30%. 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 column are additions of the numbers in the cells and they agree with the profile dimension weights indicated in the last column.

Of the total marks of 300, 60 marks, equivalent to 20% of the total marks, are allocated to Knowledge and Comprehension. 120 marks, equivalent to 40% of the total marks, are allocated to each of Application of Knowledge and Process / Experimental Skills. The weight of each of the three dimensions is indicated in the last column. The ratio of theory to practice in integrated science is 60:40.

Test Item bank

The structure of assessment recommended in the syllabus will need extra effort 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 test items, a pool of essay questions or a pool of practical test questions to fit selected specific objectives which you consider important to be tested. If you proceed diligently, you will realize you have written more than 100 objective test items and more than 30 essay questions in a space of one year or less. Randomly select from the item bank to compose the test papers. Select with replacement. This means, as items / questions are selected for testing, new ones have to be written to replace those items / questions already used in examinations. Test items that have been used in examinations may also be modified and stored in the item bank.

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.

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D)	The students will be able to:		<p>Let students:</p> <p>NOTE:</p> <ol style="list-style-type: none"> 1. Explanation of scientific method should include identification of the problem, hypothesis, experimentation (observation, collection, recording and analysis of data) and conclusion. 2. The discovery of penicillin, radioactivity and the law of floatation may be used to illustrate the scientific method. 3. Explain to students that quest for knowledge and curiosity are necessary to arrive at the truth, facts and solutions to problems. <p>PROJECT WORK:</p> <p>Teacher to assist students in small groups to investigate a common problem in the community e.g. frequent flooding, and apply scientific method to arrive at a solution to the problem. Students can also select problems of interest to them and investigate.</p> <p>Carry out demonstrations on safety precautions in the use of the Laboratory; laboratory equipment, chemicals etc.</p>	<p>There is malaria outbreak in your community. Outline the scientific method you would follow to control the outbreak.</p>
UNIT 2 MEASUREMENT	<p>1.1.3 follow basic safety precautions in the laboratory.</p> <p>1.2.1 use SI units in all measurements</p> <p>1.2.2 use scientific measuring instruments accurately.</p>	<p>Safety precautions in the laboratory.</p> <p>Basic units and Derived units.</p> <p>Using scientific measuring instruments.</p> <p>Truthful and accurate recording of data.</p> <p>Concept of replication of results.</p>	<p>Discuss the following basic units of scientific measurements: Length (m), mass (kg), Time (s), Temperature (K), Current (A), Amount of substance (mol), Luminous intensity (cd)</p> <p>Discuss the following derived quantities and their units: Volume (m^3), Density ($kg\ m^{-3}$), Velocity (ms^{-1}), Force (N), Work and Energy (J), Quantity of electricity (C), electric resistance (Ω), Potential difference(V), Power (W)</p> <p>use instruments such as ruler, balances, stop watches, thermometer, ammeter, measuring cylinder, calipers, pipettes, burette, hydrometer etc. to measure quantities in various units.</p> <p>Teacher to assist students to acquire skills in using eyes, hands and judgment when taking measurement.</p>	<p>Suggest four (4) safety measures to be taken in a Science Laboratory</p> <p>Derive the formula for finding:</p> <ol style="list-style-type: none"> i. the density of a substance ii. velocity of a body in motion <p>Give three reasons why quantities should be measured accurately and honestly.</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 MATTER	The students will be able to:	b) <u>Non-living things:</u> Elements: metals and non-metals.	Let students: Mendeleev Periodic table of elements into eighteen groups and into metals, non-metals and semi-metals, and classification of living societies. NOTE: The 1 st to the 20 th element in the period table should each be classified as metal or non-metal.	Draw and label the following atoms: Oxygen, Hydrogen and Chlorine
	1.4.1 describe the different building blocks of matter.	Particulate nature of matter: atoms, molecules and ions.	review the nature, state and properties of matter through discussion. NOTE Diagrammatic representation is necessary for atoms and molecules of the 1 st to 20 th element on the periodic table.	Classify the following materials into elements, compounds and mixtures: water, salt, iron filings sea water, sulphur, air and glass.
	1.4.2 differentiate between elements, compounds and mixtures.	Elements, compounds and mixtures.	discuss and bring out the differences between elements, compounds and mixtures. prepare simple mixtures and compounds in class.e.g. <ul style="list-style-type: none"> • solid-solid mixtures • solid-liquid mixtures • liquid-liquid mixtures • gas-liquid mixture • gas-gas mixtures 	
	1.4.3 describe the formation of covalent and ionic compounds.	Ionic and covalent compounds.	use models or diagrams to assist the students to discuss: <ol style="list-style-type: none"> 1. Ionic bond formation as a result of transfer of electrons from one atom to another resulting in the formation of cations and anions. 2. Electrostatic attractions between cations and anion to give ionic bond. 3. Covalent bond formation between atoms or groups to give covalent compound 4. characteristic properties of ionic and covalent compounds 	Describe the formation of sodium chloride (NaCl) and ammonia (NH ₃)
1.4.4 relate atomic numbers, mass numbers, isotopes and relative atomic mass among each other.	Atomic number, mass number, isotopes and relative atomic mass of given elements.	NOTE: IUPAC names of common compounds should be taught. discuss the items listed under the content.		
			write down mass number of a given element based on given number of protons or electrons and number of neutrons.	

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 MATTER (Cont)	<p>The students will be able to:</p> <p>1.4.5 perform calculations using the mole concept.</p> <p>1.4.6 prepare solutions of given concentrations.</p>	<p>Mole, molar mass and formula mass. Relationship between grams and moles</p> <p>Preparation of solutions of given concentrations</p>	<p>Let students:</p> <p>explain relative atomic masses using the periodic table. NOTE: Carbon-12 isotope should be mentioned as the reference scale.</p> <p>calculate the following:</p> <ol style="list-style-type: none"> 1. Formula mass and molar mass using given relative atomic masses. 2. Amount of substance in moles given its mass <p>NOTE: Mention should be made of the mole as a unit of the physical quantity, amount of substance. L = 6.02×10^{23} particles as the Avogadro constant; use of $n = \frac{m}{M}$ relationship to calculate amount of substance where n is the symbol for amount of substance, m is the mass, M is the molar mass.</p> <p>Brainstorm to define the concentration of a solution in mol/dm³; g/dm³, percentage and ppm.</p> <p>NOTE: <i>calculations in part per million not required</i></p> <p>carry out simple calculations with the relationship $c = \frac{\text{amount of substance}(n)}{\text{volume of solution}(v)}$</p> <p>Prepare solutions of a given concentration_e.g. 1M solution of a) NaOH (b) NaCl</p> <p>dilute solutions of given concentrations and discuss everyday application of dilution e.g. food preparation, drug preparation.</p>	<p>Calculate the amount of substance in 9g of aluminum (Al = 27 g/mol)</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 5 CELLS	<p>The students will be able to:</p> <p>1.5.1 describe the structure and function of plant and animal cells.</p>	<p>Plant and animal cells.</p> <p>Types of plant and animal cells</p> <p>Specialized cells.</p>	<p>Let students:</p> <p>Review the structure and function of plant and animal cells in a discussion.</p> <p>Observe prepared slides of different types of plant and animal cells. e.g. red blood cell, nerve cell, leaf epidermal cell, sperm cell, leaf palisade cell, lymphocyte, phagocyte.</p> <p>Discuss the functions of cell organelles. draw and label plant and animal cells</p> <p>NOTE:</p> <ol style="list-style-type: none"> 1. Electron micrographs can be obtained from books. 2. Mention should be made of stem cells. 	<ol style="list-style-type: none"> 1. State six differences between plant and animal cells. 2. State one function of each of the following organelles: <ol style="list-style-type: none"> (i) Mitochondrion. (ii) Chloroplast. (iii) Nucleus. (v) Endoplasmic reticulum (vi) Vacuole.
UNIT:6 ROCKS	<p>1.6.1 describe the major types of rocks, their formation and characteristics.</p> <p>1.6.2 explain the process of weathering of rocks.</p>	<p>Rocks: Types (igneous, sedimentary and metamorphic), formation and characteristics.</p> <p>Weathering of rocks: physical, biological, chemical.</p>	<p>Explore the school environment/community to identify different types of rocks.</p> <p>discuss the formation of igneous, sedimentary and metamorphic rocks and their characteristics</p> <p>Discuss physical, biological and chemical weathering of rocks.</p> <p>NOTE: Explanation of the effect of hydration, hydrolysis, carbonation and oxidation on rocks is required.</p>	<p>State two characteristics each of the following rock types:</p> <ol style="list-style-type: none"> (i) Sedimentary rocks. (ii) Igneous rocks. <p>Investigate and write a report on types of weathering processes occurring in the school community.</p>

SHS 1

SECTION 2

CYCLES

General Objectives: The students will

1. recognise that there are repeated patterns of change in nature and understand how these patterns arise.
2. understand the pattern of air movements around the earth, their effects and the necessary precautions to take when storms occur.
3. appreciate the cyclic movement of nitrogen between the soil and the atmosphere.

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 AIR MOVEMENT	<p>The students will be able to:</p> <p>2.1.1 explain the formation of land and sea breezes.</p> <p>2.1.2 identify the various types of air masses and describe their pattern of movement.</p> <p>2.1.3 describe the effect of moving air masses.</p>	<p>Land and sea breezes.</p> <p>Types of air masses and their movements. Trade winds: Easterlies and Westerlies</p> <p>Effect of moving air masses: Formation of storms/cyclones.</p> <p>Precautions against the effects of storms.</p>	<p>Let students:</p> <p>Design models to demonstrate convectional current during the formation of land and sea breezes. NOTE: Examples of models that could be designed are the smoke box and heated water with crystals of $KMnO_4$.</p> <p>Design models and discuss the direction of movement of major air masses on the earth's surface. NOTE: Description of pattern of air movement should be limited to air masses affecting seasons in the West African sub-region.</p> <p>Discuss differences between air masses and storms. Discuss early warning signs of approaching storms. Discuss some effects of moving air masses: Spread of pollutants, effect on climate etc. NOTE: Tornadoes, hurricanes, typhoons are terms which describe cyclones in different parts of the world.</p>	<p>Explain why sea breeze occurs during the day and land breeze during the night.</p> <p>Mention two warning signs of approaching storms and two precautions to be taken to ensure safety.</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (Cont)	The students will be able to:		Let students: PROJECT: Students in groups of two or three to use search engines from the internet or local newspapers or international news stations to gather information and write a report on storms around the world, forecasting procedures, early warning signs etc. Students make a presentation of report in class for discussion and award of marks.	Draw a future's wheel to show the consequences of the spread of pollutants by moving air masses around the earth. Explain how pollutants from one country could lead to problems in another country.
UNIT: 2 NITROGEN CYCLE	2.2.1 describe the nitrogen cycle. 2.2.2 explain the importance of nitrogen cycle to plants and animals.	Nitrogen cycle. Importance of nitrogen cycle.	Draw and discuss the Nitrogen cycle. discuss the importance of the nitrogen cycle to plants and animals e.g. improvement of soil fertility.	Explain the following processes involved in the nitrogen cycle: 1. nitrification 2. denitrification

SHS 1

SECTION 3

SYSTEMS

General Objectives: The students will

1. recognize that a system is a whole, consisting of parts that work together to perform a function.
2. recognize that the mammalian skeleton consists of many different bones which work together.
3. understand the different parts of a plant and how they function together for plant growth and reproduction.
4. be aware of the parts of the body which operate to perform respiratory and digestive functions
5. recognize the process of transportation of substances in living organism as life system.

