MINISTRY OF EDUCATION

TEACHING SYLLABUS FOR FISHERIES
(SENIOR HIGH SCHOOL 1-3)

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September, 2010

TEACHING SYLLABUS FOR SENIOR HIGH SCHOOL

RATIONALE FOR TEACHING FISHERIES

Fisheries is important to the economic development of this nation and it is the single most dominant economic activity in the coastal zone and along the shores of the Volta Lake, major rivers and other water bodies. Fishery resources provide a reliable source of animal protein, and it is a major non-traditional export commodity with significant annual earnings. The fisheries sector is also important, because about 10% of Ghana's population is dependent on fisheries resources for their livelihood. It is a key player in poverty reduction, and contributes 5% of Agricultural Gross Domestic Product (GDP) and 3% of National GDP. Because of its importance, the teaching of fisheries has been given prominence in the educational system of the country.

The development of a syllabus in fisheries, as an elective subject at the pre-tertiary level, seeks to generate the learners' interest in fisheries at an early age and equip them with the basic knowledge in entrepreneurial skills that will enable them to pursue fisheries-related vocations. The study of fisheries helps the student to combine general knowledge with practical-oriented skills. It also helps to lay the foundation for further training in the subject at the tertiary level.

GENERAL AIMS

This syllabus is designed to help students to:

1. appreciate the usefulness of fisheries resources and their importance in the socio-economic development of Ghana;
2. recognize the differences between common freshwater, brackish and marine fishery resources;
3. acquire knowledge of the basic biology of fishes.
4. select appropriate fishing techniques and equipment for inland and sea fishing;
5. apply rules and regulations for preventing over fishing and harmful fishing practices;
6. develop basic skills in culture fisheries;
7. acquire basic entrepreneurial abilities in fisheries-related vocations;
8. develop basic understanding of fishery businesses and fisheries management.

SCOPE OF CONTENT

The content of this syllabus has been revised to enhance the professional practice of learners by incorporating an appreciable amount of **occupational competencies** in such a way as to enable learners **practise some aspects of fisheries occupations after completing Senior High School**. The course offers enough knowledge, attitudes and skills that will help students, after some apprenticeship training, to work on their own or seek employment in the fisheries sector. The foundation provided in this course is adequate for those who would wish to go on for further studies in fisheries.

The syllabus covers knowledge of the fishery resources in Ghana, equipment and techniques in fishing, processing and preservation of fish, and management of fishery resources and the regulations involved. It also deals with the biology and ecology of tropical fishes and provides the basis for development of aquaculture. The professional job skills areas addressed by this syllabus include the following:

i. Provision of service on fish farms.
ii. Provision of fish hatchery and husbandry services.
iii. Provision of fish health services.
iv. Provision of processing and preservation services.
v. Provision of storage services.
vi. Provision of packaging and transportation services.
vii. Management of Small and Medium Enterprises (SME's) e.g. Fish Farm Enterprise, Ornamental Fishery Enterprise, Fishing Input Trade.

PRE-REQUISITE SKILLS AND ALLIED SUBJECTS

Students offering this course must have had average performance in Integrated Science and Mathematics at the Junior High School level. Interest in fisheries is also vital for success in this course.

ORGANISATION OF THE SYLLABUS

The syllabus has been structured to cover the three years of Senior High School. Each year's work consists of a number of sections with each section comprising a number of units. The organisation and structure of the syllabus is as follows:

ORGANISATION AND STRUCTURE OF THE SYLLABUS

YEAR 1	YEAR 2	YEAR 3
SECTION 1: INTRODUCTION TO FISHERIES UNIT 1: Fisheries and National Development UNIT 2: Fishery Organisms and their Habitats UNIT 3: Grouping of Fishery Organisms	**SECTION 1: FISH BIOLOGY (II) (Pg. 11-13)** UNIT 1: Life Processes – Excretion, Reproduction and Growth UNIT 2: Fish Ecology UNIT 3: Introduction to Fish Genetics	**SECTION 1: FISH UTILIZATION (Pg. 21-25)** UNIT 1: Nutritive Value of Fish UNIT 2: Fish Processing and Preservation UNIT 3: Fish Products and By-Products UNIT 4: Fish Spoilage
SECTION 2: FISHING ACTIVITIES (Pg. 4-7) UNIT 1: Fish Landing Sites and Facilities UNIT 2: Fishing Gear and Craft UNIT 3: Fishing Methods UNIT 4: Harmful Fishing Practices	**SECTION 2: AQUACULTURE** UNIT 1: Introduction to Aquaculture UNIT 2: State of Aquaculture in Ghana UNIT 3: Aquarium Activities	**SECTION 2: FISHERIES MANAGEMENT AND BUSINESS OF FISHERIES** UNIT 1: Fisheries Management UNIT 2: Fishery Regulations and Policies UNIT 3: Business of Fisheries UNIT 4: Fish Marketing
SECTION 3: FISH BIOLOGY (I) (Pg. 8-10) UNIT 1: Identification and Classification of Fishery Organisms UNIT 2: Structure and Function of Fishery Organisms UNIT 3: Life Processes in Fishes – locomotion, feeding, circulation and gaseous exchange.	**SECTION 3: FISH FARMING (Pg.16-20)** UNIT 1: Introduction to Fish Farming UNIT 2: Pond Construction, Maintenance and Stocking UNIT 3: Fish Harvesting UNIT 4: Water Quality Control in Fish Ponds UNIT 5: Feed Formulation and Feeding UNIT 6: Fish Diseases, Causes and Control	**SECTION 3: PRACTICES IN FISHING COMMUNITIES AND FISHERIES INSTITUTIONS (Pg. 30-31)** UNIT 1: Fishing Communities and Cultural Practices UNIT 2: Fisheries Institutional Framework and Job Opportunities in Fisheries **SECTION 4: ENTREPRENEURSHIP IN FISHERIES** UNI T 1: Establishing Enterprises in Fisheries

TIME ALLOCATION

A minimum of six periods of teaching and practical work is allocated to Fisheries per week, with each period lasting for 40 minutes. Of the six periods, three should be devoted to practical work and three to theory.

SUGGESTIONS FOR TEACHING THE SYLLABUS

This is a new subject in the Senior High School Curriculum. It may therefore consist of concepts new to the teacher and especially to students. Read this section very carefully to be able to follow the sequence of steps and processes prescribed for effective teaching and learning.

Teachers should identify resource persons who will assist them to teach some of the topics which they may find difficult to teach. Classroom activities should be supplemented with field trips to fishery related institutions and farms.

Schools are encouraged to have a fish pond for practical studies in aquaculture. Teaching-learning material on aquaculture such as water test kits may be obtained from the Department of Oceanography and Fisheries of the University of Ghana, Water Research Institute of Council for Scientific and Industrial Research (CSIR), Ministry of Fisheries and Faculty of Renewable Natural Resources of KNUST.

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

General Objectives

General Objectives have been listed at the beginning of each Section. The general objectives specify the skills and behaviours the student should acquire after learning the units of the section. Read the general objectives very carefully before you start teaching the section. After teaching all the units of the section, go back and read the general objectives again to be sure you have covered the objectives adequately in the course of your teaching.

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

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

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

Column 2 - Specific Objectives: Column 2 shows the Specific Objectives for each unit. The specific objectives begin with numbers such as 1.3.5 or 2.2.1. These numbers are referred to as "Syllabus Reference Numbers". The first digit in the syllabus reference number refers to the section; the second digit refers to the unit, while the third digit refers to the rank order of the specific objective. For instance, 1.3.5 means: Section 1, Unit 3 (of Section 1) and Specific Objective 5. In other words, 1.3.5 refers to Specific Objective 5 of Unit 3 of Section 1. Similarly, the syllabus reference number 2.2.1 simply means Specific Objective number 1 of Unit 2 of Section 2.

Using syllabus reference numbers provides an easy way for communication among teachers and other educators. It further provides an easy way for selecting objectives for test construction. Let's say for instance, that Unit 2 of Section 2 has five specific objectives: 2.2.1 - 2.2.5. A teacher may want to base his/her test items/questions on objectives 2.2.3 and 2.2.4 and not use the other three objectives. In this way, a teacher would sample the objectives within units and within sections to be able to develop a test that accurately reflects the importance of the various skills taught in class.

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

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 more information to the content presented. In a few cases the content space has been left blank. You should, as much as possible, add to the information provided by reading from books and other sources.

Column 4 -Teaching and Learning Activities (T/L): T/L activities that will ensure maximum student participation in the lessons are presented in Column 4. Avoid rote learning and drill-oriented methods and rather emphasise participatory teaching and learning, and also emphasise the cognitive, affective and psychomotor domains of knowledge in your instructional system wherever appropriate. You are encouraged to re-order the suggested teaching and learning activities and also add to them where necessary in order to achieve optimum student learning.

The major purpose of teaching and learning is to make students able to apply their knowledge in dealing with issues both in and out of school. A suggestion that will help your students acquire the habit of analytical thinking and the capacity for applying their knowledge to problems in Fisheries is to begin each lesson with a practical problem. Select a practical problem for each lesson. The selection must be made such that students can use knowledge gained in the previous lesson and other types of information not specifically taught in class. At the beginning of a lesson, state the problem, or write the problem on the board. Let students analyse the problem, suggest solutions etc., criticise solutions offered, justify solutions and evaluate the worth of possible solutions. There may be a number of units where you need to re-order specific objectives to achieve such required effects. The emphasis is to assist your students to develop analytical thinking and practical problem solving techniques. You are encouraged to use teaching aids, visits and resource persons for effective delivery of lessons.