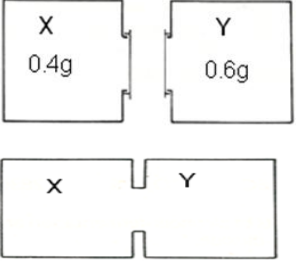
UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 SKELETAL SYSTEM	The students will be able to: 3.1.1 describe the structure and functions of the mammalian skeleton.	Major parts of the mammalian skeleton and their functions. Axial skeleton: Skull and vertebral column. Appendicular skeleton: Limbs and the limb girdles.	Let students: use a model of a mammalian skeleton to discuss major parts of the mammalian skeleton and their functions. NOTE: 1. Discussion to include types of joints. 2. Detailed treatment of the structure of individual bones not needed.	Outline five functions of the mammalian skeleton.
UNIT 2 REPRODUCTION AND GROWTH IN PLANTS	3.2.1 identify parts of a flower and variations in flower structure	Structure of flowers	examine the following: Complete flower and also half flower with free parts. Bi-sexual flower, e.g. Flamboyant or Pride of Barbados or <i>Hibiscus</i> . Uni-sexual flower with free parts e.g. water melon, gourd, pawpaw and Paretusa.	Make a half-flower drawing of a bi-sexual flower and label the parts.

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D)	<p>The students will be able to:</p> <p>3.2.2 describe the processes of pollination and fertilization.</p> <p>3.2.3 describe different types of fruits.</p> <p>3.2.4 describe the structure of seeds and state the functions of their parts.</p> <p>3.2.5 identify the agents of dispersal of seeds and fruits.</p>	<p>Mechanisms of pollination and fertilization.</p> <p>Formation of fruits and seeds.</p> <p>Types of fruits: dry fruits and fleshy or succulent fruits.</p> <p>Seed structure: Endospermous (monocots) and non-endospermous (dicots) seeds.</p> <p>Seeds and fruits dispersal</p>	<p>Let students:</p> <p>PROJECT:</p> <ol style="list-style-type: none"> 1. make a collection of about ten different flower specimens. 2. open fully to locate the main parts. 3. mount each flower on a separate sheet of paper and the parts separated out and labeled. 4. enclose each flower with a plastic sheet and transparent tape. 5. display work by groups on a bulletin board or science table for award of marks. <p>Refer to JHS syllabus to review the process of pollination and fertilization. Fertilization should be limited to processes where the male nuclei fuses with female nuclei to form zygote and endosperm.</p> <p>Formation of fruits and seeds should be discussed.</p> <p>Watch digitized or video version of pollination and fertilization.</p> <p>Collect different types of fruits and group them into dry and fleshy or succulent fruits.</p> <p>Draw a section of a drupe and a berry, e.g. mango and cowpea.</p> <p>GROUP ACTIVITY:</p> <ol style="list-style-type: none"> 1. make a collection of different seeds from the community. 2. Study the features, draw and label the longitudinal section of two of the seeds e.g. maize and <i>Jatropha sp.</i> 3. list the functions of the parts. 4. keep information on each seed including name of collector, date of collection, differences in size, shape, colour and uses. <p>Study and discuss the structure of seeds/fruits and how they are adapted to their mode of dispersal; agents for dispersal.</p> <p>Discuss the advantages and disadvantages of fruit and seed dispersal.</p>	<p>Draw and label a named endospermous seed and give the functions of each labeled part.</p> <p>Relate the structure of the following seeds and fruits to their mode of dispersal:</p> <ol style="list-style-type: none"> 1. Balsam fruit 2. Pride of Barbados fruit 3. Mango fruit 4. Coconut fruit 5. Silk cotton seed 6. <i>Tridax sp.</i>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 FOOD AND NUTRITION	The students will be able to:		Let students:	
	3.2.6 describe the process and conditions necessary for germination.	Process and conditions of germination. Types of seed germination: <ul style="list-style-type: none"> • Hypogeal, • Epigeal. 	Review the process and conditions for germination of seeds in JHS syllabus. Sow different types of seeds and identify the type of germination of each. e.g. maize(hypogeal), cowpea, groundnut/peanut(epigeal).	Use diagrams to explain epigeal and hypogeal germination.
	3.2.7 describe vegetative (asexual) reproduction in plants.	Methods of vegetative reproduction in plants and their importance.	bring samples of propagatory materials to examine and discuss how new plants are produced from corms, setts, bulbs, rhizomes, cuttings, stolons runners, - Discuss budding and grafting. Write word equations for aerobic and anaerobic respirations	Outline two advantages and two disadvantages of vegetative propagation of plants. Distinguish between budding and grafting.
	3.3.1 outline the different classes of food and describe a balanced diet.	Classes of food and food substances, their source and importance: carbohydrates, proteins, lipids, vitamins, mineral salts and water. Balanced diet.	Review topic on classes of food and food substances from the JHS syllabus. Test for starch, proteins and lipids in different types of foods. Discuss the importance of food substances to the human body Discuss the components of a balanced diet e.g. carbohydrates for energy	Students to match the following nutrients and their functions <ul style="list-style-type: none"> i. starch ii. protein iii. lipids.
	3.3.2 state the effects of malnutrition	Effects of malnutrition.	Discuss malnutrition and its effects	
3.3.3 explain the need to fortify and enrich food.	Food fortification and enrichment	Discuss the essence of food fortification and enrichment. NOTE: 1. Relation between diet and certain diseases and disorders such as Night blindness, High Blood Pressure, Diabetes, Obesity, Lactose intolerance and Kwashiorkor should be stressed. 2. Determine the Body Mass Indices (B.M.I) of students and relate to health standards. $B.M.I = \frac{\text{Body weight(kg)}}{[\text{Height(cm)}]^2}$	Explain the following terminologies <ul style="list-style-type: none"> i. balanced diet ii. Malnutrition. 	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
<p>UNIT 3 (CONT'D)</p> <p>UNIT 4 DENTITION, FEEDING AND DIGESTION IN MAMMALS</p> <p>UNIT 5 RESPARATORY SYSTEM</p>	<p>The student will be able to:</p> <p>3.3.4 outline the health benefits of water</p> <p>3.4.1 identify the different types of teeth in mammals and relate them to their functions.</p> <p>3.4.2. enumerate various ways of preventing dental problems.</p> <p>3.4.3 identify the parts the digestive system of humans.</p> <p>3.5.1 define respiration and explain its importance</p>	<p>Health benefits of water</p> <p>Structure of different types of teeth in relation to their functions.</p> <p>Care of the teeth in humans.</p> <p>Structure and functions of the digestive system of humans.</p> <p>Respiration as a source of energy for body processes.</p>	<p>Let students:</p> <p>3. Importance of roughage should be included in the discussion.</p> <p>State the importance of water to the body.</p> <p>Review structure and functions of the teeth.</p> <p>Identify the parts of the vertical section of a tooth.</p> <p>Discuss differences in dentition in human and other mammals.</p> <p>NOTE: Relate dentition to diet.</p> <p>Demonstrate proper ways of caring for the teeth to prevent dental problems, e.g.</p> <ol style="list-style-type: none"> 1. cleaning the teeth daily 2. visiting the dentist at least twice a year 3. feeding on mineral-rich food. <p>Examine a chart or model of the digestive system of human and identify parts of the alimentary canal, the glands and organs associated with digestion.</p> <p>Discuss the meaning of respiration and how energy is released from food substances for living organisms.</p> <p>NOTE: Teacher, using controlled experiments, should demonstrate the release of heat energy and carbon dioxide during respiration of germinating seeds, small animals and yeast (fermentation of corn dough).</p>	<p>Annotate structural parts of molar and canine teeth.</p> <p>Annotate a diagram of human digestive system on a chart or computer.</p> <p>The human body systems work interdependently to perform a life function and sustain life.</p> <ul style="list-style-type: none"> • Identify <i>three</i> human body systems that affect the respiratory system.

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
	<p>The students will be able to:</p> <p>3.5.2 distinguish between aerobic and anaerobic respiration</p> <p>3.5.3 identify the organs of the respiratory system of humans and describe their functions.</p> <p>3.5.4 enumerate some problems and disorders associated with the respiratory system in humans.</p> <p>3.5.5 explain how respiratory gases are taken in and out of plants.</p>	<p>Aerobic and anaerobic respiration.</p> <p>Structure and functions of the respiratory system in humans.</p> <p>Inhalation and exhalation</p> <p>Problems and disorders associated with the respiratory system in humans.</p> <p>Exchange of respiratory gases in plants.</p>	<p>Let students:</p> <p>Discuss aerobic and anaerobic respiration. Write word equations for aerobic and anaerobic respirations.</p> <p>Discuss the functions of the trachea, lungs, ribs, intercostal muscles and diaphragm.</p> <p>Observe chat/video clip/animated version of respiration process in humans.</p> <p>Mention and discuss briefly some problems and disorders associated with the respiratory system e.g. Lung cancer, Asthma, T.B., Whooping Cough, Pneumonia etc.</p> <p>Discuss how they can be prevented and controlled.</p> <p>Discuss how respiratory gases, e.g. oxygen and carbon (IV) oxide are taken in and out of plants.</p> <p>NOTE: Cell (tissue) respiration to be mentioned as a chemical process that produces energy for life activities of organisms (glycolysis and Krebs's cycle not required).</p>	<ul style="list-style-type: none"> Describe how <i>each</i> of the <i>three</i> systems affects the respiratory system. <p>Differentiate between aerobic and anaerobic respiration.</p> <p>Describe the mechanism by which air is taken in and out of the lungs in humans.</p> <p>Describe how respiratory gases enter and leave plant tissues</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 6 TRANSPORT- DIFFUSION AND OSMOSIS.	The students will be able to: 3.6.1 explain processes of diffusion and osmosis	Diffusion and osmosis	<p>Let students:</p> <p>Review topics in JHS syllabus on diffusion and osmosis. Perform simple experiments to demonstrate diffusion in air and liquids.</p> <p>Perform experiment to demonstrate osmosis in a living tissue using yam/cassava/cocoyam and in a non-living tissue using cellophane sheet.</p> <p>Record and discuss your observations.</p> <p>Give examples of life processes in which diffusion and osmosis occur, e.g. absorption in the small intestine, re-absorption of water in the kidney and transpiration.</p> <p>PROJECT: Group of student to apply the principles of osmosis in the following activities: i. Salting of fish for preservation e.g. <i>Tilapia</i> ("koobi") ii. Preservation of liquid food products e.g. fruit juice concentrate</p>	<p>(a). Explain the following terms: i. hypertonic solution ii. hypotonic solution iii. isotonic solution</p> <p>(b). Explain the effect of introducing red blood cell into i. hypertonic solution ii. hypotonic solution iii. isotonic solution</p> <p>Two containers X and Y each hold one litre of air. X also contains 0.4g of a gas and Y contains 0.6 g of the same gas. The two containers are connected together as shown in the diagram.</p>  <p>(i). Which way will the gas diffuse? (ii). After a long period of time, what will be the concentration of the gas (in grams per litre) in each container?</p>

SHS 1

SECTION 4: ENERGY

General Objectives: The students will:

1. recognize that energy has a source, and can be transferred and transformed into other forms
2. understand the application of solar energy in daily activities and in the manufacture of plant food.
3. Be aware of the behaviour of discrete electronic components

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 1 FORMS OF ENERGY AND ENERGY TRANSFORM- ATION	The students will be able to: 4.1.1 distinguish between various forms of energy and modes of transformation.	Forms of energy and energy transformation.	Let students: Refer to JHS syllabus for a review on forms of energy. Illustrate with flow charts to show the following energy transformations: <ol style="list-style-type: none"> 1. solar energy to chemical energy in photosynthesis. 2. chemical energy to electrical energy in voltaic cells 3. solar energy to electrical energy in solar cells. 4. chemical energy in fossil fuel into thermal energy/electrical energy 5. potential energy to kinetic energy in falling object. 6. electrical energy to light energy in bulbs. 7. chemical energy is released from glucose during cellular respiration. 	With the aid of diagrams show the energy transformation in (i) photosynthesis (ii) respiration.
	4.1.2 discuss the conservation of energy and efficiency of energy conversion.	Conservation of energy and efficiency of energy conversion	discuss the principle of conservation of energy. demonstrate the principle of transformation of energy by considering the transformation of potential energy to kinetic energy using a falling object discuss the efficiency (E) of energy conversion using the expression $E = \frac{\text{energy output}}{\text{energy input}} \times 100\%$	Describe three activities to show how energy is conserved. Explain why the efficiency of energy converters is not 100%

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 2 SOLAR ENERGY	<p>The students will be able to:</p> <p>4.2.1 identify the uses of solar energy.</p>	<p>Uses of solar energy:</p> <p>Generation of electricity from solar panel/solar cells.</p> <p>Drying.</p> <p>Solar heaters</p> <p>Application of solar energy in practical daily activities.</p>	<p>Let students:</p> <p>discuss the main applications of solar energy: generating electricity, drying materials and heating substances.</p> <p>Carry out practical activities to demonstrate the application of solar energy to:</p> <ol style="list-style-type: none"> 1. dry clothes 2. heat water for bathing 3. dry crops for preservation 4. cook, e.g. corn, sausages, hot dog, fish and ripe plantain 5. boil an egg. 	<p>Describe the process involved in the generation of electricity from solar panel.</p> <p>Outline the advantages of solar energy over the use of fossil fuel as source of energy</p>
UNIT 3 PHOTOSYNTHESIS	<p>4.3.1 describe the process of photosynthesis.</p> <p>4.3.2. explain the process of the transformation of energy that occurs during photosynthesis.</p>	<p>The process of photosynthesis.</p> <p>Conditions for photosynthesis:</p> <ul style="list-style-type: none"> • Light, • Chlorophyll, • carbon dioxide, • water. <p>Conversion of light energy to chemical energy.</p>	<p>Carry out control experiments to show the necessity of light, chlorophyll and carbon dioxide for photosynthesis.</p> <p>Discuss the conditions of photosynthesis.</p> <p>Use word and symbol equations to show how light energy is trapped during the process of photosynthesis and converted to glucose.</p> <p>Test for starch in a leaf.</p>	<p>Describe an experiment to demonstrate that light is essential for photosynthesis.</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4: ELECTRONICS	<p>The students will be able to:</p> <p>4.4.1 observe the behaviour of discrete electronic components in a d.c. electronic circuit.</p>	<p>Behaviour of discrete electronic components:resistor, capacitor and inductor – in a d.c and electronic circuits.</p>	<p>Let students:</p> <p>Connect a simple electronic circuit comprising a d.c. source, a resistor and a Light Emitting Diode (<i>LED</i>) in series.</p> <p>observe the behaviour of the <i>LED</i> when:</p> <ol style="list-style-type: none"> 1. the switch is closed 2. switch is opened 3. resistor is replaced with capacitor. 4. capacitor is replaced with inductor or coil. <p>Repeat the experiment by replacing the d.c. source with a 12V a.c. source.</p> <p>PROJECT: Design and construct an electronic mosquito repellent using the capacitor, inductor and transistor arrangement.</p>	<p>Compare the behaviour of an <i>LED</i> when a capacitor is in a d.c or a.c electronic circuit.</p>

SHS 1

SECTION 5: INTERACTIONS OF MATTER

General Objectives: The student will:

1. appreciate that the interaction between and within matter helps humans to better understand the environment and their role in it.
2. recognize the effect of changing climatic conditions on the environment.
3. be aware of movements of the earth and the effects of these movements.
4. recognize the harmful effects of disease-causing organisms and the need to control them.

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 1 ECOSYSTEM	<p>The students will be able to:</p> <p>5.1.1 define basic ecological terms.</p> <p>5.1.2 classify ecosystems and identify their components</p>	<p>Basic biological terms: Ecology, Species, population, community, ecosystem, ecosphere.</p> <p>Types of ecosystem and components.</p> <p>Natural: fresh water, marine, estuarine, lake, rainforest, savanna and desert</p> <p>Artificial: farmland, man-made lakes, roads.</p> <p>Components of ecosystem: Biotic/living component including plants and animals.</p> <p>Abiotic / non-living component including soil, air and water.</p> <p>Ecological factors: Biotic - predation, competition. Abiotic – climatic (rainfall, humidity, temperature) salinity, altitude, slope of land etc.</p>	<p>Let students:</p> <p>Brainstorm to bring out the meaning of the ecological terms: species, population, community, ecosystem, ecosphere.</p> <p>Classify the various ecosystems: terrestrial, fresh water, marine etc.</p> <p>Identify the components of an ecosystem and discuss how they affect each other.</p> <p>Classify ecological factors into biotic and abiotic and show how they affect the distribution, abundance and development of plants and animals (humans).</p> <p>Discuss appropriate instruments used to measure abiotic factors.</p>	<p>Differentiate between the following ecological terms:</p> <ol style="list-style-type: none"> i. ecosystem and ecology ii. ecosystem and ecosphere iii. species and population iv. population and community <p>Describe the interaction between the components of a named ecosystem.</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 2 (CONT'D)	The students will be able to:	Desertification, drought Melting of ice and polar ice caps, rising sea levels Increase in number and intensity of hurricanes (cyclones), effects on biodiversity resources, etc.	Let students: Discuss possible factors to address the problem of global warming. PROJECT: Students to interview people in the community to find out and report on climate change in the community over the past thirty to fifty years and its effect on the community.	
UNIT: 3 INFECTIONS AND DISEASES	5.2.5 explain the causes and effects of the depletion of the ozone layer.	Causes and the effects of the depletion of the ozone layer	State what the ozone layer is and discuss how it protects living organisms. Relate the sources and effects of CFCs on the ozone layer.	Mention two effects of the supersonic air transport on the ozone layer.
	5.2.6 explain the causes and effects of acid rain.	Acid rain and its effects: Damage to buildings, paints and forests.	Identify acidic pollutants which cause acid rain. discuss the effects of acid rain the environment (damage to buildings, forests etc)	Mention three examples of acidic pollutants and how they affect forests and buildings
	5.3.1 describe the causes of diseases.	Pathogenic: bacteria, virus, fungi, protozoa. Non-pathogenic: nutritional, genetic, stress.	discuss the causes of pathogenic diseases under the following headings: bacteria, virus, fungi and protozoa. describe the causes of non-pathogenic diseases under the following headings: poor nutrition, genetic, stress conditions poor sanitation etc.	Discuss the courses, symptoms, mode of transmission, prevention and control of the following common diseases: anthrax, Newcastle, avian flu, CSM and rickettia
	5.3.2 describe the modes of transmission, symptoms and modes of control of common diseases.	Modes of transmission. Symptoms and modes of control of diseases which are: Air borne, Water related, Insect borne (vectors), Food contaminated (food poisoning), Nutrition related, Sexually transmitted, Communicable, Zoonotic diseases.	discuss modes of transmission, symptoms, method of prevention and control of at least two examples of pathogenic and non-pathogenic diseases. Give one example each of the diseases mentioned under the content, their modes of transmission, symptoms and method of control. NOTE: Detailed treatment of individual diseases not needed.	

SHS 2

SECTION 1: DIVERSITY OF MATTER

General Objectives: The students will:

1. appreciate the diversity of chemical substances and their effect on matter
2. recognize the variety of substances that improve soil for optimum productivity.