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, structured questions, project work etc. Ask questions and set tasks and assignments that will challenge your students to apply their knowledge to issues and problems in Fisheries and that will engage them in developing solutions, and developing positive attitudes 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. For evaluation during class lessons, determine the mastery level you want students to achieve in their answers and responses. If for instance, you take 80% as the mastery level, ensure that each student's answer to questions asked in class achieves this level of mastery.

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

Profile Dimensions

A 'dimension' is *a psychological construct* for describing a particular learning behaviour. More than one dimension constitutes a profile of dimensions. Profile dimensions describe the underlying behaviours or abilities students are expected to acquire as a result of having gone through a period of instruction. Profile dimensions are derived from the cognitive, affective and psychomotor domains of educational objectives. From the cognitive domain, two profile dimensions have been specified for this subject; namely Knowledge and Understanding (KU) and Application of Knowledge (AK). The affective domain covers beliefs, attitudes and values. The psychomotor domain covers physical and combined skills normally referred to as process skills or practical skills. Specific objectives used in developing syllabuses or training programmes describe behaviours to be exhibited by learners after going through a learning process.

A specific objective represents attributes of learning from one or more of the domains of educational objectives. For example, the statement of a specific objective is as follows: *The student will be able to describe, ...*etc. contains an action verb "describe" that indicates what the student will be able to do after teaching and learning have taken place. Being able to "describe" something after the instruction has been completed means that the student has acquired "knowledge" from the cognitive domain. Being able to explain, summarise, give examples etc. means that the student has understood the lesson taught. Similarly, being able to develop, plan, construct etc, means that the student has learnt to create, innovate or synthesize knowledge.

Each of the specific objectives in this syllabus contains an "action verb" that describes the behaviour the student will be able to demonstrate after the instruction. "Knowledge", "Application" etc. are dimensions that should be the prime focus of teaching and learning in schools. Instruction in most cases has tended to stress knowledge acquisition to the detriment of other higher level behaviours such as application, analysis etc. 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.

DEFINITION OF PROFILE DIMENSIONS

As already stated, profile dimensions describe the underlying behaviours for teaching, learning and assessment. In Fisheries, the three profile dimensions that have been specified for teaching, learning and testing are:

Knowledge and Understanding	**20%**
Application of Knowledge	**30%**
Attitudes and Practical Skills	**50%**

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 processes. Combining the three dimensions in the teaching and learning process will ensure that Fisheries is taught and studied not only at the cognitive level, but will also lead to the acquisition of practical skills in the subject.

The explanation of the key words involved in each of the profile dimensions is as follows:

Knowledge and Understanding (KU)

knowledge	The ability to: remember, 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
explain, 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.

Application of Knowledge (AK)

The ability to use knowledge or apply knowledge, as implied in this syllabus, has a number of learning/behaviour levels. These levels include application, analysis, innovation or creativity, and evaluation. These may be considered and taught separately, paying attention to reflect each of them equally in your teaching. The dimension "Application of 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 etc.

analysis The ability to
break down a piece of material into its component parts; to differentiate, compare, distinguish, outline, separate, identify significant parts etc., recognise unstated assumptions and logical fallacies, recognize inferences from facts etc.

Innovation/
Creativity - The ability to
synthesize or put parts together to form a new whole. It involves the ability to combine, compile, compose, devise, suggest a new idea or possible ways, plan, revise, design, organize, create, and generate new 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, bring new ideas, design and create new things.

Evaluation The ability to:
appraise, compare features of different things and make comments or judgments, contrast, criticize, justify, support, discuss, conclude, make recommendations etc. Evaluation refers to the ability to judge the worth or value of some materials, ideas etc., based on some criteria. Evaluation is a constant decision making activity. We generally compare, appraise and select throughout the day. Every decision we make involves evaluation. Evaluation is a high level ability just as application, analysis and innovation or creativity since it goes beyond simple knowledge acquisition and understanding.

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

Competency Based Learning

Competency learning is a combination of knowledge, skills, and the ability to use tools and equipment for accomplishing work to acceptable standards in the industry. Competency includes cognitive and practical skills as well as attitudinal and other personality characteristics. These characteristics include principles of social

orientation that is the core values of honesty, fairness, reliability, trustworthiness, cooperation and support as well as the ability to relate well with people. Competency Based Learning has been adopted for teaching and learning practical subjects.

Competency Based Learning requires students to perform tasks by using relevant knowledge, skills, and tools to achieve specified targets within specified times.
The case study approach in teaching and learning is particularly suitable in providing students with situations which they could emulate to reach high levels of professional practice.

Competence involves *application of knowledge* in a significant range of work activities, performed in a variety of contexts/activities which may be complex or not routine and there is some individual responsibility or autonomy. Collaboration with others perhaps through membership of a work group or team, may often be a requirement. Personal accountability for analysis, diagnosis, design, planning, execution and evaluation of task may also be required.

Attitudes and Practical Skills (APS)

Attitudes and Practical skills form the third profile dimension in practical or vocational subjects. They are competencies or abilities required for performing satisfactorily in a job. Performance is a reflection of skills. Four types of skills are identified in job performance:

1. Intellectual skills
2. Psychomotor skills
3. Social skills
4. Attitudes

Intellectual skills

Intellectual skills in job performance are also referred to as perceptual skills. They enable a person to conceptualise performance. Conceptualisation is a mental skill which depends largely on one's cognitive abilities. One needs to conceptualise and visualise an action before it is performed. For example, one needs to know the names of some fish species in the country, describe their characteristics before being able to identify the attributes associated with any particular fish species.

Psychomotor skills

Psychomotor skills refer to motor activities which are performed with an intention. It needs coordinated movement of hand, body and muscles, mental abilities and intention to guide movement. They involve demonstration of manipulative skills in using tools, machines and equipment to carry out practical operations and to solve practical problems. The element of thinking is much needed in movement in order to perform a given task better.

Examples of activities involving psychomotor skills include:

1. *Equipment Handling*
2. *Observation*
3. *Manipulation*
4. *Measuring*
5. *Recording*
6. *Reporting*
7. *Creativity*

8. Communication

Equipment Handling: Students should be able to handle and use equipment properly for practical work in Fisheries. The teacher should ensure that students acquire a high level of proficiency in the use of tools and equipment relevant to the field of Fisheries.

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

Manipulation: Manipulation involves the skilful handling of scientific objects and tools for accomplishing specific tasks.

Measuring: Refers to the accurate use of measuring instruments and equipment. The teacher should guide students to make accurate measurements of specimens, chemicals etc.

Recording: Recordings must aim at a high degree of accuracy.

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.

Creativity: Students should be encouraged to be creative and be able to use new methods in carrying out projects. You can help your students to be creative by encouraging any little creative efforts, techniques and products they may develop.

Communication: Students should be guided to develop effective oral and written communication skills necessary for group work, reports etc.
The teaching and assessment of psychomotor skills should involve practical experiences in work sites, field work, experiments, projects, case studies and field studies.

Social skills

Social skills refer to activities which are performed in a given social context. For example, interviewing people for information involve social skills. The effectiveness of interviewing people for information, does not only depend on the verbal fluency of an interviewer, but largely on how well the interviewer approaches the interviewee, how accurate the interviewer was in selecting an interviewee. It is not the content of the interview but how one conducts the interview. Examples of social skills include effective communication with farmers, good relation to the farmer when conducting an interview, understanding farmers indirect expressions, etc.

Attitudes

Attitudes are feelings one develops towards something. The feelings can be positive or negative. An individual who has positive attitude to work can derive happiness from his or her work, enjoys the job and is willing to do more, makes clients feel more attached, values the individual and services rendered.
A person with negative attitudes to work does a job only as a means of livelihood, achieves no job satisfaction, has poor results and has clients who are unhappy with him or her. Attitudes influence job performance, education and training in agriculture should be geared to cultivating of positive attitudes to agricultural work.

Assessment of Attitudes and Practical Skills

Process Assessment: *The processes or steps (sub-skills) involved in performing a task are observed and rated with marks or letter grades. In awarding marks or grading, the performance of the learner is judged by comparing with the indicator of acceptable performance. In judging, depending on the type of sub-skill, if learner performance matches with the indicator of acceptable performance a grade A is given, grade B is awarded if performance is acceptable but below the indicator*

standard. Grade C is given if achieved performance is below the indicator and unacceptable. The three level grading system is adopted if the sub-skills are not crucial for successful performance of the whole task. If the sub-skills are crucial for achieving successful task performance, then a two level grading type is used. In such cases, an 'A' is awarded for successful performance and a 'B' is given for unsuccessful performance.

Product Assessment: *The quality of a finished product is assessed using the criteria describing the quality standards of the product. Marks are awarded depending on the level of match between the criteria for assessment of the product.*

Proficiency Assessment: *In this, the quality of a product or task and the speed used in performing the task are crucial. The two level grading system is normally used. For example, after students have learned and acquired the skills in sexing fish, a number of juveniles are given them to sex within a specified time frame. Students who complete the assignment successfully within the time period obtain grade A, while those who fail to sex the fish successfully or did not meet the time limits get grade B. In other words, students who obtain grade B are not proficient in performing the task.*

The action verbs provided under the 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 examinations and in practical life situations. Check the weights of the profile dimensions to ensure that you have given the required emphasis to each of the dimensions in your teaching and assessment.

FORM OF ASSESSMENT

It must be emphasised again that it is important 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 procedure you use i.e. class tests, home work, projects etc. must be developed in such a way that it will consist of a sample of the important objectives taught over a period.