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 1 ACIDS AND BASES	The students will be able to:		Let students:	
	1.1.1 define acids and bases and state their properties.	Acids as proton donors Bases as proton acceptors. Physical and chemical properties of acids and bases.	Brainstorm to bring out the definitions of acids and bases. Discuss the properties and uses of acids and bases. perform the following chemical tests to show the properties of acids and bases: (a) Reaction of acid and base (neutralization reaction). (b) Dilute acid + metal (production of H ₂ gas) (c) Acid + trioxocarbonate (IV) compounds (production of CO ₂ gas). (d) Reaction of a base and an ammonium salt (production of NH ₃ gas) (e) Test for hydrogen, carbon dioxide and ammonia gases.	Write word equation for reactions between a named: i. Acid and metal. ii. Base and ammonium salt.
	1.1.2 identify common chemical substances as acids or bases and classify them according to their sources and uses.	Acids and bases, e.g. Organic acids – vinegar, Organic bases - ammonia, Inorganic acids – dilute HCl Inorganic base – milk of magnesia	Perform chemical tests to classify each chemical substance listed under the content as an acid or a base. Discuss the uses of acids and bases in everyday life and in industry, e.g. sodium hydroxide and tetraoxosulphate(VI) acid.	Describe the laboratory preparation of NH ₃ gas. How would you test for Ammonia.
1.1.3 prepare salts.	Methods of preparation of salts.	prepare salts using any of the following methods: neutralization, precipitation, acid decomposition of trioxocarbonate (IV) salt. Visit a salt/chemical industry and write a group report on the activities observed. Present your report to the class.	Give two uses each of sodium Hydroxide (NaOH) and tetraoxosulphate (VI) acid (H ₂ SO ₄) _{aq} .	

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 2 SOIL CONSERVATION.	The students will be able to:		Let students:	
	1.1.4 describe the effect of acid – base indicators.	Acid – base indicators	describe the colours developed by phenolphthalein, litmus and methyl orange in aqueous solutions of dilute acids, dilute bases, dilute sodium chloride, distilled water and common fruit juice, e.g. citrus.	1. Explain how to determine the pH of a given solution.
	1.1.5 use universal indicators and the pH-meter to determine the pH of given solutions.	Determination of pH of given solutions. Determination of soil pH.	discuss the use of the universal indicator and the pH-meter in the determination of the pH of common household chemicals, e.g. vinegar, palm oil, shampoo and local soap. use colours developed by the universal indicator to deduce the pH of acidic, neutral and basic solutions. NOTE: Point out the limitations of the use of the pH scale for highly dilute/concentrated solutions: Their pH are outside pH = 0 to pH = 14.	2. Which is more acidic: a solution of pH = 1 or a solution of pH = 9 3. Explain why the use of universal indicator in determining the pH of solution does not work well with coloured solutions?
	1.2.1 explain the principles of soil and water conservation.	Principles of soil and water conservation. Conserving soil moisture Maintaining soil fertility	describe activities to conserve soil water and maintain soil fertility e.g.; irrigation, mulching, addition of organic matter and crop rotation relate soil fertility to soil productivity	1. Explain the concept of soil conservation.
1.2.2 distinguish between macro and micro nutrients.	Classification of soil nutrients into: Macro (major) nutrients: Nitrogen (N), potassium (K), phosphorus (P), calcium (Ca), magnesium (Mg), sulphur (S). Micro (minor) nutrients: boron (B), molybdenum (Mo), manganese (Mn), chlorine (Cl), zinc (Zn), copper (Cu) and iron (Fe).	group soil nutrients into macro (major) nutrients and micro (minor) nutrients. discuss sources of nutrients, e.g. nitrogen from nitrogenous fertilizers such as urea and organic manure.	2. Outline five activities that farmers can undertake to enhance soil productivity.	

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2: (CONT'D)	<p>The students will be able to:</p> <p>1.2.3 state the functions of some soil nutrients and their deficiency symptoms.</p> <p>1.2.4 describe methods of maintaining soil fertility.</p> <p>1.2.5 outline factors which lead to the depletion of soil nutrients.</p>	<p>Functions and deficiency symptoms of N, P, K, Mn, Fe.</p> <p>Maintenance of soil fertility: application of organic and inorganic manure/ fertilizers, crop rotation, cover cropping, liming, green manuring.</p> <p>Factors which lead to the depletion of soil nutrients:</p> <ol style="list-style-type: none"> 1. Erosion 2. Overgrazing 3. Poor farming and tillage methods, 4. Dumping of non-biodegradable waste on land 5. Improper irrigation and drainage practices. 6. Surface mining and quarrying. 7. Deforestation. 8. Excessive use of fertilizer 	<p>Let students:</p> <p>Identify and discuss plants having nutrient deficiency symptoms.</p> <p>NOTE: Students to refer to Nitrogen Cycle in SHS and the Carbon Cycle in JHS syllabuses and relate them to the maintenance of soil fertility.</p> <p>demonstrate ways of improving soil fertility.</p> <p>demonstrate ways of preparing compost.</p> <p>discuss how the factors listed under content lead to the depletion of soil nutrients.</p> <p>NOTE: Detailed discussion of erosion is not required.</p> <p>PROJECT Design a model of a farm to illustrate the harvesting of runoff water for irrigation.</p>	<p>Describe the deficiency symptoms of the following nutrients in plants: nitrogen, potassium and phosphorus.</p> <p>Outline the various processes involved in compost preparation.</p> <p>Outline three effects of soil erosion on soil productivity</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 3 WATER	The students will be able to:		Let students: refer to JHS syllabus for a review of sources of water, physical and chemical properties of water and the treatment of hard and soft water. perform experiments to investigate properties of water: (i) demonstrate the solvent action of water on a variety of substances. (ii) determine the presence of dissolved substances in some sources of water (iii) demonstrate the polar nature of water. NOTE: discussion should include uses of water.	Explain what an aqueous solution is and give three examples.
	1.3.2 distinguish between hard and soft water.	Hardness and softness of water. Advantages and disadvantages of hard and soft water.	collect water from different sources and determine their hardness using the same brand of soap. discuss the advantages and the disadvantages of hard and soft water.	Name two compounds which cause permanent hardness of water and two compounds which cause temporary hardness of water.
	1.3.3 demonstrate how to soften water.	Softening hard water.	demonstrate through an activity any one of the following processes to soften hard water: addition of washing soda, ion exchange, boiling and distillation.	Name two advantages and two disadvantages of hard and soft water.
	1.3.4 describe the steps involved in the treatment of water for public consumption.	Treatment of water for public consumption	draw a flow chart to show the steps involved in the treatment of water for public consumption discuss the importance of water as well as the role of the Ghana Water Company in public water supply. PROJECTS: 1. Organise a visit to local water treatment plant and write a report on the visit. 2. Design water filtration system using charcoal.	Describe one method by which hard water can be softened. Perennial water shortage and frequent disruptions in water supply in most communities in Ghana can be traced to erosion of human values. Discuss. Outline the role of Ghana Water Company in the control of water supplies in cities, towns and villages. List two significance of the use of charcoal in filtering water.

SHS 2

SECTION 2: CYCLES

General Objectives: The students will:

1. recognize that there are repeated patterns of change in nature and understand how these patterns arise.
2. be aware of the natural distribution of the earth's water and the need to conserve water for plant and animal use.
3. appreciate the importance of animal production to humans.
4. become aware of the production cycle of some animals
5. recognise the need to apply scientific principles in the rearing of animals

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 1 HYDROLOGICAL CYCLE	The students will be able to:		Let students:	
	2.1.1 explain the distribution of the earth's water.	Distribution of the earth's water: Groundwater Surface water (fresh water marine water)	discuss where earth's water is located and how much of it is available for human use. NOTE: Percentage distribution of water on the earth's surface to be mentioned	Draw a hydrological cycle and comment on its importance to plants and animals.
	2.1.2 explain the relevance of the hydrological cycle to plants and animals.	Relevance of hydrological cycle	discuss the processes involved in the hydrological cycle using appropriate diagrams.	Give one example each of the following water-related diseases: (i) water-washed (ii) water-borne (iii) water-based
2.1.3 outline the main sources of water contamination and the effects on humans	Main sources of water contamination: domestic waste, commercial waste, industrial and mining waste, agricultural waste, radioactive waste, and "special" waste such as waste from hospitals. Effects of water contamination: water-related diseases and infections.	discuss the various sources of water contamination to include items listed under content. discuss the effects such as water-related diseases under the following headings: water-borne, water-washed, water-based and insect based diseases. gather more information on the topic using search engines from internet sites	Discuss the importance of rainwater harvesting	

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 1 HYDROLOGICAL CYCLE(CONT'D)	The students will be able to: 2.1.4 describe household water conservation methods.	Water conservation methods	Let students: Discuss household water treatment, waste water treatment, safe water storage, modern and traditional rainwater harvesting systems. PROJECT: 1. Gather information on modern and traditional rainwater harvesting system from the following sources: i. interviewing people in the community, ii. library, websites and scientific journals 2. Design a simple water harvesting technique or a domestic water reuse system.	
UNIT 2 GENERAL PRINCIPLES OF FARM ANIMAL PRODUCTION.	2.2.1 outline the main activities involved in the production of farm animals. 2.2.2. describe ruminant production. 2.2.3 describe non ruminant production.	Main activities involved in farm animal production. Selection of suitable breeds. Choice of management system: Breeding systems and care of the young. Management practices including animal health care and feeding. Finishing, processing and marketing of produce Ruminant production: cattle/goats/sheep Production of non-ruminants: poultry/pigs/rabbits	Visit a nearby livestock farm or a commercial livestock enterprise to investigate and report on the following: i. Main activities carried out ii. Management system in use. iii. Breeding/animal improvement procedures iv. Feeding procedures v. Pest, parasite and disease control vi. Marketing of animal products. discuss goat/cattle/sheep production under the items listed under SRN 2.2.1: Types of breeds and their characteristic, management practices, breeding systems, common pests and diseases, marketing of products etc. follow main activities outlined in SRN 2.1.1 to produce a non-ruminant farm animal.	Outline five management practices used on a poultry farm. Describe three different management systems for keeping farm animals. List one advantage and one disadvantage of each system. Explain three management practices that are used to control and prevent diseases and pests in farm animals

SHS 2

SECTION 3: SYSTEMS

General Objectives: The students will:

1. recognize that a system is a whole consisting of parts that work together to perform a function.
2. recognize the processes of excretion, reproduction, and transportation of substances in living organisms as life systems.

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 1 EXCRETORY SYSTEM	The students will be able to:		Let students:	
	3.1.1 explain the meaning of excretion	Excretion in mammals	Brainstorm to bring out the meaning of excretion. discuss to bring out the differences between excretion and egestion	Distinguish between excretion and egestion in humans.
	3.1.2 identify organs of the excretory system and their products in mammals.	Organs of excretory system and their products.	discuss the main organs of excretory system (lungs, skin, liver and kidneys) and match them against their products NOTE: 1. Excretory products of liver should include bile pigment, urea and cholesterol. 2. Discussion to include: i. Structure of the skin and kidneys (Structure of nephron not required) ii. How the products of excretion (sweat and urine) are eliminated from the body after their formation. iii. Excretory product of liver should include bile, cholesterol and pigment.	List three excretory organs and their respective products
3.1.3 mention some disorders of the urinary system in humans and their remedies.	Disorders of urinary system in humans.	Discuss the disorders of the human urinary system e.g. bed wetting, urine retention, kidney stones and their remedies.		

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 2 REPRODUCTIVE SYSTEM AND GROWTH IN MAMMALS	<p>The students will be able to:</p> <p>3.2.1 identify the reproductive organs of a mammal and their functions.</p> <p>3.2.2 state the advantages and disadvantages of male and female circumcision.</p> <p>3.2.3 outline the processes leading to fertilization, zygote development and birth in humans.</p> <p>3.2.4 identify the problems associated with reproduction in humans.</p> <p>3.2.5 mention types of STIs including HIV/AIDS, how they are transmitted and their effects.</p>	<p>Structure and function of the mammalian reproductive system.</p> <p>Male and female circumcision.</p> <p>Fertilization, development of the zygote (pregnancy) and birth in humans.</p> <p>Problems associated with reproduction in humans: Miscarriage, ectopic pregnancy, infertility, impotence, fibroid, disease infections ovarian cyst.</p> <p>Sexually transmitted infections (STIs): HIV/AIDS, gonorrhoea, herpes, Chlamydia, syphilis candidiasis (white/trash).</p> <p>Mode of transmission Effects: prolonged sickness, infertility</p>	<p>Let students:</p> <p>Annotate a diagram of a dissected small male and female mammal (e.g. guinea pig, rabbit); showing the reproductive systems.</p> <p>Discuss the advantages and disadvantages of circumcision.</p> <p>NOTE: Pay particular attention to the dangers of female circumcision.</p> <p>Discuss the process of fertilization, development of zygote (pregnancy) and birth using charts, models and diagrams.</p> <p>NOTE: Discussion to include: formation of twins: 1. Identical, fraternal and Siamese. 2. Details of cell division and anatomy of the embryo not required.</p> <p>discuss problems associated with reproduction in humans as listed under content. Causes of infertility in both males and females to be discussed as well as illegal abortion.</p> <p>CASE STUDY: A childless couple thinks their problem is due to witchcraft. Use scientific method and reasoning to explain the possible causes of the infertility.</p> <p>Discuss various sexually transmitted diseases and their modes of transmission.</p> <p>Analyse the effects of STIs including HIV/AIDS on the health and reproduction in humans.</p>	<p>Identify a diagram of the organs of the male and female reproductive systems of humans on a chart.</p> <p>Explain the formation of identical, fraternal and Siamese twins.</p> <p>State one cause of each of the following: 1. ectopic pregnancy 2. infertility 3. fibroid 4. impotence</p> <p>Discuss the effects of HIV/AIDS on the family and the society.</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 3 THE CIRCULATORY SYSTEM	The students will be able to: 3.2.6 identify the phases of growth and development in humans and the associated changes.	Phases of growth and development in humans.	Let students: Discuss the various phases of growth and the physical and behavioural changes associated with each phase of human development. NOTE: The changes may include losing milk teeth and development of permanent teeth, increase in mass, height, development of secondary sexual characters, e.g. menstruation in girls (pre-menstrual syndrome (PMS) in some women- accompanied by violent moods or depression), wet dreams in boys. Changes in old age should include menopause and its associated problems.	Discuss the development of secondary sexual characteristics in males and females
	3.3.1 describe the structure and functions of the circulatory system of humans.	Structure and functions of the circulatory system of humans.	invite a psychologist and gynaecologist to talk about changes during adolescence and symptoms associated with menopause. Use charts/models/diagrams/video clip/digitized content to trace the flow of blood through the heart, the lungs and the body of humans. NOTE: 1. Detailed structure of the blood vessels not required 2. Relate it osmosis and diffusion in plants	Discuss the functions of the heart, the veins and the arteries in the circulatory system.
	3.3.2 describe the composition and functions of blood.	Composition and functions of blood.	Discuss the composition and functions of the blood(transport, defense and support) NOTE: 1. Discussion should not include the mechanism of blood clotting. 2. Functions of blood should be discussed under: transport, defense and support.	List the two main components of the blood. State three functions of the blood.
	3.3.3 identify disorders associated with the blood circulatory system of humans.	Disorders associated with the circulatory system: high blood pressure, low blood pressure, hole-in-heart, leukemia, anaemia	CLASS ACTIVITY: Carry out activities using the appropriate equipment to measure their own blood pressure Explain the causes of disorders of the circulatory system in humans. NOTE: Invite a resource person to give talk on the disorders of the circulatory system of humans.	List three disorders associated with the human circulatory system.

SHS 2

SECTION 4: ENERGY

General Objectives: The student will:

1. recognize that energy has a source, can be transferred and can be transformed into various forms
2. become aware of the various forms of energy such as electrical and sound energy and their uses
3. appreciate the behaviour of the components of an electronic circuit.
4. appreciate the use of nuclear energy as an alternate source of energy.

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 ELECTRICAL ENERGY	The students will be able to: 4.1.1 describe static and current electricity.	Nature of static and current electricity. Sources of and static current electricity.	Let students: Comb dry hair with plastic comb and use it to collect bits of tissue paper and explain the phenomenon. Explain that the formation of lightning is based on electrostatics. discuss protection of buildings and installations from lightning strikes using lightning arrestors state sources of current electricity. Discuss differences between a.c and d.c.	Explain in terms of electron movement what happens when a plastic comb is used to rub the hair.
	4.1.2 name the various components of electric circuits and state their functions.	Simple electric circuits: Series and parallel arrangements of components.	Draw a simple electric circuit and discuss the functions of each component. Connect the components of a simple circuit in series and parallel and explain their advantages and disadvantages.	state the functions of the following components of an electric circuit; 1. Battery 2. Switch 3. Resistor

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D)	<p>The student will be able to:</p> <p>4.1.3 calculate resistance, current, potential difference and power.</p> <p>4.1. 4 identify the sources of electric power generation.</p> <p>4.1.5 describe the stages of electric power transmission.</p>	<p>Resistance (R),current (I), potential difference (V) and power (P)</p> <p>Sources of electric power generation.</p> <p>Power transmission: Transformers (step up and step down transformers).</p> <p>Wiring a plug Household wiring Stabilizers, fuses and Earthing.</p>	<p>Let students:</p> <p>state Ohm's law and carry out simple calculations using the relation $V = IR$</p> <p>Carry out simple calculations for electric power.</p> $P = IV = I^2R = \frac{V^2}{R}$ <p>State power ratings (wattage) of some electrical devices, e.g. stove 750W and bulbs 40W, 60W,</p> <p>Discuss the importance of power ratings of electric appliances.</p> <p>Discuss the importance of the use of energy saving electrical appliance.</p> <p>Discuss the effect of electric power rationing on electrical appliances.</p> <p>discuss sources of electric power generation: Hydro, thermal, nuclear, solar, wind, tidal and biogas.</p> <p>PROJECT: i. Visit a thermal/hydro-electric power station and write report.</p> <p>discuss the gadgets and processes involved in the transmission of power under the following headings:</p> <ol style="list-style-type: none"> 1. Use of step up and step down transformer. 2. Wiring of a plug. 3. Household wiring. 4. Use of stabilizers. 5. Use of fuse. 6. Use of earthing. 	<p>Resistors 2Ω and 6Ω are connected in (i) parallel and (ii) series to a 1.5 V cell. Calculate the current flowing in each arrangement</p> <p>An electric appliance is rated 240V, 750W. Calculate (i) the current (ii) the resistance</p> <p>Discuss how electric power reaches your home from a hydro-electric power station (Akosombo).</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 2 ELECTRONICS	<p>The student will be able to:</p> <p>4.2.1 classify solid materials into conductors, insulators and semi conductors.</p> <p>4.2.2 explain the formation of P-type and N-type semi conductors</p> <p>4.2.1 describe the formation of a P-N junction diode.</p> <p>4.2.2 explain the behaviour of a P-N junction diode in a d.c. and a.c electronic circuits.</p>	<p>Conductors, insulators and semi conductors</p> <p>P-type and N-type semi conductors</p> <p>P-N junction diode formation.</p> <p>Doping</p> <p>Behaviour of a P-N junction diode</p> <p>Rectification.</p>	<p>Let students:</p> <p>discuss conductors insulators and semiconductors</p> <p>discuss the formation of P-type and N-type semi conductors</p> <p>observe a P-N junction diode</p> <p>Discuss the formation of a P-N junction diode.</p> <p>Explain the behaviour of the diode when it is <i>ON</i>(forward bias).</p> <p>Explain the behaviour of the diode when it is <i>OFF</i>(reverse bias).</p> <p>Connect a 3.0V battery, a switch, an LED and a P-N junction diode in series. Switch on the circuit and observe the behavior of the LED.</p> <p>Reverse the position of the P-N junction diode and observe the behavior of the LED.</p> <p>Explain half wave Rectification.</p>	<p>Describe the behaviour of a loud speaker in an amplifier circuit when</p> <p>(i) the switch is closed</p> <p>(ii) the switch is opened.</p>
UNIT: 3 SOUND ENERGY	<p>4.3.1 explain the sources and nature of sound.</p>	<p>Sources of sound.</p> <p>Nature of sound: velocity, reflection, refraction.</p>	<p>produce sound from different instruments (pipes, rods or strings and percussions)</p> <p>discuss reflection and refraction of sound</p> <p>discuss differences in velocity of sound in gas, liquid, solid and vacuum.</p> <p>NOTE:</p> <p>1. Discussion should include formation of echoes.</p> <p>2. Determination of the velocity of sound is not required.</p>	<p>How is sound produced by the following musical instruments:</p> <p>(i) pipes,</p> <p>(ii) strings,</p> <p>(iii) percussion.</p> <p>State three facts about the nature of sound energy.</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 NUCLEAR ENERGY	The students will be able to: 4.3.2 describe musical notes and distinguish musical notes from noise.	Musical notes and noise.	Let students: Produce different sounds and classify them as musical notes or noise. Explain pitch, loudness and quality of musical notes.	
	4.3.3 identify the parts of the human ear and describe their functions.	Structure and functions of the human ear.	NOTE: Teacher to mention that loudness of sound is measured in decibels. Compare notes produced by different types of musical instruments in terms of pitch, loudness and quality. Let students: Describe the human ear and the functions of each part. Discuss the effect of loudness and pitch on humans e.g. sound pollution. Discuss the importance of ear muffs.	Differentiate between: i. Pitch and loudness ii. Loudness and quality of sound What is the effect of high pitch sound on humans?
	4.4.1 describe the nature of radioactivity	Radioactivity	Discuss the causes of nuclear instability and how they emit radiation to become stable. Mention types of radiation (alpha particles, beta particles and gamma rays).	Name the three radiations emitted during radioactivity. Compare the radiations under the following headings: (i) mass (ii) charge (iii) penetrating power.
	4.4.2 describe the nature and uses of radioisotopes	Nature and uses of radioisotopes	Discuss the nature, production and use of radioisotopes: food preservation, sterilization of equipment, treatment of diseases, pest control and crop improvement etc.	
	4.4.3 state the uses of nuclear energy	Uses of nuclear energy	Discuss uses of nuclear energy e.g. in the production of electricity,	
	4.4.4 outline ways for protecting people from the effects of radioactivity	Protection from the effects of radioactivity. Problems associated with nuclear waste disposal.	Use charts/video clips to discuss the harmful effects of radioactivity and how to protect people from the effects e.g. atomic bombs. Discuss the problems associated with the disposal of nuclear waste	