The example on the next page shows an examination consisting of three papers, Paper 1, Paper 2, Paper 3 and School Based Assessment. Paper 1 will usually be an objective-type 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, and SBA will be based on all three dimensions as indicated. The distribution of marks for the objective test items, essay type questions and the practical questions in the three papers and in the SBA should be in line with the weights of the profile dimensions already indicated and as shown in the last column of the table below.

The West African Examinations Council (WAEC) generally sets about 60 objective test items at the WASSCE. 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 below, Paper 1 is marked out of 60; Paper 2 is marked out of 90, Paper 3 marked out of 100, and continuous assessment is marked out of 150, giving a total of 400 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
Knowledge and Understanding	40	20	-	20	80	20
Application of Knowledge	20	70	-	30	120	30
Attitudes & Practical Skills	-	-	100	100	200	50
Total Marks	60	90	100	150	**400**	
% Contribution of Papers	15	35	20	30		**100**

You will note that Paper 1 has a contribution of 15% to the total marks; Paper 2 has a contribution of 35% to the total marks; Paper 3 has a contribution of 20%, and School-Based Assessment (SBA) has a contribution of 30% to the total marks. The numbers in the cells indicate the marks to be allocated to the items/questions that test each of the dimensions within the respective test papers.

The last but one column shows the total marks allocated to each of the dimensions. Note that the numbers in this 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 400, 80 marks, equivalent to 20% of the total marks, are allocated to Knowledge and Understanding. 120 marks, equivalent to 30% of the total marks are allocated to Application of Knowledge and 200 marks, equivalent to 50% are allocated to Attitudes and Practical Skills. The weight of each of the three dimensions is indicated in the last column. The ratio of theory to practice in the Fisheries is 50:50.

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

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

GUIDELINES FOR SCHOOL-BASED ASSESSMENT (SBA)

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.

SBA may be conducted in schools using the following: Mid-term test, Group Exercise, End-of-Term Test and Project

1. Project: This will consist of a selected topic to be carried out by groups of students for a year. Segments of the project will be carried out each term toward the final project completion at the end of the year,

   The projects may include the following:
   i) experiment
   ii) investigative study (including case study)
   iii) practical work assignment

   A report must be written for each project undertaken.

2. Mid-Term Test: The mid-term test following a prescribed format will form part of the SBA

3. Group Exercise: This will consist of written assignments or practical work on a topic(s) considered important or complicated in the term’s syllabus

4. End-of-Tem Test: 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.

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. The WASSCE structure is as follows:

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 totalling 18 marks, and then give the remaining 2 marks or part of it for organisation of answer. For objective test papers you may develop an answer key to speed up the marking.

SENIOR HIGH SCHOOL – YEAR 1

SECTION 1

INTRODUCTION TO FISHERIES

General Objectives: The student will:

1. be aware of the various aspects of fisheries
2. recognise the importance of fisheries to national development
3. be aware of the various fishery habitats
4. recognise common types of fishery organisms and their habitats
5. appreciate the danger of Invasive Alien Species on Fishery habitat

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **FISHERIES AND NATIONAL DEVELOPMENT**	The student will be able to: 1.1.1 explain the term fisheries.	Meaning of Fisheries.	Students to brainstorm to bring out the meaning of fisheries.	What is the meaning of fisheries?
	1.1.2 describe the different types of fisheries.	Types of Fisheries: Culture fisheries (aquaculture) Capture fisheries (fishing) - Subsistence Fisheries - Artisanal Fisheries - Commercial Fisheries - Industrial Fisheries.	Students to describe and compare the various types of fisheries listed under content.	Compare subsistence fisheries and industrial fisheries.
	1.1.3 analyse the importance of fisheries to national development.	Importance of Fisheries to national development: - Food source - Income generation - Employment - Foreign exchange - Industrial Raw materials - Social and cultural life	Groups of students to discuss the importance of fisheries to national development, and make oral presentation in class.	Write an essay on the importance of fisheries to Ghana's economic development.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 **FISHERY ORGANISMS AND THEIR HABITATS**	The student will be able to: 1.2.1 identify and describe common fishery organisms.	**Common Fishery Organisms:** Fin fishes (herring, tuna, tilapia, etc); Shell fishes (crustaceans and molluscs).	**Students to:** Bring different types of fishery organisms such as tilapia, prawns, clams, etc., to class for students to group into fin fishes and shell fishes. Provide common names of fishery organisms brought to class.	Differentiate between fin fish and shell fish.
	1.2.2 describe the characteristics of fishery habitats.	**Fishery Habitats:** Freshwater (e.g. river, lake), Brackish water (e.g. estuary, lagoon), Marine (sea) - Pelagic zone - Demersal zone	Identify the various fishery habitats from pictures, charts, internet sites, etc. Discuss the characteristics of the various habitats.	Differentiate between freshwater and brackish water.
	1.2.3 Identify and describe the characteristics of Invasive Alien Species in Fishery habitats	**Major aquatic Invasive Alien Species** 1. *Eichhornia crassipes* (Water Hyacinth) 2. *Cyperus papyrus* (Popyrus reed) 3. *Salvinia molesta* (Kariba weed) 4. *Limnocharis flova* (Limnocharis) 5. *Pistia stratiotes* (Water lettuce) 6. *Azolla filiculoides* (Water fern) 7. *Enteromorpha flexura* (Filamentous algae) 8. *Ceratophyllum* (Hornwort)	Download photographs of aquatic Invasive Alien Species to identify and describe their characteristics as listed in content in terms of their establishment, mode of propagation, growth and development.	Draw and label three aquatic Invasive Alien Species.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) **FISHERY ORGANISMS AND THEIR HABITATS**	The student will be able to: 1.2.4 analyse the effects of Invasive Alien Species in fisheries	**Effects of aquatic Invasive Alien Species on:** **Fishery habitat** - Spread to cover water surfaces - Decrease light penetration - Reduction of oxygen content in water - Increase acidity of water - Sedimentation through decaying - Rapid water loss due to transpiration - **Fishery Organisms** - Blurred vision of fish due to turbid water - Reduction in growth due to acidity of the water - Poor respiration due to low oxygen level of water	Students to: Discuss the effects of aquatic Invasive Alien Species on fishery habitats, fishery organisms, fishers, use of water bodies and the economy. Teacher to invite a resource person from the Environmental Protection Agency to give a talk on Invasive Alien Species to students Use Futures wheel to trace the consequences of allowing aquatic Invasive Alien Species on water bodies of a community.	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) **FISHERY ORGANISMS AND THEIR HABITATS**	The student will be able to:	**Fishers** - Hinder transportation on water body - Inhibit the use of fishing gears - Limit quantity of fish caught leading to loss of revenue - Makes water unsafe for fishers due to growth of water snails which carry bilharzia - Bad colour and odour leading to poor quality of drinking water	Students to:	List and explain three effects of aquatic Invasive Alien Species on i. Fishers ii. Fishery habitat iii. Fishery organisms
	1.2.5 prevent and control aquatic Invasive Alien Species	**Preventive Measures** - Awareness creation through education - Screening of plants at Border Posts and other Entry points - Monitoring of Invasive Alien Species - Enforcement of Plant Protection and Regulatory laws	Brainstorm to identify measures for preventing occurrence and spread of Invasive Alien Species. Use digital content to identify and describe the preventive and control measures of aquatic Invasive Alien Species	
		Control Measures - Physical (Manual removal of plants) - Biological (Use of host specific insects, pathogens, parasitoids use of some fish species	Discuss methods of controlling aquatic Invasive Alien Species In groups, students plan and execute a programme on controlling aquatic Invasive Alien Species in their locality.	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 (CONT'D) **GROUPING OF FISHERY ORGANISMS**	The student will be able to: 1.3.1 group common fishery organisms into freshwater, brackish water and marine types.	Grouping of common freshwater, brackish water and marine fishery organisms: A Fresh water organisms: B. Brackish water organisms: *Tilapia* Grey mullet Shrimps Lagoon crab C. Marine organisms: *Sardinella* Sea bream Cassava fish Tuna Mackerel Anchovy Ray Shrimp Crab Shark Cuttle fish/squid Lobsters	Students to: Students to identify and group the common fishery organisms into freshwater, brackish water and marine types. Students to produce albums of fishery organisms found in fresh water, brackish water, and marine habitats, using cut-out pictures.	Put the following fishery organisms into their respective habitats (i.e. freshwater, brackish water and marine): *Tilapia* Tuna Grey mullet Rays Anchovy *Clarias* *Lates* Lobster *Alestes* *Sardinella* Cuttle fish

SECTION 2

FISHING ACTIVITIES

General Objectives: The student will:

1. appreciate the activities and facilities at fish landing sites.
2. become aware of various fishing equipment and their uses.
3. recognise various fishing methods.
4. appreciate the dangers of harmful fishing practices.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **FISH LANDING SITES AND FACILITIES**	The student will be able to: 2.1.1 locate local fish landing sites.	Fish landing sites - beaches, harbours, lagoons, river banks and lake shores.	Students to locate important fish landing sites on a map of Ghana: beach – e.g. Chorkor harbour – e.g. Tema lagoon – e.g. Elmina river bank – e.g. Buipe lakeshore – e.g. Yeji	Locate four fish landing sites on a map of Ghana.
	2.1.2 describe the use of facilities at fish landing sites.	Facilities at fish landing sites: winch, cold store, ice plant, fuel station, slipway, dry dock, jetty, break-water, etc.and their uses	Teacher to organise visits to fish landing sites and/or show films/pictures of landing facilities for class discussion.	Student to write report on visit to a fish landing site.
	2.1.3 describe activities at fish landing sites.	Activities at fish landing sites: - unloading fish from vessels. - fuelling vessels - loading ice into vessels - beaching of vessels for repairs - repair and maintenance of vessels/gear - fish processing - fish marketing	Students in groups to describe activities at fish landing sites.	Describe two activities at a fish landing site.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONTD) **FISH LANDING SITES AND FACILITIES**	The student will be able to: 2.1.4 plan proper sanitation systems for fish landing sites.	Sanitation practices at fish landing sites: proper disposal of fish entrails, refuse, human waste, oil, engine parts, gear, vessel parts, food wrappings, etc.	Students in groups to plan a sanitation system for a fish landing site **NOTE**: Plan to include proper sitting of facility, numbers needed, etc. Students to assess sanitation practices at landing sites during field visits and to present a report in class.	Describe ways of improving sanitation at a fish landing site you have visited. **Project**: Make a model of a fish landing site, including facilities needed.
UNIT 2 **FISHING GEAR AND CRAFT**	2.2.1 classify basic fishing gear used in inland, coastal and deep sea fishing.	Classification of fishing gear: 1. Active fishing gear: - Cast net - Seine net, - Trawl, etc. 2. Passive fishing gear: - Hooking devices - Traps, - Stationery nets, etc.	Students to identify and classify fishing gear into active and passive gear using models, pictures, charts, digital content, etc. Teacher to arrange visits to fishing communities for students to observe various gear used in inland, coastal and deep sea fishing.	Give an example each of active and passive fishing gear.
	2.2.2 describe basic fishing gear used in inland, coastal and deep sea fishing.	Structure and components of common fishing gear – - traps (e.g. baited and unbaited) - hooking devices (e.g. long line) - stationery nets (e.g. gill net) - trawl (e.g. otter trawl) - surround nets (e.g. seine nets).	Students to sketch and describe some examples of fishing gear common to their locality. Students to search for more information on gears from the internet and present reports.	Draw and label the following fishing gear: (a) hook and line (b) trawl (c) cast net

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) **FISHING GEAR AND CRAFT**	The student will be able to: 2.2.3 describe fishing crafts.	Identification and description of fishing vessels and accessories: - Canoes (dug out or planked) and the uses of oars, sails, outboard engines, etc. - Trawlers and the use of in-board engines, winches, sonar, radar, etc.	Teacher to organise visits to boatyard/dry dock, fish landing sites for students to observe some of the common fishing vessels and their accessories.	Draw and label a canoe. Discuss the merits and demerits of two materials used in the construction of canoes.
	2.2.4 construct fishing gear.	Materials for making fishing gears (e.g. nylon twine for nets; palm fronds for traps); Construction of simple fishing gears (e.g. cast net, gill net, hook, pole);	Students to bring to class different materials used in constructing fishing gears.	What materials are needed for constructing a gill net?
	2.2.5 maintain basic fishing gear and craft.	Basic maintenance of fishing gear and craft: - selection of appropriate materials - repair and maintenance of damaged nets; - proper storage of fishing gear; - maintenance of outboard motors; - maintenance of fishing craft (e.g. caulking, puttying and painting)	Invite a resource person to demonstrate construction and repair of fishing gears to students.	With the aid of a diagram, describe the processes involved in repairing a damaged gill net
	2.2.6 state the merits and demerits of using various fishing gear.	Merits and demerits of common fishing gear listed in 2.1.2. Merits: - allows for juveniles to reach mature stage - prevents destruction to habitat	Students to discuss the merits and demerits of using various fishing gear. Students to discuss the particular gear used to catch certain fishes, e.g. long-line for tunas, trawlers for demersal fishes.	Tabulate the advantages and disadvantages of using the following gears for fishing: a) traps b) trawls c) seine nets d) gill nets

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 **FISHING METHODS**	The student will be able to:	Demerits: - harvesting of juvenile fish - high cost of operation - destruction of the environment.		Why do fishers use particular types of gear to catch certain fishes?
	2.3.1 describe various fishing methods used in inland, coastal and deep sea fishing.	Fishing methods: - active fishing methods (use of trawls, seine nets, dredges, etc.), - passive fishing methods (use of hooking devices, traps, gill nets, tangle nets, etc).	Students in groups to discuss various fishing methods and compare them. Students to use models of fishing gears to demonstrate fishing methods. Teacher to show films/pictures of fishers fishing.	Compare active and passive fishing methods.
UNIT 4 **HARMFUL FISHING PRACTICES**	2.4.1 describe harmful fishing practices.	Harmful fishing practices. - inappropriate mesh size of nets, - explosives - poisonous chemicals/plants - bamboo traps - drag nets in inland water bodies, - trawling very close to shore.	Students to list some fishing methods and group them into harmful and good practices. Students to discuss ways of minimising harmful fishing practices.	Interview fishers on harmful fishing practices and write a report.
	2.4.2 analyse the effects of harmful fishing practices.	The effects of the harmful fishing practices listed.	Invite a resource person to give a talk on the dangers of harmful fishing practices. Teacher to exhibit materials used in harmful fishing and show films/pictures on some harmful fishing practices for class discussion. Students to brainstorm on the impact of harmful fishing practices. E.g. blockage of fish migratory routes.	In what ways do harmful fishing practices affect the fishing industry?

SENIOR HIGH SCHOOL – YEAR 1

SECTION 3

FISH BIOLOGY (I)

General Objectives: The student will:

1. acquire practical skills in the identification of fishery organisms.
2. appreciate taxonomic classification of fishery organisms.
3. recognise external and internal features of fish.
4. appreciate the basic life processes in fish.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **IDENTIFICATION AND CLASSIFICATION OF FISHERY ORGANISMS**	The student will be able to: 3.1.1 classify common fishery organisms into their taxonomic groups.	Identification of common fishery organisms by taxonomic groups and species. Classification of common fishery organisms under the following headings: Phylum Mollusca Class Bivalvia (e.g. clam/*Egeria*) Class Gastropoda (e.g. sea snail) Class Cephalopoda (e.g. squid) Phylum Arthropoda Class Crustacea (e.g. crab, prawn) Phylum Echinodermata Class Asteroidea (e.g. starfish) Class Echinoidea (e.g. sea urchin) Phylum Chordata Class Pisces Sub-Class Elasmobranchii (cartilaginous fishes) Sub-Class Teleostei (bony fishes)	Students to bring different types of fishery organisms for identification, classification and drawing. Students to identify fishery organisms by their common and scientific names. NOTE: 1. Classification of invertebrates specified to end at Class. **2.** Classification of vertebrates specified to end at Sub-Class	Indicate the taxonomic Class of the following organisms: (i) clam (ii) skate (iii) horse mackerel (iv) prawn (v) sea urchin

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 **STRUCTURE AND FUNCTION OF FISHERY ORGANISMS**	The student will be able to: 3.2.1 assess the length and weight of fish.	Fish body measurement: - total length - standard length - fork length - weight	Students to measure lengths and weights of various fishes.	Determine the standard length of *Tilapia* and *Clarias*
	3.2.2 draw and label the external features of a fishery resource.	External features of: - a mollusc e.g. cuttle fish - a crustacean e.g. shrimp, crab - a cartilaginous fish e.g. shark, ray - a bony fish e.g. Tilapia, claria.	Students to draw and label external features of fishery organisms belonging to those listed under content.	Using well labelled diagrams, compare the differences in the external features of a bony fish and a cartilaginous fish.
	3.2.3 relate the external structures of a fishery organism to their functions.	Relationship between external structure to function: e.g. streamlined body of fish – ease in movement fish fins – for swimming lateral line in fish – detection of vibration in water crustacean exoskeleton – protection mollusc foot – movement echinoderm spine - defence	Discuss with students the functions of the external features of molluscs, crustaceans, bony and cartilaginous fishes.	Draw and label the external features of a bony fish and a crustacean. Describe the function of the following features: (a) foot of mollusc (b) spines of echinoderm
	3.2.4 relate the internal organs of bony fishes to their functions.	Internal organs of bony fishes and their functions: e.g. gills – gaseous exchange alimentary canal – digestion heart and blood vessels – circulation kidney – excretion gonads – reproduction	Students to dissect a bony fish (e.g. tilapia) and observe the arrangement of the internal features. They should draw and label the internal features of the fish. Students to compare the digestive tracts of a herbivorous and a carnivorous fish in relation to their diet. **NOTE:** The presence of accessory structures in some fishes, e.g. *Clarias*, should be mentioned.	Draw and label the gonads of a tilapia. State and describe the functions of the following organs in a bony fish: - gills - heart - swim bladder - stomach

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 **LIFE PROCESSES IN FISHES – LOCOMOTION, DIGESTION, CIRCULATION AND GASEOUS EXCHANGE.**	The student will be able to: 3.3.1 describe locomotion in fishes.	Mode of locomotion in fishes: movement of muscles and fins during swimming, maintaining balance, pitching, etc.	Students to observe and describe the movement of fish in an aquarium.	Describe the movement of the tail fin during swimming in fishes.
	3.3.2 describe feeding and digestion in fishes.	Ingestion, digestion, absorption and egestion in fishes.	Students to observe fish feeding in an aquarium. Students to dissect a fish and remove the alimentary canal for gut content analysis.	Identify the types of food material in the gut of a dissected Tilapia.
	3.3.3 describe blood circulation in fishes.	Circulation and function of blood in fishes.	Students to discuss the composition, circulation and function of the blood.	Describe the circulatory system of a bony fish.
	3.3.4 describe gaseous exchange in Fishes.	Mechanism of gaseous exchange in fishes.	Students to discuss the mechanism involved in the absorption of dissolved oxygen from water, and expulsion of carbon dioxide from the fish.	Describe the use of gills in fishes.