SHS 2

YEAR 2 SECTION 5: INTERACTIONS OF MATTER

General Objectives: The Students will:

1. appreciate that interaction between and within matter helps humans to better understand the environment and their role in it
2. understand the principles of operation of magnets, forces and motion of objects
3. recognise the importance of proper sanitation in communities for healthy living
4. be aware of safety precautions at the community and to prevent hazards
4. understand the working of simple machines and how to maintain them.
5. become aware of existing endogenous technology and possible ways for improvement.
6. be aware of modern technology and how it has caused great improvement in our way of living.

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 1 MAGNETISM	The student will be able to:		Let students:	
	5.1.1 distinguish between magnetic and non magnetic materials.	Magnetic and non-magnetic materials.	Move magnets closer to various kinds of materials and classify them as: magnetic and non-magnetic materials. discuss permanent and temporary magnet	Name five each of common household items that are: i. magnetic ii. non-magnetic materials.
	5.1.2 distinguish between permanent and temporary magnet and their uses	Types of magnet and their uses	Explore the uses of magnets in everyday life e.g. Telephone earpiece Loud speakers Microphones Magnetic compass Generation of electricity Fridge doors	Explain the difference between permanent and temporary magnet.
	5.1.3 explain magnetic field.	Magnetic field.	Brainstorm to bring out the meaning of a magnetic field. Use a compass or iron filings to demonstrate magnetic fields around a bar magnet.	Draw a magnetic field around a bar magnet.
5.1.4 describe the methods of magnetisation and demagnetisation.	Magnetisation and demagnetisation	Discuss the magnetisation of a steel bar using electrical (d.c.) method Discuss complete demagnetisation of a permanent magnet using a.c. discuss the production and uses of electromagnets.	Describe how you would magnetise a steel bar by electrical method.	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 FORCE, MOTION AND PRESURE	<p>The student will be able to:</p> <p>5.2.1 explain force and outline various types.</p> <p>5.2.2 state the Archimedes Principle and the law of floatation.</p> <p>5.2.3 explain the terms distance, displacement, speed, velocity and acceleration.</p>	<p>Force: What it is and types: Frictional,</p> <ul style="list-style-type: none"> • Viscous, • Gravitational, • Electrostatic, • Magnetic, • Upthrust • Tension • Weight • Push/pull <p>Archimedes Principle and law of floatation.</p> <p>Distance, displacement, speed, velocity, acceleration and momentum</p>	<p>Let students:</p> <p>Brainstorm to define force.</p> <p>investigate the effect of force by:</p> <ol style="list-style-type: none"> 1. stretching a piece of elastic string 2. pushing an object. 3. stopping a moving object. <p>Explain the various types of forces as listed in the content and carry out activities to demonstrate each one of them.</p> <p>discuss to bring out the meaning of upthrust</p> <p>discuss Archimedes principle and the law of floatation and use them to explain the following phenomena:</p> <ol style="list-style-type: none"> 1. the flight of birds 2. why boats float in water <p>GROUP ACTIVITY:</p> <ol style="list-style-type: none"> 1. Observe and record what happens when different metallic and wooden objects are placed in water. 2. Place a fresh egg first in water and then in concentrated salt solution and explain the observation in each case. <p>Brainstorm on what the following terms stand for: distance, displacement, speed, velocity, acceleration and momentum</p> <p>(i) $\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$; (ii) $\text{velocity} = \frac{\text{displacement}}{\text{time taken}}$</p> <p>(iii) $\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$</p> <p>Note: The above equations are not definitions. They are expressions of relationships Use the knife edge (wedge) method to determine the centre of gravity of rectangular, triangular and irregular shaped cardboards.</p>	<p>State three effects of force on a body.</p> <p>Explain the term upthrust.</p> <p>An object of mass 4kg moving with initial velocity of 20ms^{-1} accelerates for 10s and attains a final velocity of 60ms^{-1}. Calculate the acceleration.</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D)	<p>The students will be able to:</p> <p>5.2.4 define centre of gravity and distinguish between stable, unstable and neutral equilibrium</p> <p>5.2.5 define pressure and describe the effects and application of pressure in solids, liquids and gases.</p>	<p>use the knife edge (wedge) method to determine the centre of gravity of rectangular, triangular and irregular shaped cardboards.</p> <p>demonstrate the three types of equilibrium using a cone on a flat surface.</p> <p>discuss the effect of loading a vehicle on the top carrier or the base carrier on the stability of the vehicle.</p> <p>Pressure; definition and effects.</p>	<p>Let students:</p> <p>Demonstrate the three types of equilibrium using a cone on a flat surface.</p> <p>Discuss the effect of loading a vehicle on the top carrier or the base carrier on the stability of the vehicle.</p> <p>Brainstorm to define pressure</p> <p>perform simple calculations using the formula:</p> $\text{Pressure} = \frac{\text{Force}}{\text{Area}}$ <p>Use a rectangular block of wood to demonstrate the effect of surface area on pressure exerted by solids</p> <p>Use a tall container with three holes at different heights to demonstrate pressure in liquids.</p> <p>Use bicycle pump to demonstrate the transmission of pressure in gases.</p> <p>Observe the operation of siphons.</p> <p>CLASS PROJECT: Students to design a simple fountain or sprinkler system.</p>	<p>Explain the terms stable, unstable and neutral equilibrium and give example of each type of equilibrium.</p> <p>Explain the danger associated with loading the top carriers of vehicle heavy.</p> <p>A cement block of weight 50.0N and one side of area 0.2m² rests on a table. Calculate the pressure exerted on the table by the cement block</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 SAFETY IN THE COMMUNITY	The student will be able to: 5.3.1 identify appliances used at home and how to use them properly.	Safe use of appliances at the home.	Let students: Discuss proper use or handling of household appliances to prevent accidents at home: avoidance of overloading of electric sockets, extreme care in using the heating coil in metal/plastic containers, use of gas stoves.	State two methods of extinguishing <ol style="list-style-type: none"> 1. electric fire 2. gas fire
	5.3.2 use first aid methods to treat accidents a home.	First Aid methods	NOTE: Precautions to include: 1. Keeping hands dry before touching electrical gadgets. 2. Viewing television from a distance. 3. Viewing television in a dark room. Demonstrate the following using models: <ol style="list-style-type: none"> 1. mouth-to-mouth resuscitation method. 2. methods of extinguishing different fires. 3. treatment of burns, cuts and electric shocks. Invite a Fire Service Officer or Red Cross Personnel to talk to class on accidents prevention and first aid.	Illustrate three safety symbols and state their meanings.
	5.3.3 identify hazardous substances at the work place and their effects on humans.	Hazardous substances and their effect.	Discuss possible hazards that can occur in any working environment, e.g. dust, fumes, toxic gases, corrosive substances, fire, food contamination, harmful radiation (x-rays), poisonous chemicals e.g. dioxins from heated or frozen plastics. Discuss the effects of hazardous substances on the human body, e.g. blindness, burns, nausea, vomiting, and allergies. Discuss various hazards, warning labels on containers and other places, and appraise their adequacy. Discuss the proper storage of some hazardous substances and other safety measures at work places, e.g. protective clothing. Discuss the techniques involved in preventing fires due to electrical and chemical causes, and bush fires.	
	5.3.4 identify some common hazards in the community	Common hazards in the community: Diseases, pests and parasites outbreak.	Discuss the general effects of the hazards on humans.	

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4: ENDOGENOUS TECHNOLOGY	<p>The students will be able to:</p> <p>5.3.5 outline the role of organizations working to improve the health of mankind and the factors which promote Public Health.</p>	<p>Insanitary conditions, problems of waste generation and pollution</p> <p>Traffic problems in towns and cities.</p> <p>The role of Health Service Organizations.</p> <p>Public Health and Sanitation.</p> <p>Public Education.</p>	<p>Let students:</p> <p>Discuss the functions of health organisations such as Ghana Health Service, Red Cross, Red Crescent, Blue Cross, WHO, FAO, UNICEF, UNFPA, Environmental Protection Agency (EPA), Ghana Standards Board, Food and Drugs Board.</p> <p>Discuss the factors that promote public health; e.g. siting of refuse dumps, provision of waste disposal facilities, cleaning and desilting of gutters, proper house planning to improve ventilation, efficient town planning and village planning systems (with water supply), places of garbage disposal, good clean roads and street connections</p> <p>Discuss the implications of expiry dates on consumable items e.g. food and medicine.</p> <p>Justify the need for education in the promotion of good health.</p> <p>Discuss the importance of proper sanitation in disease control.</p> <p>NOTE: Emphasize that improper sanitation and hygiene problem in communities can best be solved through co-operation, team spirit and civic responsibility of the people and not by health workers alone.</p>	<p>Describe the functions of EPA, Ghana Health Services and WHO.</p> <p>Outline how sanitation and hygiene education can promote good health.</p> <p>Discuss the role of human values in sanitation and hygiene education.</p>
	<p>5.4.1 outline the inter-dependency of science and technology.</p>	<p>Inter-dependency of science and technology</p>	<p>Discuss how science and technology depend on each other to solve societal problems: communication, transportation, health, nutrition etc. Gather more information on the topic from the internet..</p>	<p>Explain, with examples, how science and technology have helped to improve the living standards of human kind</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 5 BIOTECHNOLOGY	The students will be able to:		Let students:	
	5.4.2 explain the term endogenous technology.	Meaning of endogenous technology	Discuss the meaning of endogenous technology. Discuss the effects of modern technology on the development of endogenous technology in Ghana. Discuss some small industries in Ghana in terms of raw materials, equipment and market.	
	5.4.3 identify the scientific principles underlying the operations of some small scale industries.	Small scale industries: Soap making, Vegetable Oil Extraction, Shea Butter/Palm Oil Extraction, Bread Making, Salt Extraction, Pomade Making, Herbal Medicine extraction. Scientific basis of some industries.	Discuss the scientific processes involved in the following industries e.g. i. salt making – evaporation, crystallization/recrystallization, ii. soap production – decolorization, saponification using soda ash or caustic potash solution, precipitation(salting-out) iii. palm oil production – collection and fermentation, pulp production, extraction of fruit juice, separation of oil iv. yoghurt production - mixing of raw materials, homogenization, pasteurization (flash process), cooling, storage/packaging.	
	5.5.1 explain the term Biotechnology.	Meaning of Biotechnology.	Brainstorm to bring out the meaning of bio-technology. NOTE: Explanation to include application of genetic engineering, reactions of enzymes, hormones, and microbes in industry.	Discuss the importance of microbes in food processing in Ghana.
	5.5.2 give examples of industries based on biotechnology.	Examples of industries based on biotechnology	Give examples of industries based on biotechnology e.g. yeasts for bread making and brewing, <i>Penicillium sp.</i> for manufacture of drugs (penicillin), <i>Lactobacillus sp.</i> for yoghurt, cheese.	
5.5.3 explain the meaning of genetic engineering and list examples of its applications.	Genetic engineering.	Discuss the meaning of genetic engineering and its application in agriculture to produce high yielding and disease resistant crops, genetically modified foods.		

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 6: WORK AND MACHINES	The students will be able to:		Let students:	
	5.5.4 explain the term tissue culture and give examples of its application.	Tissue culture and its application.	<p>NOTE: Genetic engineering is used to alter the nature of genes.</p> <p>Visit a tissue culture laboratory and observe how healthy plants can be produced from tissues obtained from parts of a plant, e.g., leaves, storage organs, meristematic tissues, etc.</p> <p>NOTE: 1. Examples of places to visit: Ghana Atomic Energy Commission, Accra. Universities, Crop Research Institute – Kumasi, Cocoa research Institute of Ghana(CRIG)-Tafo, Plant Genetic Research Institute-Bunsu</p> <p>2. Visit internet site to gather information on biotechnology and report.</p>	Discuss the importance of tissue culture in agriculture
	5.6.1 explain work, energy and power.	Work, energy and power.	<p>Brainstorm to define work, energy and power</p> <p>discuss the work done when: i. a load is lifted up from the ground on the head. ii. a load is carried on the head along a horizontal distance iii. drawing water from a well using bucket and rope. Review potential and kinetic energy from JHS syllabus.</p>	A stone is dropped from a tall building 100m high. Discuss the changes in energy that takes place before the stone reaches the ground.
	5.6.2 identify simple machines.	Simple machines, such as levers, pulleys, wheel and axle and inclined planes.	Discuss how some simple machines e.g. scissors, hammer, secateurs, cutlass, wheel barrow, make work easier.	List the three classes of levers and give one example each.
	5.6.3 explain the terms mechanical advantage, velocity ratio and efficiency of machines.	Mechanical advantage, velocity ratio and efficiency of machines.	<p>Discuss mechanical advantage, velocity ratio and efficiency.</p> <p>NOTE: Only simple treatments of these terms are required.</p>	Explain why the efficiency of a machine is less than 100%.
5.6.4 explain the effects of friction and methods of reducing friction in machines.	Effects of friction and methods of reducing the effects:- use of ball bearings and lubricants.	<p>Discuss various ways of reducing friction in machines.</p> <p>Discuss how friction is reduced in machines.</p>	State the advantages and disadvantages of friction in every day life.	

SHS 3

SECTION 1: DIVERSITY OF MATTER

General Objectives: The students will:

1. recognize the variety of materials around us in the form of metals, semi-metals and non-metals and their uses.
2. be aware of the effect of the environment on mineral exploitation.
3. recognize the variety of organic and inorganic compounds around us, their properties and uses

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 1 METALS AND NON- METALS	The student will be able to:		Let students:	
	1.1.1 classify chemical elements into metals, semi-metals and non-metals and relate them to their physical and chemical properties.	Classification of elements into metals, semi-metals and non-metals and their properties.	Collect various materials and classify them as follows: <ul style="list-style-type: none"> • metals • semi-metals (metalloids) • non-metals Discuss the physical properties of metals, semi-metals and non-metals under conductivity, lustre, malleability, ductility, sonority, tensile strength.	What are metalloids? Give two examples. Give examples of elements which can be used for each of the following:
	1.1.2 relate the properties of metals, non- metals and semi-metals to their uses in the home and other places.	Uses of metals, semi-metals and non-metals.	Discuss the uses of metals, semi-metals and non-metals. Discuss the application of semi-metals. tabulate the uses of the following elements: Al, Cu, Fe, Au, C, O ₂ , N ₂ .	i. electrical cables ii. construction of buildings
1.1.3 explain what alloys are, their properties and uses.	Alloys, properties and uses. Steel (C and Fe) Brass (Cu and Zn) Bronze (Cu and Sn)	Brainstorm to bring out what alloys are. Give examples of alloys found in the home and state their constituents. Discuss the uses of alloys. Discuss reasons why alloys are preferred to pure metals in the manufacture of certain household items (keys and cooking utensils)	Why are alloys preferred to pure metals in the manufacture of certain household items?	

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 EXPLOITATION OF MINERALS	The student will be able to: 1.2.1. outline the effects of exploitation of minerals on the environment	Mineral exploitation and the environment	Let students: Brainstorm to bring out a list of minerals exploited in Ghana: Bauxite, diamond, manganese, gold and crude oil kaolin. Discuss the negative impact of crude oil, bauxite and gold exploitation on the environment and how to minimize the effect. (GALAMSEY) NOTE: Use flow chart/video clip/digitized content if available to study the environmental degradation in some mining centres in Ghana or visit any mining company and report.	Why should cyanide and mercury be used with caution in the extraction of gold?
UNIT 3: RUSTING	1.3.1. explain the process of rusting.	Rusting: Process of rusting Prevention of rusting	Perform experiment to show that air and water are necessary for rusting of iron. Perform experiment to show how salt, dilute acid, dilute base and heat affect the rate of rusting in iron. List items in the home that undergo rusting. Describe how the following processes can be used to prevent rusting: oiling/greasing, painting, galvanizing, tin-coating, electroplating, and keeping the metal dry. Discuss the effectiveness of various methods of preventing rusting.	List the conditions necessary for rusting to occur. Explain why wooden poles are preferred to steel reinforced concrete poles in erecting transmission lines along the coast. Suggest an appropriate method of preventing rusting in each of the following: (i) sewing machine (ii) Underground steel pipes. (iii) Food cans.

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 ORGANIC AND INORGANIC COMPOUNDS	<p>The student will be able to:</p> <p>1.4.1 classify chemicals as organic or inorganic compounds.</p> <p>1.4.2 identify organic compounds by their functional groups.</p> <p>1.4.4 identify sources and application of petrochemicals.</p>	<p>Organic and Inorganic compounds</p> <p>Organic compounds: Hydrocarbons, alkanols, alkanolic acids, alkanoates, fat and oils.</p> <p>Crude oil/ petroleum.</p> <p>Petrochemicals: application and effect on the environment.</p>	<p>Let students:</p> <p>Discuss the differences between organic and inorganic compounds with examples.</p> <p>Discuss the importance of organic chemistry in industrialization.</p> <p>Discuss the functional groups of given organic compounds. Write their structures and give examples of each.</p> <p>NOTE: For the hydrocarbons: (alkane, alkene and alkyne), only the 1st to 4th members in each group should be considered. For the alkanols, consider only methanol, ethanol and propanol. For the alkanolic acids and the alkyl alkanoates consider only the first two members</p> <p>Discuss the properties and uses of organic compounds</p> <p>Give examples of naturally occurring organic compounds and their uses.</p> <p>Discuss the differences between neutralization and esterification.</p> <p>Outline the refinery of crude oil and the uses of the fractions.</p> <p>Discuss the uses of petrochemicals: plastics, pharmaceuticals and agrochemicals.</p> <p>Discuss the effects of products of petrochemicals on the environment.</p> <p>NOTE: Discussions on cracking, knocking and octane number are not required.</p> <p>PROJECT: Group students to discuss the problem of pollution as a result of plastic waste disposal in their communities. Teacher to guide students to design the re-use of plastic wastes in such areas as weaving, thread making, nursing of seeds, etc.</p>	<p>Differentiate between organic and inorganic compounds.</p> <p>Write the functional groups of the following hydrocarbons: (i) alkanolic acid (ii) alkyne (iii) propanol</p> <p>List three fractions of petroleum distillation and state their uses.</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 2 CROP PRODUCTION	<p>The student will be able to:</p> <p>2.2.1 describe general principles of crop production.</p> <p>2.2. 2 cultivate a crop up to harvesting stage.</p>	<p>General principles of crop production:</p> <ul style="list-style-type: none"> i. selection of appropriate varieties ii. site selection and land preparation iii. method of propagation and planting methods iv. cultural practices v. pests and disease control vi. harvesting, processing, storage and marketing <p>Production of crops</p>	<p>Let students:</p> <p>Discuss the general principles of a crop production cycle as listed in the content.</p> <p>Visit a crop farm or watch a film on crop production and document the general principles involved in crop production.</p> <p>PROJECT: Teacher to divide class into four groups. Each group to acquire a piece of plot to cultivate one crop from the following crop groupings: Vegetable, cereals, grain legume, root or tuber crop.</p> <p>Students to apply all the principles of crop production to produce a crop, harvest, generate new planting materials, keep records and market. Students to take precautions against post harvest losses.</p> <p>NOTE: Production should be limited to the following crops: Vegetables – okro/lettuce/carrots Cereals – maize/millet Legumes - cowpea/groundnuts Tuber crops – cassava/yam</p>	<p>Describe how soil and climate influence crop production.</p> <p>Outline the main cultural practices involved in a cereal crop production.</p> <p>Prepare a farm diary showing the activities carried out from planting to harvesting stage.</p>