SENIOR HIGH SCHOOL – YEAR 2

SECTION 1

FISH BIOLOGY (II)

General Objectives: The student will:

1. be aware of the basic life processes in fish
2. recognise the behaviour of fishes in their habitat
3. appreciate the environmental conditions necessary for fish survival
4. appreciate the importance of fish health
5. be aware of the basic principles in fish genetics and evolution

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **LIFE PROCESSES – EXCRETION, REPRODUCTION AND GROWTH**	The student will be able to: 1.1.1 describe excretion in fishes.	Excretion in fishes: The process of excretion and Osmo-regulation in fishes. Excretory products of fishes.	Students to use diagrams and information from internet sites to learn about the processes of excretion and osmo-regulation in fish. Student to discuss the excretory products of fishes.	Describe osmo-regulation in fish.
	1.1.2 describe reproduction in fishes.	Reproduction in Fish: - gamete formation - spawning - fertilization - parental care	Students to discuss reproduction in fishes according to the topics listed under content. Students to identify male and female tilapia. Students to examine eggs of gravid/berried fish.	Explain the following terms as used in fish reproduction: Spawning Gravid/berried Fertilisation Parental Care Fry Fingerlings
	1.1.3 describe growth in fishes	Growth in fishes: Life cycle, factors affecting growth. (e.g. temperature, dissolved oxygen, nutrients, food availability, competition).	Students to discuss fish growth and factors which affect their growth. Students to monitor growth stages in fish kept in an aquarium. They should keep records of environmental factors that affect the growth of fish in the aquarium.	Describe the life cycle of a named fish.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2	The student will be able to:			
FISH ECOLOGY	1.2.1 assess environmental factors affecting fish population.	Environmental conditions in fish habitats - temperature - dissolved oxygen - salinity - pH - turbidity - light - nutrients - upwelling phenomenon	Students to discuss environmental conditions of fish habitats and how they affect fish populations. Students to discuss optimal environmental conditions necessary for fish survival. Teacher to arrange for water test kits for students to test the various environmental conditions listed under content using water from a pond, stream, lake, lagoon, river, sea, etc.	Describe the method for measuring turbidity in a fish habitat. Compare the salinity levels in fresh water and sea water.
	1.2.2. outline the causes of pollution in natural water bodies.	Pollution in natural water bodies - (reservoirs, rivers, lakes, lagoons, estuaries, sea)	Students to discuss causes of pollution in natural water bodies. Students to discuss the effect of water pollution on fish populations.	Discuss the effect of water pollution on fish populations.
	1.2.3 assess the basic ecological processes within a fish habitat.	Ecological processes in a natural fish habitat: - feeding behaviour - predation and competition - food chain and web - food pyramid - fish mortality - natural and fishing mortality - adaptation to environment	Students to construct feeding relationship in a fish habitat (e.g. food chain and food web). Students to discuss the effects of changes in number of predators and prey on fish populations. Students to discuss the causes of fish mortality.	Construct a food web in a fish habitat. What is the effect of competition in fish populations?
UNIT 3				
INTRODUCTION TO FISH GENETICS	1.3.1 explain the principles of genetics.	Principles of genetics as related to fishes: - chromosomes - genes - genetic crossings - phenotype - genotype	Students to explain the principles of genetics in fish breeding, e.g. development of the super male tilapia; Genetically Improved Farmed Tilapia (GIFT). Students to discuss the concept of inheritance of characters in fishes.	Describe the processes involved in the production of the super male tilapia.
	1.3.2 explain the concept of inheritance	Inheritance of external characters in fishes.		Explain how fish inherit skin colour.

SENIOR HIGH SCHOOL – YEAR 2

SECTION 2

AQUACULTURE

General Objectives: The student will

1. be aware of the importance of aquaculture
2. appreciate the general principles and practices of aquaculture.
3. develop interest in the practice of aquaculture.
4. develop practical skills in constructing an aquarium
5. be aware of the role of aquarium in reducing stress

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **INTRODUCTION TO AQUACULTURE**	The student will be able to: 2.1.1 explain the meaning of aquaculture.	Meaning of Aquaculture: - culture of organisms in water (freshwater, lagoon/estuary, sea)	Students to brainstorm on the meaning of aquaculture.	What is aquaculture?
	2.1.2 outline the importance of aquaculture to the economy.	Importance of aquaculture: - supplements the output from capture fisheries - generates income - provides employment - for scientific research **- enables** judicious use of land	Students to discuss the importance of aquaculture.	Discuss the importance of aquaculture to the economy of your country.
	2.1.3 describe types of aquaculture.	Types of aquaculture: - fish farming - clam farming - shrimp farming - sea weed farming, etc.	Students to discuss the various types of aquaculture. Students to search for more information on other types of organisms that could be cultured from the internet, fishery journals etc.	Describe three types of aquaculture.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 **STATE OF AQUACULTURE IN GHANA**	The student will be able to: 2.2.1 describe the state of aquaculture in Ghana.	State of Aquaculture in Ghana: - number and sizes of farms; - types of cultured species, etc.	Invite a resource person to give a talk on the state of aquaculture in Ghana. The talk should include prospects and challenges in the industry. Students to review the existing aquaculture infrastructure.	Write an essay on the state of aquaculture in Ghana.
	2.2.2 identify the basic problems facing aquaculture development in Ghana.	Factors affecting aquaculture development in Ghana: e.g. - few specialists in the field - high cost of pond construction - high cost of feed - difficulty in obtaining fingerlings - difficulty in accessing credit - difficulty in land acquisition	Students watch film/pictures on various aquaculture practices and discuss the problems facing the aquaculture industry in Ghana.	Outline two problems encountered in the aquaculture industry and suggest solutions to them.
	2.2.3 outline solutions to the problems of aquaculture in Ghana.	Solutions to problems facing aquaculture in Ghana: - improved land tenure system - availability of fingerlings etc.	Groups of students to brainstorm on solutions to problems facing aquaculture in Ghana.	Compare aquaculture practices in Ghana and another country of your choice.
UNIT 3 **AQUARIUM ACTIVITIES**	2.3.1 identify the requirements for constructing an aquarium.	Requirements for constructing an aquarium: - receptacle (e.g. perspex or glass), - adhesive, filters, aerator/pump - water	Students to discuss the requirements necessary for the construction of an aquarium.	
	2.3.2 design and construct an aquarium.	Aquarium design, construction and stocking. -	Teacher to invite a resource person to assist students to design and construct a simple aquarium.	List three (3) items needed for the construction of an aquarium.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 (CONT'D) **AQUARIUM ACTIVITIES**	The student will be able to: 2.3.3 maintain fish in an aquarium.	Maintenance of fish in aquarium - capture of live fish - transport of live fish from field to aquarium - feeding of fish maintain optimum conditions for fish survival.	Students to obtain live fish (ornamental fish) to stock their aquarium (e.g. guppy, gold fish). Students to feed fish and maintain aquarium Students to record daily management activities.	Describe the construction of an aquarium. Include costing of the items used. **Project:** Construct an aquarium and stock it with fish. Write a report on the daily management practices.
	2. 3.4 describe the importance of aquarium	Importance of aquarium - aesthetic value - reduction of stress - scientific purposes	Brainstorm on the importance of keeping an aquarium Visit the Internet and download information on aquarium Download pictures of various types of aquarium Use digital content and brainstorm on the use of aquarium for reducing stress. **Project:** Stress Reduction using aquarium Students interview persons in the community who have aquarium and find out from them how aquarium is used in reducing stress. Teacher to invite a resource person to talk to students on how aquarium is used in reducing stress.	Prepare and present reports on the project - Stress Reduction using aquarium

SENIOR HIGH SCHOOL – YEAR 2

SECTION 3

FISH FARMING

General Objectives: The student will:

1. appreciate the importance of fish farming
2. acquire skills in the establishment and development of fish farms
3. acquire necessary knowledge and skills to harvest and market good quality cultured fish.
4. appreciate the importance of maintaining pond water quality.
5. acquire the skills in formulating fish feed.
6. recognise fish diseases and their causes.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **INTRODUCTION TO FISH FARMING**	The student will be able to: 3.1.1 explain the importance of fish farming to the economy.	Importance of fish farming: - to supplement output from capture fisheries - to generate income - to provide employment - for scientific research	Students to discuss the importance of fish farming.	What is the importance of fish farming to the economy?
	3.1.2 identify levels of fish farming.	Levels of fish farming: - Extensive fish farming - Semi-Intensive fish farming - Intensive fish farming	Students to discuss the differences in levels of fish farming. Teacher to organise visits to fish farms for students to observe levels of fish farming for discussion in class.	Describe the differences between extensive, semi-intensive, and intensive fish farming.
	3.1.3 describe types of fish farming.	Types of fish farming: - monoculture (culture of one species of fish only) - polyculture (culture of more than one species of fish) - integrated culture (e.g. fish-cum-ducks, fish-cum-rice culture).	Students to discuss different types of fish farming. Teacher to assist students to discuss types of fish farming using audio-visual aids. Students to report on types of fish farming using information from journal and internet sites.	Describe the following: a) monoculture b) polyculture c) integrated culture

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **INTRODUCTION TO FISH FARMING (CONT'D)**	The student will be able to: 3.1.4 describe different facilities for growing fish.	Facilities for growing fish: - earthen ponds - cages - concrete tanks - raceways - fish pens	Teacher to show films/pictures of different facilities used in fish farming for class discussion. Students to gather more information on facilities for growing fish using internet search.	Describe three facilities in which fish could be grown.
UNIT 2 **POND CONSTRUCTION, MAINTENANCE AND STOCKING**	3.2.1 select suitable sites for construction of ponds, cages, and pens.	Site selection criteria for fish ponds, cages and pens: - topography, soil type, water supply, etc.	Students to discuss the criteria for selecting sites for fish ponds, cages and pens.	Describe the following activities in relation to fish farming: 1) site selection 2) species selection 3) stocking
	3.2.2 construct fish pond of appropriate size and depth.	Pond construction: Excavation, construction of walls, fitting drainage pipes, grassing, etc.	Students to discuss appropriate equipment and measurements in pond construction. Students to design and construct a model fish pond e.g. 1.0 m x 1.0m x 0.1 m using appropriate materials.	
	3.2.3 maintain fish pond.	Pond maintenance activities:	Students to undertake maintenance of fish pond by: - maintaining minimum level of water - repairing leakages - getting rid of unwanted weeds and animals. - fertilising ponds, etc.	
	3.2.4 select suitable fish species for culture.	Selection of fish species based on: - feeding habits - availability of fingerlings - adaptability - growth rate	Students in groups to select appropriate species for stocking in their ponds, based on the criteria outlined under content.	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CON'D) **POND CONSTRUCTION, MAINTENANCE AND STOCKING**	The student will be able to: 3.2.5 stock fingerlings in fish ponds with minimum mortalities.	Stocking: - source of fingerlings - packaging - transportation - release into pond	Students to stock their ponds with *Tilapia* and/or *Clarias* fingerlings. Students to take precautions during stocking of fish: - keep fish at optimum temperature during transportation; - condition fish during transportation - preventing overstocking, etc.	**Project:** Students to keep records of fish farming activities in a diary for inspection.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 **FISH HARVESTING**	The student will be able to: 3.3.1 harvest fish from ponds.	Harvesting of fish from ponds: - partial harvesting using cast nets and drag nets - total harvesting by drainage and collection with hand nets, scoop nets, baskets, etc.	Students to discuss procedures for partial and total harvesting of fish from ponds. Teacher to arrange visits to fish farms for students to observe harvesting of fish.	Describe total harvesting of fish from a pond. **Project:** Harvest fish from a pond and carry out the marketing of the fish.
	3.3.2 drain and re-fill fish ponds.	Draining and re-filling of fish ponds.	Students to drain and re-fill their model fish ponds.	Prepare a report on how you drained and refilled the pond. Include any problems encountered and how you attempted to solve them.
UNIT 4 **WATER QUALITY CONTROL IN FISH PONDS**	3.4.1 monitor the quality of water in a fish pond.	Indicators of water quality: pH, dissolved oxygen, turbidity, ammonia, temperature, etc.	Students in groups to monitor levels of pH, dissolved oxygen and turbidity in their fish ponds, using appropriate equipment/methods (e.g. secchi disc, hand lens, probes, and titration).	Mention four indicators for monitoring water quality of a fish pond.
	3.4.2 state the causes of water pollution in a fish pond.	Causes of pollution in fish ponds e.g. poisons/pesticides, sewage, debris, household refuse.	Students to discuss causes of water pollution in fish ponds. Teacher to arrange visits to fish ponds and identify those which are polluted and the source of pollution.	Describe two sources of pollution in a fish pond.
	3.4.3 outline methods for preventing and controlling water pollution.	Methods of preventing and controlling pollution in fish ponds, e.g. controlling entry of sewage into fish pond.	Students to discuss methods of preventing and controlling pollution in fish ponds.	Describe two ways of preventing pollution in fish ponds.
	3.4.4 adopt measures to improve water quality in fish ponds.	Improvement of water quality in fish ponds: - stirring water to increase dissolved oxygen concentration - application of lime to correct pH.	Students to discuss methods of improving water quality in fish ponds. Students to carry out activities to improve the quality of water in a polluted fish pond.	Describe ways of improving water quality in fish ponds. **Project:** Monitor quality of water in a fish pond for a period and write a report. .

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
	The student will be able to:			
UNIT 5	3.4.5 fertilise a fish pond.	Fertilisation of fish pond: use of inorganic fertiliser (e.g. phosphates and nitrates); organic manure (e.g. cow dung).	Students to identify suitable fertilisers and use them to fertilise fish pond, emphasising method of application.	Describe three methods of pond fertilisation.
FEED FORMULATION AND FEEDING	3.5.1 identify the types of fish feeds and their nutrient content.	Types of fish feeds and their nutrient content: - formulated feeds - agricultural by-products etc.	Display various types of fish feed for identification and discussion. Students to discuss the nutritive value of feeds displayed. Students to take note of the use of pelletised and floating feeds.	Name three types of fish feed and indicate their nutrient contents.
	3.5.2 formulate fish feed.	Feed formulation: e.g. percentage composition of groundnut husk, rice bran, blood meal in feed.	Students to discuss the composition of a balanced fish feed. Students in groups to prepare a formulated fish feed.	Formulate a fish feed containing 30% protein from wheat bran (16% protein) and fish meal (46% protein).
	3.5.3 feed fish	Procedure for feeding fish.	Students to carry out feeding of fish in a pond, noting feeding times, quantities, etc.	Describe the procedure of feeding fish in a pond.
UNIT 6				
FISH DISEASES, CAUSES AND CONTROL	3.6.1 state the types and causes of fish diseases.	Fish diseases and their causes: - gill rot: fungus - furunculosis : bacteria - ich: protozoa	Students to discuss the various diseases of fishes using films/pictures.	Identify the causative agents and symptoms of furunculosis and ich in fishes.
	3.6.2 identify fish diseases from Symptoms.	Symptoms of fish diseases: - Gill rot: red/whitish spots on gills - Furunculosis: ulcers on skin - Ich disease: white spots on skin and fins.	Students to discuss symptoms of fish diseases specified under content.	Describe the methods used in the treatment of the following fish diseases: a) gill rot b) furunculosis c) ich

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 6 (CONT'D) **FISH DISEASES, CAUSES AND CONTROL**	The student will be able to: 3.6.3 state the methods for preventing, controlling and treating fish diseases.	Prevention, Control and Treatment of Fish Diseases: - chemotherapy - sterilisation - minimal handling of fish - suitable diet - disinfection	Using specimens, films or pictures students are to identify types of fish diseases and their causative agents. Students to discuss measures for controlling, preventing and treating fish diseases. Note: 1. Teacher to explain aquatic conditions which favour fish diseases. 2. Teacher to explain that usually fish diseases do not infect humans. .	

SENIOR HIGH SCHOOL – YEAR 3

SECTION 1

FISH UTILISATION

General Objectives: The student will:

1. be aware of the nutritive value of fish
2. develop skills in fish processing and preservation to prevent spoilage
3. be aware of the various uses of fish by-products.
4. recognise the signs of fish spoilage.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **NUTRITIVE VALUE OF FISH**	The student will be able to: 1.1.1 identify the nutrients in fishery organisms.	Nutritive composition of fin fish, crustaceans and molluscs: - proteins - lipids - mineral salts - water - vitamins	Students to be familiar with major nutrients present in fishery organisms. Students to carry out activities to test for proteins and lipids in fish.	Carry out an experiment to test for protein in fish and write a report.
UNIT 2 **FISH PROCESSING, PRESERVATION AND PACKAGING**	1.2.1 explain the meaning of fish processing and preservation.	Meaning of fish processing: activities carried out to prepare fish for consumption, marketing, etc. Meaning of fish preservation: activities carried out to extend the shelf life of fresh fish.	Students to brainstorm on the meaning of fish processing and preservation.	Distinguish between fish processing and fish preservation.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) **FISH PROCESSING, PRESERVATION AND PACKAGING**	The student will be able to: 1.2.2 explain the general principles of fish processing and preservation.	General principles of fish processing and preservation: - removal of microbes - removal of water - slowing down of enzymatic action - denaturing of enzymes, - slowing down bacterial activity, etc.	Students to discuss the general principles of fish processing and preservation.	State four principles of fish processing and preservation.
	1.2.3 describe methods of fish processing.	Methods of fish processing: - washing - scaling - gutting - filleting, etc.	Teacher to arrange a visit to a fish processing factory for students to observe equipment and methods of fish processing and preservation. Students to undertake basic fish processing activities listed under content.	Describe two methods of processing fish.
	1.2.4 describe the traditional and modern methods of fish preservation.	Traditional methods: Smoking Cooking Salting Drying Frying Modern Methods: Freezing Canning Irradiation Use of chemicals (Pickling)	Students to undertake basic fish preservation activities using traditional and modern methods.	Compare traditional and modern methods of fish preservation in terms of shelf life.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D)	The student will be able to:			
FISH PROCESSING AND PRESERVATION AND PACKAGING	1.2.5 give reasons for processing and preserving fish.	Reasons for processing and preserving fish: - prevent spoilage. - increase shelf life. - improve taste. - add value	Students to discuss the reasons for processing and preserving fish.	Suggest ways for improving traditional methods of fish preservation.
	1.2.6 construct a fish preservation equipment.	Construction of preservation equipment.	Students to build models of fish preservation equipment e.g. Chorkor smoker, drying racks.	State two reasons why fish should be: (i) processed (ii) preserved.
	1.2.7 prepare and package fish for local and export markets.	Preparation and packaging of fish for local market or for export	Students to identify material needed for packaging fresh or preserved fish for local market or for export. e.g. Crates and baskets.	**Project:** Construct a Chorkor smoker and use it to preserve fresh fish. Exhibit products in class.
			Students to demonstrate methods of packaging fresh and preserved (smoked, dried, salted) fish for local or foreign markets.	Outline the procedures involved in packaging the following for a foreign market: i. smoked fish ii. frozen fish iii. salted fish iv. dried fish.
	1.2.8 analyse supply and value chains in the fishery industry.	Supply and value chains in the fishery industry.	Students to discuss value chains in the fishery industry and the responsibilities of actors in the supply and value chains.	Explain the supply and value chain in the fish industry. Draw a flow chart to show the linkage among the value chain players of a named fishery product.
	1.2.9 describe food fish quality and safety standards	**Food fish quality and safety Standards:** **Smoked Fish:** - Hygiene of processing environment, - Absence of living or dead organisms, - Absence of foreign matter, - Absence of bad odour and flavour - Absence of moulds, - Absence of faecal matter.	Students to contact Standards Board or the Food and Drugs Board to find out Food fish quality and safety standards of various fish products: Smoked fish Frozen fish Canned fish Dried fish Salted fish	Itemise quality and safety standards of two fish products.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) **FISH PROCESSING AND PRESERVATION AND PACKAGING**	The student will be able to:	**Frozen Fish:** - Hygiene of freezing environment - Appearance - Absence of foul odour **Canned Fish** - Undented can - Non-Rusted can - Non-Bloated can - Expiry date - International Standards Organisation (ISO) certification **Dried and Salted Fish** - Appearance - Absence of bad Odour/ Scent of chemicals - Absence of living organisms - Absence of dead or living parasites - Absence of foreign matter - Absence of moulds - Absence of insects - Absence of faecal matter	Teacher to invite a resource person to talk to students on fish food quality and safety standards.	Project: Students to conduct a survey of fish food products in the locality by visiting fish processing sites to interview and observe activities carried out in these sites. They should compare the observed activities to the fish food quality standards listed in content. Students to design a programme to ensure maintenance of fish food quality standards in the community.
	1.2.10 trace the effects of consuming poor quality fish food products on human health	Effects of consuming poor fish food products on human health	Students to use the Futures Wheel to trace the effects of consuming poor quality animal food products on human health	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 **FISH PRODUCTS AND BY-PRODUCTS**	The student will be able to: 1.3.1 identify the major fish Products.	Major fish products: - fish fillets - fish chunks - fish flakes - canned fish - smoked fish - dried fish - salted fish - pickled fish - marinated fish	Students to discuss the various fish products listed under content.	List four fish products.
	1.3.2 identify fish by-products and indicate their uses.	Fish by-products: - fish liver oils - fish entrails (guts, gills) - fin bones, etc. Uses of fish by-products: - liver oils – medicinal - bones, fins, gills – feed - fish intestines/entrails– bait, fertilizer	Students to identify by-products from processed fish and discuss their uses.	List four fish by-products and indicate their uses.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 **FISH SPOILAGE**	The student will be able to: 1.4.1 detect signs of fish spoilage.	Signs of fish spoilage: e.g. sunken eyes, mucus on the skin, darkening gills.	Students to discuss various ways of detecting spoilage in fish.	State three differences between fresh and spoiled fish.
	1.4.2 explain the causes of fish spoilage.	Causes of Fish Spoilage: - microbial (bacteria and fungi) - enzymatic - fat oxidation	Students to explain the causes of fish spoilage.	Describe three causes of fish spoilage.
	1.4.3 outline the effects of fish spoilage.	Effects of fish spoilage: - public health hazard - loss of value and taste - loss of income	Students to discuss some of the effects of fish spoilage.	**Project**: Expose fresh fish to agents of spoilage, observe changes over a period and write a report.

SENIOR HIGH SCHOOL – YEAR 3

SECTION 1

FISHERIES MANAGEMENT AND BUSINESS OF FISHERIES

General Objectives: The students will:

1. appreciate the importance of fisheries management
2. become aware of fisheries regulations and government policies
3. become aware of procedures in fish marketing
4. acquire the basic skills of managing fish farm as a business entity

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **FISHERIES MANAGEMENT**	The student will be able to: 2.1.1 explain fisheries management.	Fisheries Management: - measures taken to maintain fish stock levels for sustainable exploitation - Maximum Sustainable Yield (MSY).	Students to brainstorm to bring out the meaning of fisheries management and the role of MSY in fisheries management.	Explain fisheries management.
	2.1.2 outline fisheries management objectives and strategies.	Fisheries management objectives and strategies: - maximizing sustainable catches - maintaining spawning stocks - Etc.	Students to discuss objectives and strategies involved in fisheries management, including its importance.	Mention two objectives of fisheries management and explain how they can be achieved. Discuss the importance of fisheries management.
	2.1.3 explain some traditional fish stock management practices.	Traditional fisheries management practices - closed seasons - taboos - non-fishing days, etc.	Teacher to arrange visits to local fishing communities for students to learn some traditional fisheries management practices.	Outline two traditional fisheries management practices and indicate how they contribute to increased fish stocks.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D)	The student will be able to:			
FISHERIES MANAGEMENT	2.1.4 gather and analyse basic data for fisheries management.	Basic data requirement for fisheries management: - fish catch - fishing effort - fish length and weight - fish age - gear type, etc.	Students in groups to obtain fisheries data and carry out basic analysis for fisheries management (e.g. daily fish catch, number of vessels, number of fishers etc).	How can each of the following types of data be used to manage a fishery? a) fish catch b) fishing effort c) gear type
	2.1.5 give reasons for seasonal differences in fish catch.	Factors affecting variations in fish catch (bumper and lean harvests) e.g. climatic and breeding factors.	Students to discuss the factors that lead to bumper and lean harvest of fish. Students to brainstorm on the effect of upwelling in bumper harvest of fish.	Describe two factors that lead to bumper and lean harvest of fish.
UNIT 2 **FISHERY REGULATION AND POLICIES**	2.2.1 outline government policies and regulations on fisheries.	Government policies and laws on fisheries. e.g. subsidy on fishing inputs, role of stakeholders in fisheries.	Invite a resource person to talk on fisheries policies and regulations in Ghana. Talk to include regulatory strategies (e.g. limiting number of fishing units, fishing closures, regulating mesh sizes and catch quotas).	Outline the government's policy on the use of fishing gears in Ghana.
	2.2.2 state the importance of fisheries policies and regulations.	Fisheries Policies, regulations and their importance: - prevent capture of juvenile fishes - protect environment , etc.	Students to discuss potential effects of fishery policies and regulations on fish stocks and fishing communities.	What is the importance of regulating the fisheries industry?

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2(CONT'D)	The student will be able to:			
FISHERY REGULATION AND POLICIES	2.2.3 state the importance of the Exclusive Economic Zone.	Exclusive Economic Zone (EEZ). - resources within 200 nautical miles from the shoreline of a coastal nation.	Students to discuss the meaning and economic benefits of EEZ to a coastal nation. Students to investigate and report on how the EEZ regulations are being flouted.	Explain the term Exclusive Economic Zone (EEZ).
	2.2.4 identify some of the fishery organisms protected by international laws.	Endangered fishery organisms, and international fishery conventions e.g. IUCN Red List, Convention on Biodiversity (CBD), International Convention for the Conservation of Atlantic Tunas (ICCAT).	Students to list endangered fishery organisms and discuss the need to protect them. E.g. turtles, dolphins, whales etc. Students to discuss the importance of international fishery conventions.	**Project:** Produce an album of endangered fishery organisms
UNIT 3 **BUSINESS OF FISHERIES**	2.3.1 prepare a budget for a fishery business.	Budget for a fishery business: - expenditure for culture fisheries (land acquisition, pond construction, fingerlings, feed, medication, labour, maintenance, etc) - expenditure for capture fisheries (vessels, fuel, fishing gears, labour, maintenance, etc) - expenditure on fishing input sales business (nets, gears, ropes, floats etc).		

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 (CONT'D) **BUSINESS OF FISHERIES**	The student will be able to:	-expenditure on fish marketing business (refrigerated vans, ice, crates, cold stores etc).	Students to prepare budgets for culture and capture fishery ventures.	Outline the capital and operating expenses in (i) a capture fishery business, (ii) a culture fishery business.
	2.3.2 make financial projections.	- income from sale of products. - cash flow projections.	Students to brainstorm on other fisheries-related businesses such as sale of fishing inputs.	
	2.3.3 price fish products.	Pricing of fish products.	Students to discuss expenditure items involved in trading in fresh and smoked fish, fishing inputs business. Teacher to invite resource person to discuss fisheries business with students, including pricing of fish products, demand and supply.	**Project:** Interview a fish farmer and write a report on the business operation of a fish farm.
UNIT 4 **FISH MARKETING**	2.4.1 describe the various activities involved in fish marketing in Ghana.	Quality control, packaging, storage, transportation.	Students to be guided to perform a sketch on activities involved in fish marketing. Students to name and describe fish marketing centres they know of.	A fish farmer harvests 5000 kg of tilapia from a fish pond. An amount of 2000 Ghana cedis was spent on fingerlings, feed and labour. At what price should a kilogram of tilapia be sold to enable the farmer make a 20% profit on the operational cost?
	2.4.2 name some of the major fish marketing centres in Ghana.	Tema and Takoradi fishing harbours, Elmina beach, Yeji landing site; Other markets which are not fish landing sites (e.g. Mankessim).	Students to discuss activities at fish marketing centres and suggest ways of improving efficiency of the marketing process.	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 (CONT'D) **FISH MARKETING**	The student will be able to: 2.4.3 name major companies involved in fisheries activities in Ghana.	Major Companies involved in Fishery activities in Ghana: Kaas, Afko, Enyidado, Tropo farms, Crystal Lake, Felibat, etc.	Teacher to arrange a visit to a fishing company for students to familiarise themselves with the Company's operations and to discuss the processes involved in fish import and export.	Investigate and write a report on the activities of a fishing company under the following headings: - name of company, location - type of fish caught, gears operated - vessels, storage facilities
	2.4.4 identify problems of fish marketing in Ghana and suggest solutions to them.	Problems of fish marketing in Ghana.	Students to discuss problems of fish marketing in Ghana and suggest solutions to them.	Discuss problems of fish marketing in Ghana.
	2.4.5 outline the activities involved in fish import and export.	Activities involved in the export/import of fish:	Teacher to invite a fish import/export company to brief students on activities involved in fish import and export business.	
	2.4.6 identify the problems of Fish import and export in Ghana.	Effects of bumper harvest on import/export and prices, etc.	Students to discuss the effects of bumper harvest on fish imports and exports and fish marketing in Ghana.	**Project:** Interview the management of a cold store company and write a report on their import operations.