SHS 3

SECTION 3: SYSTEMS

General Objectives: The students will:

1. recognize that a system is a whole consisting of parts that work together to perform a function.
2. understand that the physiological processes of an organism are co-ordinated and interdependent

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 1 NERVOUS SYSTEM	The student will be able to:		Let students:	
	3.1.1 describe the structure and functions of the nervous system of humans.	Structure and functions of the nervous system of humans.	Discuss the structure and function of the nervous system. NOTE: Treatment should include: i. Parts of the brain: fore-brain (cerebrum), mid-brain (cerebellum) and hind-brain (medulla oblongata). ii. The spinal cord iii. Details of the electrical and chemical nature of impulse transmission not required.	Annotate a diagram of the motor neurone.
	3.1.2 identify the causes and effects of damages to the brain and spinal cord.	Cause of damage to the central nervous system: accidents, diseases, drug/substance abuse and depression Effects of damage to the central nervous system.	Discuss causes of damage to the brain and spinal cord. NOTE: invite a psychiatrist or mental health personnel to give a talk on mental health and drug/substance abuse. Use the future's wheel to explain consequences of drug/substance abuse on the individual, the family and the society.	Discuss the effects of drug/substance abuse on the youth.
3.1.3 classify stimulus responses as voluntary or involuntary actions.	Voluntary and Involuntary actions.	Carry out activities to identify voluntary actions e.g. walking, singing, writing, reading. Carry out activities to identify involuntary (reflex) action, e.g. knee jerk, blinking of the eye, heartbeat, and peristalsis. Annotate a diagram of the reflex arc. Discuss the importance of reflex action (the blinking of the eye when an object gets too close, sudden withdrawal of the hand when a hot object is touched).	Explain what happens when one touches a hot object with the hand.	

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D)	The student will be able to: 3.1.4 describe the endocrine system and its functions.	Endocrine system and its functions.	Let students: Discuss the endocrine system, the hormones and their functions. NOTE: Treatment should include the role of the following hormones only: thyroxin, adrenaline, testosterone, estrogen and insulin in the co-ordination of the functions under the following headings: name of gland producing hormones, normal functions of hormones, effect of over-production and under-production. Discuss the importance of iodated salt.	What are hormones? Describe the functions of the following hormones in the body (i) estrogen (ii) adrenaline (iii) insulin

SHS 3

SECTION 4: ENERGY

General Objectives: The students will:

1. become aware of the importance of light and heat energy.
2. understand the behaviour of electronic circuit components.

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 LIGHT ENERGY	<p>The student will be able to:</p> <p>4.1.1 review reflection and refraction of light and characteristics of images formed by plane mirrors.</p> <p>4.1.2 describe the structure of human eye and its functions.</p> <p>4.1.3 describe and explain how to separate white light into its component colours.</p> <p>4.1.4 differentiate between primary and secondary colours.</p> <p>4.1.5 outline the components of the electromagnetic spectrum.</p>	<p>Reflection, refraction and characteristics of images</p> <p>Structure and functions of human eye</p> <p>Eye defects</p> <p>Dispersion of light.</p> <p>Primary colours– red, green, blue. Secondary colours– yellow, magenta/purple, cyan/blue-green</p> <p>Electromagnetic spectrum</p>	<p>Let students:</p> <p>Review topics on reflection, refraction and characteristics of images from JHS syllabus</p> <p>Examine a model of human eye and discuss its structure in relation to function.</p> <p>Discuss the use of lenses to correct eye defects.</p> <p>Use glass or water prism to disperse light from the sun or electric bulb</p> <p>Explain the formation of rainbow.</p> <p>demonstrate the behaviour of objects under different coloured lights (bulbs).</p> <p>NOTE: Primary and secondary colours of light are not the same as that of colour pigments</p> <p>use a chart to explain electromagnetic spectrum Discuss the application of each component in the electromagnetic spectrum in everyday life.</p> <p>NOTE: Calculation and detailed treatment not required.</p>	<p>Explain how the structure of the eye is related to its functions</p> <p>Name the type of lenses used to correct</p> <p>(i) long sightedness (ii) short sightedness</p> <p>Draw a ray diagram to show how light is dispersed by a triangular prism.</p> <p>State one advantage and one disadvantage of radio wave, microwave and UV radiation</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 2 HEAT ENERGY	<p>The student will be able to:</p> <p>4.2.1 describe the nature and sources of heat energy.</p> <p>4.2.2 describe the modes of heat transfer.</p> <p>4.2.3 explain the concept of temperature and how it is measured.</p>	<p>Nature and sources of heat energy.</p> <p>Modes of heat transfer.</p> <p>Temperature: definition and measurement.</p>	<p>Let students:</p> <p>Explain why heat is a form of energy.</p> <p>discuss sources of heat energy.</p> <p>Carry out activities to demonstrate conduction, convection and radiation of heat energy.</p> <p>Demonstrate the rate of flow of heat in a metal bar of different materials.</p> <p>Discuss applications of conduction, convection and radiation. (e.g. vacuum flask, ventilation, etc)</p> <p>Discuss what temperature is.</p> <p>Carry out activities/experiment to demonstrate thermal equilibrium between two liquids of different temperatures.</p> <p>Discuss the units degree celsius ($^{\circ}\text{C}$) and kelvin (K) in which temperature is expressed.</p> <p>Examine the structures of laboratory and clinical mercury –in- glass thermometers.</p> <p>Discuss the uses of laboratory and clinical thermometers – both analogue (mercury –in- glass) and digitized.</p> <p>Discuss the advantages and disadvantages of mercury and alcohol as thermometric liquids.</p>	<p>Explain the major difference between heat and temperature.</p> <p>Convert the following temperature from $^{\circ}\text{C}$ to K</p> <p>(i) 245°C</p> <p>(ii) 75°C</p> <p>(iii) -112°C.</p> <p>State and explain two advantages of the use of clinical thermometer over laboratory thermometer in the determination of the temperature of a patient.</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D)	The student will be able to: 4.2.4 discuss the effects of heat.	Thermal Expansion. Change of state of matter:	Let students: Perform the ball and ring experiment to show that a body expands when heated. Heat water in a test-tube to demonstrate expansion in liquids. Discuss various applications of expansion e.g. thermostats, sagging of electric cable, bursting of inflated hot lorry tyres. Record the temperature of ice until it becomes a liquid, then heat the cold water until it boils. Note the temperatures at the various states/changes that the water goes through. Discuss the application of cooling due to evaporation, e.g., regulation of body temperature by the skin, cooling of water in local clay water pots and refrigerators. Use digitized content/video clip if available to investigate the effect of heat on changes in the state of matter.	Describe two applications of thermal expansion. Explain why steam from boiling water inflicts more burn than boiling water. Explain how water in a clay pot becomes cold after standing for some time.
UNIT 3 ELECTRONIC S	4.3.1 describe the structure of a transistor and investigate its uses.	Transistor and its uses.	Observe an N-P-N or P-N-P transistor and identify the emitter, the base, and the collector. Discuss the application of a transistor as an amplifier and as a switch. PROJECT Design and construct a remote control switch using a transistor circuit.	Draw the symbol of an N-P-N transistor. List two uses of a transistor

SHS 3

SECTION 5: INTERACTIONS OF MATTER

General objectives: The students will:

1. appreciate that interaction between and within matter helps humans to better understand the environment and their role in it.
2. appreciate inheritance as a characteristic of variation.

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT: 1 VARIATION, INHERITANCE	<p>The student will be able to:</p> <p>5.1.1 relate the nucleus, chromosomes and genes as a sequence in inheritance.</p> <p>5.1.2 explain the causes and consequences of variation.</p>	<p>Chromosomes and genes.</p> <p>Variation: Meaning, causes and consequences.</p>	<p>Let students:</p> <p>Discuss chromosomes as bearers of genes/hereditary materials and recessive and dominant characters; genotype and phenotype.</p> <p>Discuss inheritance of a single pair of contrasting characters e.g. height (tallness and shortness) up to the second filial generation.</p> <p>NOTE: Simple treatment of inheritance (Mendel's first law of inheritance) and DNA test are required.</p> <p>Discuss the application of the sequence of inheritance with respect to cloning and stem cells.</p> <p>Discuss some heritable and non heritable characters in humans.</p> <p>Brainstorms to bring out the meaning of variation.</p> <p>Discuss the causes and consequences of variation. e.g. production of animal and crop breeds and varieties.</p> <p>Measure heights or weights of their peers in class to illustrate variation in humans.</p> <p>Observe grain colours in maize to illustrate variation in plants. NOTE: Mutation should be mentioned as one of the causes of variation e.g. resistance of some organisms to drugs or chemicals, albinism in humans.</p>	<p>Explain the following terms:</p> <p>(i) gene (ii) genotype (iii) phenotype (iv) dominant character. (v) recessive character</p> <p>What is a hybrid?</p>

UNIT	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 VARIATION, INHERITANCE . (CONT'D)	<p>The student will be able to:</p> <p>5.1.3 explain how sex is determined in humans.</p> <p>5.1.4 discuss the inheritance of the various blood groups and Rh-factor and outline their importance.</p> <p>5.1.5 explain how sickle cell gene is inherited and sickle cell disease is acquired.</p>	<p>Sex determination Sex-linked characters</p> <p>Blood Groups and Rhesus factor. Inheritance of Blood groups and Rh-factor and its practical application.</p> <p>Sickle cell gene Sickle cell disease</p>	<p>Let students:</p> <p>Explain how sex is determined at fertilization.</p> <p>Discuss how sex preference of children can affect family relationship and size.</p> <p>Discuss some sex-linked characters.</p> <p>Discuss types of blood groups and Rhesus factor, and their importance for marriage, blood transfusion and paternity test.</p> <p>Discuss the inheritance of blood groups and Rh-factor.</p> <p>Discuss problems in marriage due to incompatible Rh-factor and how to avoid these problems.</p> <p>Discuss how the sickle cell gene is inherited.</p> <p>Discuss how the sickle cell disease is acquired.</p> <p>Discuss how sickle cell disease could be managed.</p> <p>NOTE: Counseling against marriage between sicklers should be stressed.</p>	<p>How is sex determined in humans?</p> <p>Name the types of blood groups and Rh-factor in humans.</p> <p>Explain why it is important that couples should know their sickling and their Rh-factor status before marriage.</p> <p>What is the genotype of one with sickle cell disease?</p>

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