SENIOR HIGH SCHOOL – YEAR 3

SECTION 2

PRACTICES IN FISHING COMMUNITIES AND FISHERIES INSTITUTIONS

General Objectives: The students will:

1. be aware of the cultural/traditional practices of fisher folks.
2. recognise the institutions dealing with fisheries in Ghana.
3. be aware of the available career opportunities of fisheries and related industries in Ghana.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **FISHING COMMUNITIES AND CULTURAL PRACTICES**	` The student will be able to: 3.1.1 name important fishing communities in Ghana.	Freshwater and marine fishing communities in Ghana: Freshwater – Yeji, Dambai, Kwamikrom, Abotoase; Marine – Teshie, Elmina, Chorkor, Shama.	Arrange visits to both marine and freshwater fishing communities for students to observe local practices in fishing.	**Project** Write a report on traditional fishing practices of a named fishing community.
	3.1.2 name cultural festivals related to local fishing.	Fishing/cultural festivals and taboos in Ghana: - Edina: Bakatue - Oguaa: Fetu, etc.	Invite local fishers to talk on fishing practices, cultural festivals and taboos in their communities. Students to discuss the effects of cultural practices on fishing in Ghana.	Students to write essay on the influence of festivals and taboos on the Ghanaian fishing industry.
	3.1.3 assess some of the fishing taboos and their effects on the fishing industry.	Influence of taboos on the fishing industry e.g. close season.	Students to discuss effects of taboos and other cultural practices on the fishing industry. Teacher to use film/pictures of fishing festivals for discussion in class.	Explain 'close season' as used in traditional fishery practices. Discuss the importance of fishing festivals.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 **FISHERIES INSTITUTIONAL FRAMEWORK AND JOB OPPORTUNITIES**	The student will be able to: 3.2.1 name institutions involved in fisheries training and research in Ghana.	Fisheries training and research Institutions.	Teacher to arrange visits to fishing industries, universities, research institutions etc, to find out about their activities. Notable institutions are Department of Oceanography and Fisheries of University of Ghana, Marine Fisheries Research Division of Fisheries Department, Water Research Institute of CSIR, and Faculty of Renewable Natural Resources KNUST.	Name three fisheries-related institutions and outline their activities.
	3.2.2 outline the objectives of fisheries training and research institutions in Ghana.	Objectives of fisheries training and research institutions in Ghana: - To train manpower for the fisheries sector - to carry out research into fisheries-related matters	Invite resource persons to talk about the functions of the Ministry of Fisheries and other fisheries organisations; opportunities available for further training in fisheries; the fishing industry in Ghana and job opportunities in the fisheries sector.	Mention ten (10) types of jobs available to fisheries students.
	3.2.3 identify job opportunities in the fishery sub-sector.	Job Opportunities in Fisheries: - teaching/research - fishing - fish farming - fish pond engineer - import/export/sales person - fish processing - cold store operation - fishing gear/craft manufacturing - fisheries extension services, etc.	Students to discuss job opportunities in fisheries.	Mention three job opportunities in the fisheries sub –sector and indicate the education and training required to enter those jobs.
	3.2.4 explain the role of extension services in the fisheries sector.	Role of extension services: - Technical assistance to fish farmers - Education of fisher folks on fishery regulations, etc.	Students to discuss the role of Fishery Extension Officers in the fishery industry.	**Project:** Students to investigate and report on activities of extension officers in a fishing community.

SENIOR HIGH SCHOOL – YEAR 3

SECTION 3

ENTREPRENEURSHIP IN FISHERIES

General Objectives: The student will:

1. plan and establish an enterprise in Fisheries.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **ESTABLISHING ENTERPRISES IN FISHERIES.**	The student will be able to: 3.1.1 identify and describe the factors that should be considered when establishing a fishery enterprise. .	**Factors for establishing enterprises in Fisheries:** - identification of business Opportunities in Fisheries - identification of a fishery product or service needed in a locality - availability of market for the fishery product or service - demand for the fishery produce/products or service, etc. Resources: - land - capital - materials and structures - services - labour (personnel) - technical know-how - task analysis	- brainstorm on identification of fishery business ideas - identify and discuss factors for establishing fishery enterprises	Discuss the importance of business plans in Fisheries Outline the content of a simple fisheries business plan Write a report on the task analysis of any Fisheries vocation of your choice.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONTN'D) **ESTABLISHING ENTERPRISES IN FISHERIES**	The student will be able to: 3.1.2 describe procedures for establishing an enterprise Fisheries.	Procedures for establishing enterprises - development of a business plan - registration of business, - Management of the business, etc.	Students to: - describe the procedures for establishing an enterprise in Fisheries - discuss the importance of fisheries business plans - discuss the format and contents of a fisheries business plan - prepare a simple fisheries business plan - present the fisheries business plan for class discussion **NB:** Teacher to invite a resource person from Fisheries to give a talk on how to develop a business plan and procedures for establishing an enterprise in Fisheries.	i. Write out the outline of a fisheries business plan. ii. Describe four procedures in establishing a fisheries enterprise.

FISHERIES FACILITIES, EQUIPMENT AND TEACHING/LEARNING MATERIALS		
FACILITIES 1. Aquarium 2. Fish Pond (Concrete, Sandcrete) 3. Fish Smoker **4.** Solar Drier	**EQUIPMENT** 1. Fishing Craft (Boat/Canoe, Trawlers) 2. Secchi Disc 3. Soil /Water Test Kit 4. PVC pipes/Bamboo,/ plastic/metal 5. Valves 6. Water Hose 7. Spools 8. Fish Storage Containers(wooden/plastic/metal crates/baskets/ paper cartons, polysacks)	**FISHING GEAR** 1. Hook and Line 2. Fishing Nets 3. Floats/Foam/Polythene 4. Thread(Rope/Twine/ Nylon) 5. Artificial baits
	TEACHING/LEARNING MATERIALS 1. Legislative Instruments on Fisheries 2. Charts, Pictures, Photographs 3. CD Roms on Fishing gears, types of fishery species, fishing crafts, facilities, etc. 4. Lime Powder	

BIBLIOGRAPHY

1. Bardach, J. (1997). Sustainable Aquaculture. John Wiley & Sons. New York.
2. Blaxter, J. H. S. and Q. Bone (1995). Biology of Fishes. 2nd edn. Blackie Academic & Professional. 344 pp. Hardback 0751402435
3. Cresswell, L. R. (ed.) (1993). The aquaculture manual. 150 pp. Hardback 0442010818.
4. FAO (2006) Simple methods for aquaculture. Manual from the FAO training series. (CD-ROM)
5. Hall, S. J. (1999). The effects of fishing on marine ecosystems and communities. Fish Biodiversity and Aquatic Resources Series 1.
6. King, M. (1995). Fisheries Biology, assessment and management. Fishing News Books. London. 341 pp.
7. Lovell, T. (1988). Nutrition and feeding of fish. 224 pp. Hardback 0442259271
8. Moyle, P. B. and J. J. Cech Jr. (1982). Fishes: An introduction to Icthyology. Prentice-Hall Inc, USA.
9. Nielsen, L. A. and D. L. Johnson (eds). Fisheries Techniques. American Fisheries Society.
10. Pauly, D. and G. I. Murphy (ed.) (1982). Theory and management of tropical fisheries. ICLARM, Manilla, Phillipines. 360 pp.
11. Pitcher, T. J. and Hart P. J. B. (1983). Fisheries Ecology. 416 pp. Paperback 041238260.
12. Poxton, M. (1995). Water quality for fish culture. Chapman and Hall Aquaculture Series 2. 352 pp. Hardback 041244860
13. Regenstein, J. M. and C. E. Regenstein (1991). An introduction to fish Science and technology. 269 pp. Hardback 0442005008
14. Ross, M. R. (1997). Fisheries conservation and management. Prentice & Hall
15. Schreck, C. B. and P. B. Moyle (ed.) (1990). Methods for fish biology. American Fisheries Society, Bethesda. 684 pp.
16. Vita, (1996). Freshwater Fish Pond Culture and Management. Revised Edition
17. Schneider, W. (1990). Field Guide to the Commercial Marine Resources of the Gulf of Guinea, FAO – ROME.